Rural Management WASH 2 - Sanitaiton and Hygiene

Rural Management

WASH 2- Sanitation and Hygiene

First Edition

MoE
Government of India
Ministry of Education

Editorial Board

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First Edition: 2022

ISBN:

Price: ₹ 750/-

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Department of Higher Education

Ministry of Education, Government of India

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Published by: Mahatma Gandhi National Council of Rural Education (MGNCRE), Hyderabad

About the Book

India is a country that has the highest number of individuals residing per unit space with majority of its population in rural or Mo fusil areas. Due to the vast population growth in these regions it is imperative that it creates an unreasonable pressure on all the available resources, notable among them being accessibility to water, food, sanitation and hygiene. As a result of the restricted resources, facilities available for hygiene and sanitation take a back seat forcing the population to indulge in open defecation procedures. This in turn results in poor hygiene and other issues like managing the waste generated, including its effective disposal. The open defecation practice also pollutes nearby water bodies or runway water that leads to diarrhoea and associated deaths especially among young children. As the population lives in make shift arrangements/jhuggis or shanties etc. there is no provision of hand wash post the wash room use resulting in unsanitary environments and contaminated water. The practice of not washing hands before eating further makes the population susceptible to diarrhoeal diseases and respiratory ailments. There is also limited awareness available to the population due to lack of a strong public health system. In many sub populations these lead to severe malnourishment, stunting and even death of young children and adults. A large part of the malnutrition burden is owing to the unhygienic conditions in which children grow up. Recurrent diarrhoeal outbreaks impair the ability of these children to absorb nutrients and as a result lower the immunity of these children as they grow into adults. Children weakened by these frequent outbreaks are also more susceptible to opportunistic infections such as pneumonia and infection from worms.

The situation is even more complex for the adolescent females who lack the essential facilities, products and education to allow for proper menstrual hygiene. As a result many girls drop out of school as managing the menstrual cycle becomes even more difficult in school with improper toilets, lack of adequate washroom facilities, lack of water in these toilets and efficient ways to dispose of the menstrual waste. Many a times schools do not have separate washroom facilities for boys and girls, this again secludes the young female population from dropping coming to school. Add to this the open defecation practice makes them vulnerable to exploitation, violence, shame and humiliation, inadequate hygiene and sanitation facilities in schools are health hazards and affect school attendance, retention and educational performance. Measures need to be taken to give girls the knowledge and facilities for good menstrual hygiene which is key to their dignity, privacy, educational achievement and their health thus empowering adolescent girls are through improved menstrual hygiene management. Awareness campaigns for mothers and caregivers reminding them to wash hands with soap at critical times are important for protecting the health of the whole family. Mothers and caregivers can also help set examples by being a role model to establish healthy hygiene practices, in their children which will serve them for life.

From the data released by the National Sample Survey Office (NSSO) of a survey conducted in 2012, it is evident that the state of sanitation in rural India is in an abysmal state. There is a stark difference in the sanitation and hygiene facilities in rural and urban India with only 32% of rural households having a toilet at home. Of the estimated billion people in the world who defecate in the open, more than half reside in India. Poor sanitation facilities affect children health resulting in an estimated 6% loss to the GDP. Poor sanitation facilities coupled with a high population density makes states like Bihar, Jharkhand and Madhya Pradesh reporting the highest levels of child malnutrition in the country. The resultant unhygienic environment is due to a gross neglect of the

Public Health Services. An effective Public Health Network, strengthening of the grassroots workers in the need of the hour in a densely populated country like India to manage the extraordinary high disease burden.

The importance of public health programmes on hygiene and prevention tools have been highlighted by many organisations and public- private collaborations working to improve access to toilets, improving drainage facilities and creating awareness through education campaigns. They focus primarily on the importance of preventive tools such as hand washing, as this is among the most effective and inexpensive ways to prevent diarrhoeal diseases and pneumonia. There are varying percentage of people who wash their hands with soap after defecation (53%), wash hands with soap before eating (38%) and wash hands before preparing food. Others include washing of hands by birth attendants/health care workers during child birth, washing of hands by mothers before handling their newborns and more, only 11 per cent of the Indian rural families dispose child stools safely. As a standard practice majority of children's stools are left in the open or thrown into the garbage.

In 2014, began the doctrine of SWATCH BHARAT ABHIYAN, under which there has been significant progress in making clean water and hygiene amenities available to the population at large. Several initiatives were taken to provide clean drinking water and ensure proper sewage disposal leading to much improvement in small pockets of the country. USAID collaborates with the Indian government to allow growing access to safe water and cleanliness in towns and villages. The importance of public health programmes and the hindrance to them have been highlighted by several International organisations and have also forced the government to assess the accessibility of sanitation and hygiene measures to the population at large. Under the aegis of the Swachh Bharat (Clean India) Mission an endeavour has been made to systematically make places ODF open defecation free. The programme also aims to involve the citizens with the local administration to solve problems of access to water, sanitation and hygiene in their homes. The innovative public health campaigns and programmes to improve health and hygiene have shown good results and these models need to be adapted in other areas as well.

I thank Dr Anupma Harshal W, Consultant for Science Communication and Public Engagement, for contributing to this book and for her outstanding insights. Also, I would like to thank MGNCRE Team Members for extending their extreme support in completing this text book.

Dr. W G Prasanna Kumar
Chairman MGNCRE

Contents

Chapter 1 Sanitation and Hygiene **1-31**
1.1 Introduction and Overview
1.2 Effects of poor sanitation
1.3 Personal and domestic hygiene
1.4 Sanitation ladder
1.5 Sanitation technologies and concepts of ODF

Chapter 2 Toilet **32-60**
2.1 Sanitation facilities
2.2 General design considerations
2.3 Toilet infrastructure and feasibility of usage
2.4 WASH in Institutions
2.5 Management and sustainability

Chapter 3 Title **61-110**
3.1 Sanitation Infrastructure
3.2 Wastewater Management
3.3 Water Quality Testing
3.4 Faecal Sludge Management
3.5 FSM-Reuse and Disposal

Chapter 4 Sanitation Infrastructure **111-143**
4.1 Technology in Sanitation
4.2 Evaluation of Construction & Maintenance of Sanitation Infrastructure
4.3 Management of Sanitation Infrastructure
4.4 Levels of Investment
4.5 Subsidies for Sanitation & Sanitation Marketing

Chpater 5 Community and Sanitation **144- 180**
5.1 Community Sanitation
5.2 Promotion of Sanitation & Hygiene
5.3 Capacity Building at Community Level
5.4 Subsidy Mechanism & Partnership
5.5 Participation and Working with Communities & Households

List of Tables

1.1 The health impact of unsafe sanitation	7
1.2 Health problems associated with poor sanitation and management of wastes	10
1.3 Economic Impact of Poor Sanitation	13
1.4 Quality of water sources tested in Calcutta	18
1.5 Means of disposal of children's stools (% of families)	19
1.6 Sanitation ladder in the Joint Monitoring Programme	20
1.7 Classification of cities (PAS Project)	21
1.8 Factors used for the Assessment of a Sanitation Technology	25
1.9 Check-list to declare a village ODF Plus	27
2.1 Sanitation requirements for various location types	35
2.2 Categorization of public toilets	38
2.3 Norms for sanitary facilities in public toilets	39
2.4 Norms for community toilet	40
2.5 Size of toilet cubicle, bathroom, urinal & washing area	40
2.6 Suggestions for design considerations/solutions for accessible sanitation	45
2.7 Public / community toilets: User feedback format	56
2.8 What will it take to Improve Sanitation?	58
3.1 Comparison of different types of toilets and systems	72
3.2 Potential risk factors and benefits of greywater, urine and faeces	90
3.3 FSM Implementation Approach Matrix	95
3.4 Project outlay of village level zero-based SWMP	106
4.1 "Access to basic" vs "access to improved" sanitation	112
4.2 Main processing steps of a sanitation system and its technology options	114
4.3 Flow scheme illustrating waste processing in a dry sanitation system with urine separation and final application of all products.	115
4.4 Flow scheme illustrating waste processing in a water-based sanitation system with alternating double pits and final application of all products.	115
4.5 Flow scheme illustrating waste processing in a water-based (wet) sanitation system with off-site treatment and final application of all products.	116
4.6 Suggested maximum sludge accumulation rates (litres per person per year)	117
4.7 Factors that determine the individual/Community response in case of an emergency	120
4.8 Sphere guidance on possible alternatives for safe excreta disposal	121
4.9 Factors to be considered for arrangement of sanitation measures in an emergency	121
4.10 Institutional Framework for Rural Sanitation	127
4.11 Sources of Funding for ODF Plus Projects	128
4.12 Typical cost heads for construction	129
4.13 Typical cost heads for O&M	131
4.14 List of equipments and consumables	135
5.1 PHAST for the prevention of diarrheal disease (WHO pioneered this method)	150
5.2 Raising awareness and knowledge on sanitation and hygiene	153
5.3 Detailed measures to monitor the ongoing status of the program	156
5.4 Approaches used to encourage men to stop open defecation in India	170
5.5 SLWM in Rural Areas	172

List of Figures

1.1 Sanitation Service Chain 4
1.2 F-diagram on faecal-oral disease transmission 6
1.3 The Faeco-oral disease transmission pathways and interventions to break them 8
1.4 Hypothesized causal pathways for intervention impact and measurements 11
1.5 Tipy tap arrangement for hand washing 16
1.6 Good Hygiene practices 17
1.7 Sanitation value chain in urban Maharashtra, 2011 22
1.8 ODF Sustainability (ODF-S) interventions 23
1.9 Some of the impacts of Swachh Bharat Mission-Gramin (Rural) 27
2.1 Gender Sensitive Toilet Facility 36
2.2 Height adjustable washbasin 37
2.3 Design pyramid (adapted from Benktzon, 1993) 41
2.4 Types of toilet Indian vs Western model1 41
2.5 Cistern flush toilet 42
2.6 Twin leach pit pour flush toilet 46
2.7 Distance between toilet and drinking water source 47
2.8 Single leach pit pour flush toilet 47
2.9 Toilet linked to bio gas plant 48
2.10 Agents of change 49
2.11 Menstrual hygiene challenges faced by women in emergencies 51
2.12 Essential Components of MHM program 52
3.1 Overview on Components Involved in Wastewater Management and Treatment 63
3.2 Features of EcoSan toilet-dry type with twin pit set (Nepal) 65
3.3 EcoSan toilet at Tiruchirapalli, Tamil Nadu 65
3.4 Schematic of an Anaerobic Baffled Reactor 67
3.5 Schematic of Biogas Plant 67
3.6 Choice of On-Site Sanitation based on Various Factors 71
3.7 Concepts of Centralized (Left) and Decentralized (Right) Sewerage Systems 74
3.8 Liquid Waste or Waste Water 75
3.9 Sources of Wastewater 75
3.10 Set-up Decentralized Water System for Generic Landscape 82
3.11 Set-up Decentralized Water System for Waterlogged Areas 82
3.12 Set-up Decentralized Water System for Rocky Areas 83
3.13 Schematic Representation of a Leach Pit & Household Leach Pit with Slit Chamber 83
3.14 Schematic Representation of a Magic Pit 84
3.15 Community Leach Pit 84
3.16 Schematic of the three main types of waste stabilization ponds (WSPs) 85
3.17 Constructed wetland for wastewater treatment at Indian Agriculture Research Institute, Pusa, New Delhi 86
3.18 (DEWATS) was built by CURE over the Kuchpura drain 87
3.19 Developing water conveyance system in Tube Well command area (UP) 88
3.20 Laying down of Bore Lines 88
3.21 Sludge Treatment 97

3.22 A Constructed Wasteland 102
3.23 Unplanted Sludge Drying Bed 104
3.24 Planted Sludge Drying Bed 105
3.25 General process flow on co-composting and pellet production 105
3.26 Selection of Treatment Technologies Depending on Desired End Product 107
4.1 Solid Waste Burial Pit (Davis & Lambert, 2002) 122
5.1 Flow Chart Depicting Factors Affecting Sanitation 147
5.2 PHAST Methodology 152
5.3 Communication tools used for improved interpersonal communication 159
5.4 Use of emo demos during the interpersonal communication sessions 160
5.5 Drafting and implementing a SLWM plan 173
5.6 Comparison of a few composting methods 176

List of Boxes

1.1 Abbreviations 2
1.2 Human right to sanitation 3
1.3 BABY WASH Messages 9
1.4 Time savings due to water improvements 14
1.5 Health Facts-Clean Hands are Safe Hands 15
1.6 Ebola crisis in West Africa a threat to global health 19
1.7 Rules to be adopted by state/cities for improved septage management 22
1.8 Rural Sanitary Marts (RSM) in India 24
2.1 Toilets for Special Needs 37
2.2 Mobile Toilet Van 43
2.3 Essential Features of Toilets 44
2.4 WASH in Schools 50
2.5 Sustainable Development Plan 57
3.1 Different Waste Products Generated 62
3.2 The decentralised Wastewater Management Approach 86
4.1Usage of Appropriate Technologies 113
4.2 Government Subsidy 136
4.3 Nirmal Bharat Abhiyan 137
5.1 India-Total Sanitation Campaign (TSC) 146
5.2 Sanitation and Water for All (SWA) 161
5.3 CLTS and CATS 165

Case Studies

Case Study 1: Branded Bread Spreads Handwashing Message (India) 5
Case Study 2: Installing and Use of Toilets (Sijbesma and Koutou, 1995) 10
Case Study 3: KISHINCHAND CHELLARAM COLLEGE, Swachh Bharat Abhiyan 26
Case Study 4: Good Practices in Swacch Bharat Mission (Gramin) implementation 34
Case Study 5: Toilets for Special Needs 37
Case Study 6: Twin-pit toilet constructed in Gonda, Uttar Pradesh 64
Case Study 7: Gram Panchayat Water and Sanitation Committee (GPWSC), Punjab 66

Case Study 8: Biodigester toilets developed by Hyderabad-based Banka Bioloo 69
Case Study 9: Linked Biogas Plants Tackle Faecal Sludge Problem in Gujarat's Villages 70
Case Study 10: WSP in Ludhiana 89
Case Study 11: Wai Municipal Council 100
Case Study 12: Cultural considerations when locating toilets and selecting plots in India 117
Case Study 13: Municipal Corporation of Greater Mumbai (MCGM) – Slum Sanitation Project 126
Case Study 14: Slum sanitation program 133
Case Study 15: SWACHH CHATTISGARH- Focus on Community Toilets 139
Case Study 16: GIS Linked Tirupati City Maps-Sanitation 141
Case Study 17: Creating Demand by Highlighting the Benefits of Sanitation 141
Case Study 18: Status of Community toilets in MP (5 CITIES) 148
Case Study 19: Eco-san toilets, Trichirapalli 151
Case Study 20: Citizen's First – SaciWATER – Hyderabad 163
Case Study 21: Participation of Women in WASH 171
Case Study 22: Making Nightsoil-based Biogas Plants viable in Maharashtra's Pune District 178

Suggested Readings:

1. Gupta, S (2012). Rural Water Supply and Sanitation, Vayu Education of India

2. Manual on liquid and solid waste management by Ministry of drinking water and sanitation http://documents.worldbank.org/curated/en/298721467993218355/pdf/102623-WPBox394834B-

Chapter 1 Sanitation and Hygiene

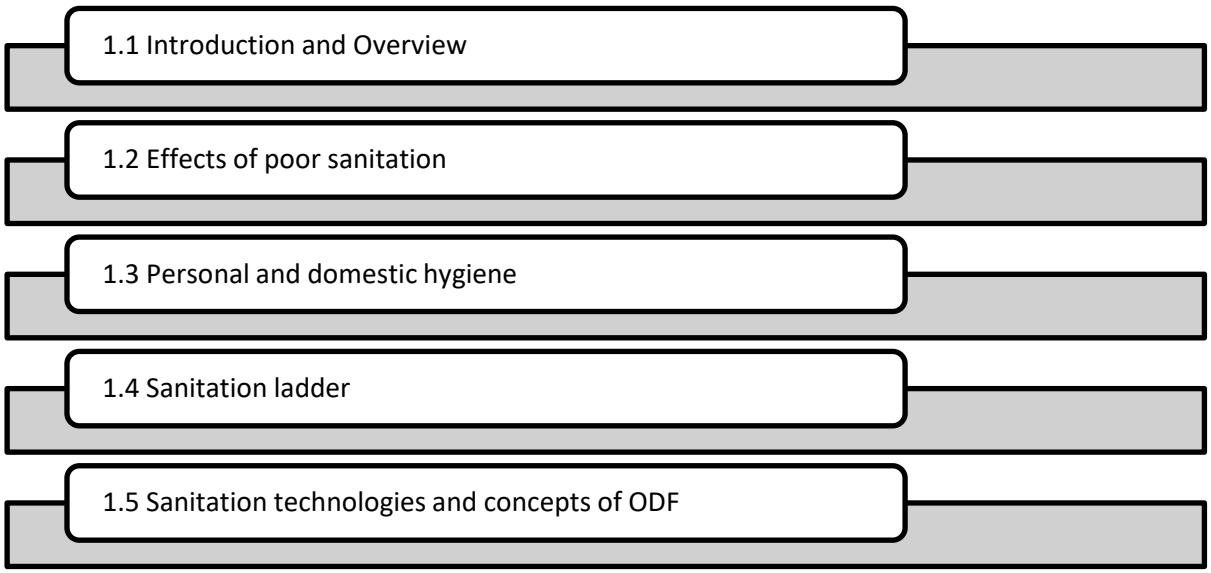
Introduction

It has been 90 years since the Father of the Nation of India emphasized about the importance of sanitation, but the country still lacks the "basic sanitation" facilities in most parts despite gaining independence way back in 1947. A majority of the population in the rural areas and in the cities of India live in dire conditions with access to little or no water supply and sanitation facility whatsoever. It may be an overlook of the local governance, lack of the best suited technology for that area or insufficient funds. Another important attribute to be considered here is the repercussions of the caste system in the country where removing excrements is still frowned upon, and the importance of sanitation to safeguard human health is compromised for a large section of society. Sanitation, safe drinking water, and good hygiene which should be a fundamental right are still a luxury for many of the world's poor people. The lack of sanitation not only results in millions of deaths through diarrheal disease, but is also associated with environmental degradation and poverty thus weakening the three pillars of sustainability: social, environmental and economic. Cleanliness is one of the most important practices for a safe and healthy environment. Everyone should learn about cleanliness, hygiene, and sanitation, as they are all related to public and personal hygiene.

Objectives

- To describe sanitation, its definition, scope, importance, link with health and relation with economic development
- To know the specific effects of poor sanitation-direct, indirect
- To understand personal and domestic hygiene: habits, behavior and practices
- To identify the role of Sanitation in everyday life
- To provide an overview of sanitation technologies and concepts of ODF

Chapter Structure



1.1 Introduction and Overview

There are 2.6 billion people in the globe who do not have access to "improved sanitation," with India accounting for 814 million of them. As a result, many resort to open defecation, which is harmful to one's health and pollutes the environment. In South and Southeast Asia, Africa, and Latin America, practises such as open defecation, unsanitary behaviour, and uncontrolled rubbish disposal are common. These factors contribute to environmental degradation, which has an impact on the health and quality of life of millions of people in these areas, particularly the poorest, who are the most vulnerable. Sanitation, together with excellent hygiene and safe drinking water, are essential for good health and social and economic growth.

Box 1.1 Abbreviations

ASHA	Accredited Social Health Activist
ANM	Auxiliary nurse midwife
AV	Audio Visual
AWC	Aanganwadi Center
AWW	Anganwadi Worker
BCC	Behaviour Communication Change
BLC	Block Level Cell
BPL-	Below Poverty Line
BDO	Block Development Office
CLTS	Community Led Total Sanitation
DWSM	District Water Sanitation Mission
DSBM	District Swachh Bharat Mission
DDWS	Department of Drinking Water and Sanitation
FTIs	Faecally Transmitted Infections
FSM	Faecal Sludge Management
GPDP	Gram Panchayat Development Plan
GoI	Government of India
GP	Gram Panchayat
HH	Household
HRD	Human Resource Development
HWWS	Handwashing with Soap
IEC	Information, Education and Communication
HCGI	Highly credible gastrointestinal illness
IHL	Individual household latrine
ITT	Intention to treat
JMP	Joint Monitoring Programme
MUAC	Mid-upper arm circumference
TSC	Total Sanitation Campaign
TSSM	Total Sanitation and Sanitation Marketing
WSP	Water and Sanitation Program (the World Bank)
WASH	Water Sanitation & Hygiene

Sanitation

The majority of infections are caused by a lack of hygienic conditions in and around settlements. Hygiene and sanitation may mean different things to different people. “Hygiene” is described as a collection of actions that are viewed as a path to healthy living or good health by a group of individuals. On the other side, “sanitation” is described as the process by which humans promote healthy living and good health by avoiding contact with trash and other disease-causing bacteria. Sanitation, according to DFID (1998), refers to the safe management of human excreta and involves both "hardware" (physical sanitation elements such as latrines) and "software" (intangible factors such as hygiene promotion and behavioural change) needed to reduce faecal-oral disease.

Basic sanitation, also known as adequate sanitation, is described as the cheapest alternative for ensuring long-term access to safe, sanitary, and appropriate facilities for excreta disposal, protecting privacy and dignity while maintaining a clean and healthy environment (WHO and UNICEF, 2006). Sanitation refers to a collection of techniques for enhancing hygiene with the goal of avoiding human contact with wastes such as faeces. In simple terms, it is the process of keeping areas clean, providing clean water, and having a suitable sewage disposal system in place to avoid any type of faeces contact. After treatment, all human excreta (solid and liquid) should be disposed of immediately.

Box 1.2-Human Right to Sanitation (UN, 2010)

The human right to sanitation guarantees everyone to sanitation services that are physically accessible and inexpensive, safe, hygienic, secure, socially and culturally acceptable, and give privacy and dignity. Principles of human rights must be applied to the realisation of all human rights, including the right to sanitation:

1. **Non-discrimination and equality**: Everyone, without exception, must have access to basic sanitation services, with the most vulnerable and disadvantaged individuals and groups receiving priority.
2. **Participation**: Without discrimination, everyone should be able to participate in choices affecting their sanitation access.
3. **The right to information:** Access to sanitation information, including planned programmes and initiatives, must be made openly available to all who will be affected, in appropriate languages and through acceptable media.
4. **Accountability** (monitoring and access to justice): States must be held accountable for any failure to ensure sanitation access, and access (and lack thereof) must be monitored.
5. **Sustainability**: Sanitation access must be financially and physically viable in the long run.
6. The normative content of the human right to sanitation is defined by:
7. **Availability:** Individuals must have access to a sufficient quantity of sanitary facilities.
8. **Accessibility:** Sanitation services must be available to everyone who lives, works, or visits a household, a health or educational institution, a public institution, or a public area. When accessing facilities, physical security must not be jeopardized.
9. **Quality:** Sanitation facilities must be safe to use both hygienically and technically. It is vital to have access to water for cleansing and handwashing at all times in order to maintain excellent hygiene.
10. **Affordability:** Sanitation and services must be affordable to all without jeopardising people's ability to pay for other human rights-guaranteed basics like water, food,

It is described as having access to and using facilities and services for disposing of human urine and faeces in a safe manner. A safe sanitation system is one that keeps human excreta away from people at all stages of the sanitation service chain, from toilet capture and containment to emptying, transportation, treatment (on-site or offsite), and final disposal or end use (Figure 1.1). Safe sanitation systems must meet these requirements while also addressing the co-disposal of greywater (water generated in the home but not from toilets), associated hygiene practises (such as the management of anal cleansing materials-water, toilet paper), and essential services required for the proper operation of technologies (e.g., flush water to move excreta through sewers).

Figure 1.1 Sanitation Service Chain

Hygiene

It is a series of behaviours that must be included into our daily routine in order to preserve excellent health. It also refers to behaviours and practises that go beyond human faeces management. These are steps in addition to hand washing, which is considered one of the most important hygiene habits. Hygiene practises aid in breaking the chain of infection transmission in the home and in the larger community. Hygiene is defined as conditions and activities that aid in the maintenance of good health and the prevention of disease transmission in the community. Furthermore, studies in India indicated that possessing a toilet was insufficient to change behaviour, and that many households continued to conduct open defecation despite having a toilet.

- Hygiene of the body and hands
- Hygiene in food production (cooking, storing, preventing cross contamination)
- Pure and safe water at the 'point of use'
- Respiratory hygiene
- Proper faeces disposal (both human and animal)
- Solid waste disposal, wastewater and rainwater control
- General hygiene (laundry, surfaces, toilets, bathtubs, sinks)

There is no global mechanism that monitors hand washing practises in homes and communities, unlike household access to drinking water and sanitation. In reality, solid global estimates on hand washing with soap are difficult to come by. However, according to a recent systematic assessment of 42 studies of observed handwashing with soap in 19 countries, just 19% of people wash their hands following possible contact with excreta (Freeman et al., 2014). Despite the fact that food and environmental hygiene practises are important for health and nutrition, there are few rigorous statistics on them.

To do Activity

Learn about the various activities carried out under the Swacch Bharat Abhiyan, comment in a group discussion what can be a good measurable input to evaluate the success of this mission through the completed activities.

Water supply (enhancing water quantity and quality), sanitation (especially safe excreta disposal), and hygiene promotion/education are all examples of WASH efforts (including hand washing, food, personal and environmental hygiene). Individual health is influenced by water availability, sanitation, and hygiene, all of which are intertwined. Personal cleanliness, for example, is dependent on the availability of water, which makes hygienic sanitation much easier; filthy latrines jeopardise the quality of surrounding water sources, resulting in an increase in the number of flies and toxins. . Good hygiene practices can prevent contamination after collecting water from the source, etc. (UK Aid, 2013).

Case Study 1: Branded Bread Spreads Handwashing Message (India)

The Kumbh Mela is a Hindu pilgrimage that takes place every three years in India and attracts about 100 million people. As part of its ongoing campaign to promote awareness about proper handwashing habits, Lifebuoy worked with more than 100 restaurants and cafés at the festival. The first roti in every food order had the promotional message "Lifebuoy se haath dhoye kya?" (Did you use Lifebuoy to wash your hands?) To ensure that the baked roti was totally edible, the phrases were heat stamped onto it without the use of ink.

Washing hands with soap at the right time

“The ‘Roti Reminder' captures a consumer's attention at precisely the right time to assist avoid the transmission of germs that cause preventable diseases. That instance, when customers sit down to eat roti with their hands,” says Sudhir Sitapati, General Manager, Hindustan Unilever Limited's Skin Cleansing division. “The Kumbh Mela offers a once-in-a-lifetime opportunity to spread this message to a huge, mostly rural and small-town population. In effect, this simple, clutter-busting concept will enable us to reach a large audience for a fraction of the cost.” Watch the Roti Reminder video on YouTube to find out more.

The importance of handwashing

By the end of the month-long promotion, more than 2.5 million branded rotis will have been consumed. Lifebuoy also provided soap in each of the eateries' washrooms and used banners and billboards to spread the handwashing message to millions more people. The campaign's reach has extended well beyond the event. The novelty of food branding has garnered a lot of media attention and conversation in India, which has helped to spread the message about how important it is to wash your hands with soap before eating.

Hand washing with soap after defecation and disposal of child faeces, before preparing and handling food, before eating, and before and after inspecting patients and doing medical operations in health care institutions. Furthermore, solid global estimates on handwashing with soap are difficult to come by. However, according to a recent systematic assessment of 42 studies of observed handwashing with soap in 19 countries, just 19% of people wash their hands following possible contact with excreta (Freeman et al., 2014). Despite the fact that food and environmental hygiene practises are

important for health and nutrition, there are few rigorous statistics on them.

Scope

It is essential that sanitation systems are designed in a manner that ensures minimum microbial hazard caused by human excreta. They must be controlled carefully to safeguard human health from the negative health effects of such exposure, such as infectious disease, nutritional status, and educational outcomes. They should also incorporate solid waste management as part of menstrual hygiene management. It's worth noting that, while animal faeces contain viruses that might cause sickness in humans, sanitation systems can't handle it. From a public health perspective the aim of safe sanitation services is to fulfil the human right and to ensure interruption of pathogen transmission from human excreta (faeces and urine) to the population.

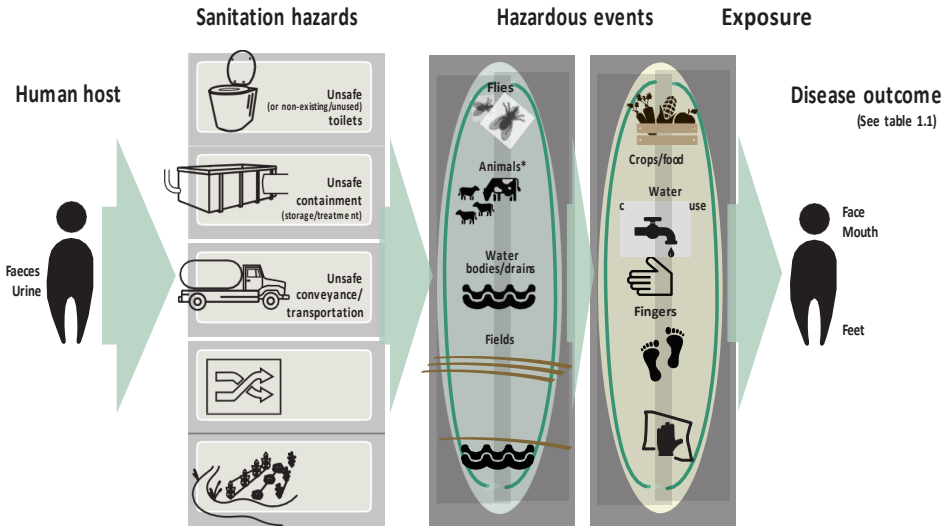


Figure 1.2 F-diagram on faecal-oral disease transmission
Source-WHO Guidelines on Sanitation and Hygiene, 2018.

From left to right, Figure 1.2 depicts the transmission channels of excreta-related illnesses. The presence of excreta in the sanitation system indicates the possibility of dangerous events. Where unsafe toilet refers to open defecation, the diagram clearly explains both horizontal and vertical interactions. Interactions can take place at any level of the vertical representation. The potential for hazardous events to interact can result in the establishment of complicated or indirect pathways. For example, pathogens can be spread to fingers and surfaces, furthermore, animals may introduce pathogens to fields and water bodies, thereby introducing them into a new host; untreated excreta discharged to fields may lead to contamination of ground water or water bodies; and pathogens can be transmitted to food during cooking by fingers contaminated during toilet use or by hands that have come into contact with animals or contaminated surfaces.

Following an excretion event from a human host that results in illness effects, the figure depicts the probable pathogen transmission pathways. Potential hazardous events include:

To do Activity

Arrange for a visit to the Primary Health Centre/Clinic in your area to discuss with the Health Officer the prevalent status of various diseases caused due to unsafe sanitation and hygiene practices. Tabulate numbers wherever possible and make observations if there are any specific factors that influence this, try to do a cause effect relationship from the data obtained.

Unsafe/ non-existing (or not used) toilets: Pathogens can be spread into the environment (fields,

water bodies, etc.) as a result of open defecation, infecting new hosts through feet or crops (e.g. soil-transmitted helminths); into water bodies, infecting new hosts through water contact (e.g. schistosomiasis from urination/ defecation in surface water) or consumption; and overall spread within the household environment by insects or an infected object Poorly designed pit toilets can attract flies and other insects, as well as transfer faeces infections to food, fingers, and other surfaces.

Unsafe containment (storage/ treatment): Poorly designed latrine pits or septic tanks can cause contamination of ground water, which is then absorbed by new hosts, resulting in an overflow into the residential environment.

Unsafe conveyance/transportation: Poor emptying techniques can expose sanitation workers, maintenance personnel, cleaners, and others involved in the emptying process to germs. When viruses are released onto household surfaces, more people are exposed to them through contaminated surfaces. Untreated faeces released into bodies of water, drain fields, and other surfaces have the potential to spread through a variety of dangerous events. Leakage, overflow, and dangerous discharge into drains, water bodies, ground water, and exposed surfaces can all result in exposure from open and unsafe sewers.

Unsafe offsite treatment: Inadequate treatment can result in insufficient pathogen removal from faecal sludge, resulting in pathogen discharge onto fields (through fertilisation) and thus crops, as well as pathogen discharge into water bodies via runoff or purposeful discharge, contaminating drinking water. Animals may come into touch with untreated excreta as a result of poorly managed treatment processes, resulting in increased exposure.

Unsafe end use/ disposal: Untreated faecal sludge discharge into the environment can result in a variety of harmful occurrences via numerous paths.

Table 1.1 The health impact of unsafe sanitation

Direct impact (infections)	Sequel (conditions caused by preceding infection	Broader well-being
Faecal-oral infections • Diarrhoeas (incl. cholera) • Dysenteries • Typhoid **Helminth infections** • Ascariasis • Trichuriasis • Hookworm infection • Cysticercosis (Taenia solium/ infection) • Schistosomiasis **Insect vector diseases** (vectors breed in faeces or faecally- contaminated water) • Lymphatic filariasis • West Nile Fever • Japanese encephalitis • Trachoma	**Stunting/ growth** faltering (related to repeated diarrhea, helminth infections, environmental enteric dysfunction) **Consequences of stunting** (obstructed labour, low birthweight) **Impaired cognitive function** **Pneumonia** (related to repeated diarrhea in undernourished children) **Anaemia** (related to hookworm infections	**Immediate:** **Anxiety** (shame and embarrassment from open defecation and shared sanitation) and related consequences Sexual assault (and related consequences) **Adverse birth outcomes** (due to underuse of healthcare facilities with inadequate sanitation) **Long-term** School absence Poverty Decreased economic productivity Anti-microbial resistance

Collated from: Bartram & Cairncross, 2010; Bouzid et al, 2018; Campbell et al, 2015; Cumming & Cairncross, 2016; DFID, 2013; Schlaudecker et al, 2011.

Sanitation measures to preserve public health should be single- and multi-component, incorporate technologies, integrate policies, establish rules, and take financial and manpower resources into account. The efforts should try to modify people's sanitation habits. Sanitation measures may be directed at residential settings (such as prisons), as well as workplaces and all other public restrooms. They can be implemented at the local, regional, national, and international levels, as well as in other areas.

1.2 Effects of Poor Sanitation

Sanitation is a basic prerequisite for good health, and it has a significant impact on social and economic growth. Poor sanitation is a feature of urban, semi-urban, and peri-urban regions as a result of overpopulation, indiscriminate waste dumping, and open defecation and urination. This results in pollution of the available land and water resources on a local level. This permits garbage to flow into streams, rivers, lakes, and wetlands, harming marine life while also exposing the younger population to disease. Faeces is one of the most hazardous items to human health. 106 virus pathogens, 106–108 bacterial pathogens, 104 protozoan cysts or oocysts, and 10–104 helminth eggs can all be found in a gramme of fresh faeces from an infected person. The ‘‘F Diagram" (Figure 1.3) depicts the key faeco-oral disease transmission pathways, emphasising the need of specific interventions, such as proper faecal disposal, in reducing disease transmission.

The majority of these tropical diseases thrive in areas where basic sanitation is lacking. NTDs add to an already overburdened health-care system, resulting in lower individual productivity and, as a result, a negative impact on the national economy. Trachoma, a bacterial infection, is a primary cause of preventable blindness. Contact with eye-seeking insects, fingers, and fomites transmit the disease. The WHO's SAFE strategy for trachoma elimination emphasises good hygiene behaviours such as facial cleanliness and environmental enhancement. Face washing is essential to eliminate eye discharges, and environmental enhancement involves proper excreta disposal to limit fly populations.

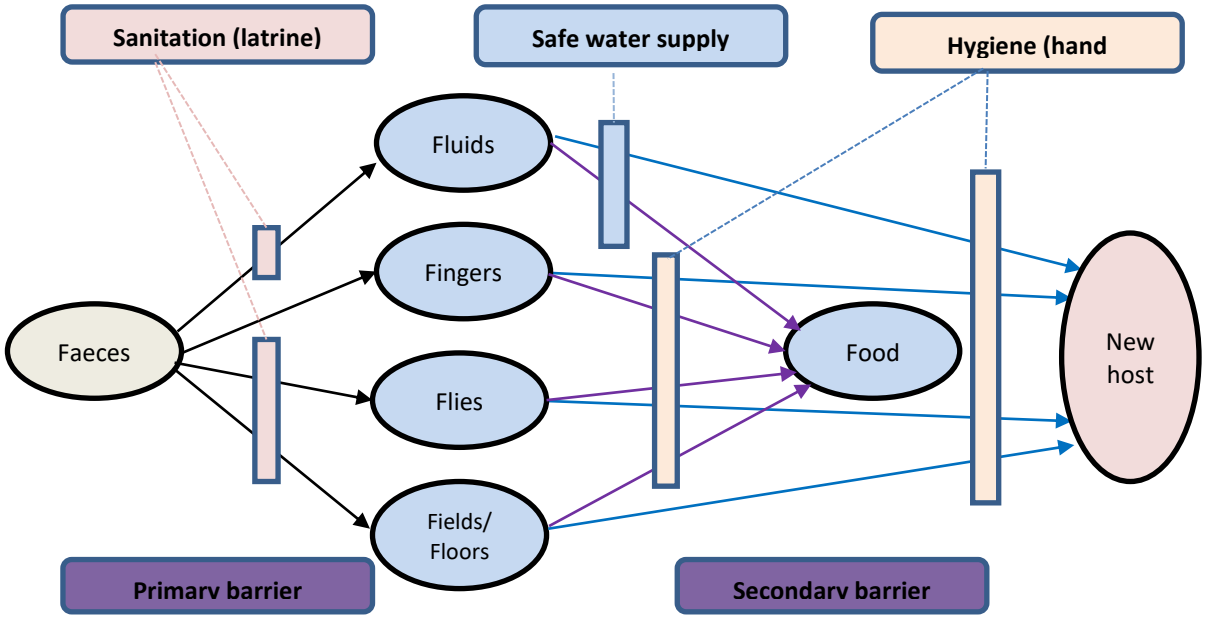


Figure 1.3 The Faeco-oral disease transmission pathways and interventions to break them.
Source: Wagner EG, Lanoix JN (1958) Excreta disposal in rural areas and small communities. Geneva: World Health Organization. 327 p.

Sanitation is one of the most important preventative strategies for soil-transmitted helminthiases. Intestinal worm eggs and other faecal pathogens are prevented from contaminating the environment and infecting people through contaminated food, drink, filthy hands, and direct skin contact with the soil through good sanitation measures. Undernutrition, anaemia, and poor academic performance plague children infected with soil-transmitted helminthiases. Improved sanitation and water management, in particular in metropolitan settings, can significantly reduce mosquito breeding. Human diseases such as lymphatic filariasis, dengue fever, and chikungunya are transmitted by these insects. Poorly constructed latrines may aid in the reproduction of the Culex mosquito, which is known to spread filarial parasites to humans. The mosquitoes Aedes aegypti and Aedes albopictus, which are known to transmit dengue and chikungunya to humans, can be considerably reduced by properly storing water.

Box 1.3 BABY WASH Messages {Example from the SHINE study, Zimbabwe (2014)}

1. Safely dispose of all animal and human feces;
2. Wash hands with soap after faecal contact and before preparing food, eating food, or feeding children;
3. Protect children from ingesting soil and animal feces;
4. Freshly prepare children's food, or reheat to boiling prior to feeding;
5. Give children (after 6 months of exclusive breastfeeding) only drinking water that has been treated with an appropriate household water treatment method.

Sanitation has a variety of negative consequences. Poor sanitation facilities have a negative impact on people's health as well as the nation's overall development. Although the economic benefits of good sanitation and hygiene are difficult to quantify on a cost-benefit scale, various studies have indicated that they have a major impact on the economy. According to many studies based on data collected in 2006, poor sanitation costs India an estimated 6.4 percent of its GDP - more than the GDP of five Indian states combined. These losses and economic impacts disproportionately affect the poor, as illness, slow growth, death results in loss of man hours thus affecting the employment rates of the affected individuals.

Sanitation has been shown to prevent contaminating water sources, conserving the environment and preventing infectious diseases. As a result, malnutrition, stunting, and mental stress are reduced. Women and adolescent girls are the ones who are most affected by the dangers of poor sanitation and water-related diseases in impoverished nations and around the world (WHO, 2006). because of the lack of sufficient sanitation facilities in the school, a number of girls drop out.

Diarrhoeal infections are spread by human excreta and have a particularly negative influence on youngsters. Approximately 1.5 million deaths per year in children under the age of 5 years are caused by diarrhoea related to unsafe water, lack of basic sanitation and poor hygiene, most of them in developing countries (JMP 2008). Diarrhoea, however, is not the only disease that claims a lot of lives because of lack of access to adequate and safe water and sanitation facility. Pneumonia kills about 2 million young children every year making it another deadly disease (Wardlaw et al., 2005).

Case Study 2-Installing and Use of Toilets (Sijbesma and Koutou, 1995)

Owners in Dosso (Africa), rural Niger, cited 36 reasons for installing the system; health was only one of them, and it was ranked quite low on the priority list. According to a study conducted in rural Benin, there are three types of explanations, each with a decreasing importance:

(1) prestige

(2) well-being, covering health, but also safety from accidents, various types of animals, robbers and sorcery, as well as convenience and comfort, cleanliness and privacy and

(3) special situational factors, such as physical restrictions due to old age or illness, charging higher housing rents and religious requirements.

Similar findings have been reported from four Bangladesh villages, although the classification differs somewhat, health benefits were the least frequently cited.

Table 1.2 Health problems associated with poor sanitation and management of wastes

Disease causing agent	Disease	Description
Bacteria	Shigellosis	Causes abdominal pain and diarrhoea
	Typhoid	Mild to severe fever lasting a few days to several weeks
	Cholera	An infection of the intestine that causes watery diarrhea leading to dehydration
	Diarrhoeal diseases (can also be caused by viruses)	Production of frequent watery faeces that can lead to dehydration, it can be very fatal in the young population Diaarhoea is a symptom of several other diseases in this table
Viruses	Hepatitis A	An infection of the liver that can cause pain, diarrhea and jaundice
	Polio	Can cause temporary or permanent muscle weakness and sometimes death
Protozoa	Amoebiasis (also known as amoebic dystentry)	Infection can occur upto several years post exposure to the protozoa It can cause mild to severe diarrhea and liver damage
	Giardiasis	Infection of the small intestine. It is usually symptomless but can have a variety of intestinal symptoms such as chronic diarrhea, abdominal cramps, gas production and frequent loose, pale and greasy stools.
Parasitic worms	Ascaris (round worm)	One in four of the world's population has this infection, which can lead to weight loss, malnutrition and anaemia
	Hookworm infection	Two species of nematodes that inhabit the small intestine, from where they suck blood, leading to anemia
	Tapeworm infection	A worm that normally lives in the intestines which can cause anaemia and malnutrition. This is usually spread through eating improperly cooked food that contains the worm or its eggs
	Bilharzia or schistomiasis	A disease caused by the Schistosoma worm that can cause diarrhea and blood in the urine and faeces. In the long term, it can lead to liver and kidney damage

While it's difficult to separate the effects of sanitation from the overall effects of better water, sanitation, and hygiene interventions, a longitudinal cohort study in Salvador, Brazil, found that increasing sewerage coverage from 26% to 80% of the target population resulted in a 22% reduction in diarrhoea prevalence in children under the age of three. Low socioeconomic position, inadequate sanitation, the presence of intestinal parasites, and the lack of prenatal assessment are the key risk factors for diarrhoea in the first three years of life, as documented in the MDG from many countries. Interventions aimed at improving the sanitary and general living conditions of LMIC families can significantly reduce diarrheal illness rates. Furthermore, it is not just vital to provide sanitation and have adults utilize it; hazardous faeces disposal practices raise the risk of diarrhoea in the population.

The practice of open defecation is regarded to be a significant factor in the global burden of diarrhoea and enteric parasite infection in children under the age of five (Mara et al, 2010). Access to and usage of improved sanitation facilities is required to reduce the burden of open defecation. In 2010, it was estimated that 47% of the world's population lacked access to proper sanitation. India alone accounts for a third of individuals without improved sanitation (814 million), nearly 60% of those who practice open defecation (626 million), and a quarter of all diarrheal disease mortality among children under the age of five years (UNICEF, WHO 2012). (UNICEF, WHO 2009).

According to a study conducted on the TSC in rural Madhya Pradesh, a slight increase in the availability of individual household latrines leads to a decrease in the practice of open defecation. However, these changes have a minor impact on behaviours and are insufficient to improve child health outcomes. As a result of the reduced open defecation, the amount of faeces emitted into the environment would be reduced. As a result, contamination of shallow groundwater aquifers, water delivery networks, and community soil is avoided. As a result, enteric pathogen transmission through flies, which are well-known vectors for transmission, would be reduced. The unintentional link between the initiatives. The casual chain between the interventions and health outcomes is represented in Figure 1.4

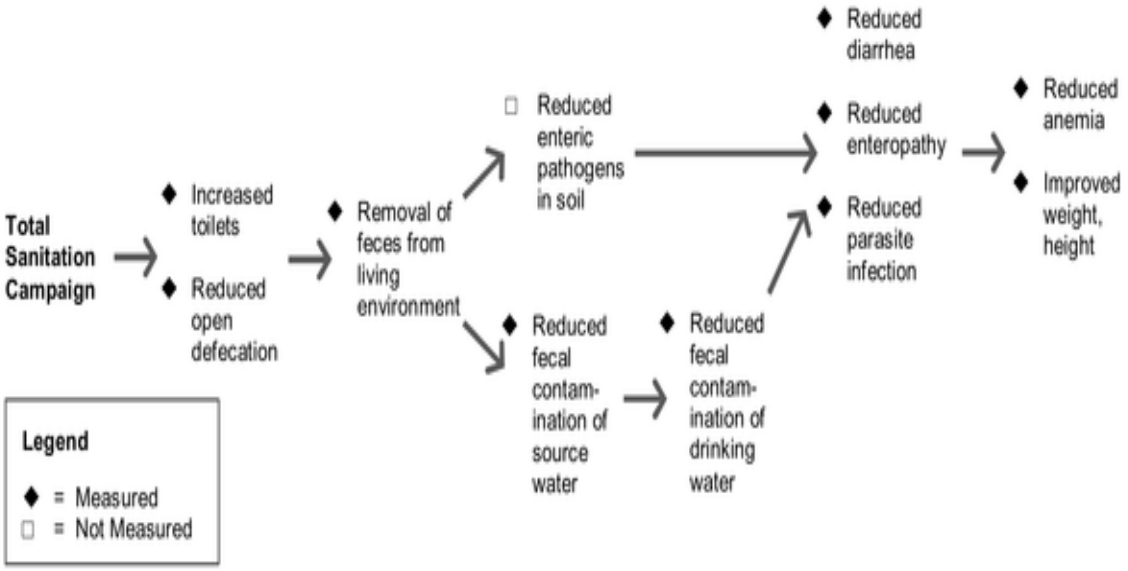


Figure 1.4 Hypothesized causal pathways for intervention impact and measurements
Source-Patil Sumeet R et al.2014.

The calculation of the total societal economic benefit of sanitation and hygiene is the sum of:

1. Health sector benefit from avoided illness
2. Patient expenses avoided as a result of avoided sickness
3. Value of lives saved
4. Value of time saved owing to access to water and sanitation
5. Health sector benefit from avoided illness
6. The value of school days obtained by individuals who avoided illness
7. The value of the additional child days acquired by those who avoided illness

Observational studies have demonstrated that interventions that prevent human faeces from entering the environment diminish diarrheal disorders (Clasen et al, 2010), enteric parasite infections (Normaon et al, 2010), and enteric parasite infections (Barreto et al, 2010). The majority of the data is from urban areas, and only a few studies have looked at the impact of rural sanitation programmes on diarrheal disorders, intestinal parasite infections, anaemia, or premature child growth. Diseases linked to poor sanitation are particularly linked to poverty and infancy, accounting for roughly 10% of the worldwide burden of disease [Mascarini et al, 2010]. At any given time close to half of the urban populations of Africa, Asia, and Latin America have a disease associated with poor sanitation, hygiene, and water (Ziegelbauer et al, 2012).

The economic value of a resource, product or service is measured by market price, how far one can rate or estimate the cost at which which access to improved water and sanitation is extended - is an important way of achieving efficient and equitable applications. Diseases associated with poor sanitation and hygiene conditions have a considerable effect on public health administration. They could be health or non-health benefits Table 1.3.

These are classified into 3 categories for the ease of comprehension:

1. **Direct economic benefits of avoiding diarrhoeal disease**

Direct costs of a non-health care nature are mainly those incurred to the patient, and are usually related to one or more visits to the health care facility, such as transport costs. Other expenses associated with a visit (e.g. food and drinks) and opportunity costs (e.g. time that could have been spent more productively) are also included here.

2. **Indirect economic benefits related to health improvements**

These include household production, or income-generating or earning activities, the true opportunity cost is the amount in monetary units that the person would earn over the same period of time if he/she were working, however this does not apply to people who are not in the working age like infants and children. This is a relatively easy estimate to make for those of working age, where the minimum wage can be taken as a minimum value for what their time is worth.

3. **Non-health benefits related to water and sanitation improvements**

Time savings occur due to, for example, the relocation of a well or borehole to a site closer to user communities, the installation of piped water supply to households, closer access to latrines and shorter waiting times at public latrines. These time savings translate into either increased production, improved education levels or more leisure time.

Table 1.3 Economic Impact of Poor Sanitation

BENEFICIARY	Direct economic benefits of avoiding diarrhoeal disease	Indirect economic benefits related to health improvement	Non-health benefits related to water and sanitation improvement
Health sector	Low expense on treating diarrhoeal disease	The value of fewer diarrhoea-related illnesses among health professionals	Effects of more efficiently managed water resources on vector bionomics
Patients	Less money spent on diarrhoeal illness treatment and associated costs/ Less money spent on transportation to get to treatment/ Less time lost due to treatment seeking	Value of days saved at work or school/Value of time saved by parents or caregivers of sick children /Loss of life avoided	More efficiently managed water resources and effects on vector bionomics
Consumers			Savings in time spent collecting water or using sanitary facilities. Switch away from more expensive water sources with labor-saving gadgets in the home. The value of the property is increasing. Non-use value and leisure activities
Agricultural and industrial sectors	Reduced expense on treatment of employees with diarrhoeal disease	Reduced impact on the productivity of health professionals	Improved water supply, more efficient water resource management – time-saving or income-generating technologies, and land use modifications all benefit agriculture and industries.

Benefits of improving sanitation include the following:

- reducing the spread of intestinal worms, schistosomiasis and trachoma, which are neglected tropical diseases that cause suffering for millions
- the severity and impact of malnutrition is reduced significantly
- it helps to promote dignity and boost safety, among female members of the community

- promoting school attendance by the provision of separate sanitary facilities helps improve girls' school attendance
- potential recovery of water, renewable energy and nutrients from faecal waste

Box 1.4- Time savings due to water improvements (Whittington, 1990)

It was assumed that, on average, a household gaining access to improved water supply will save 30 minutes per day (range: 15 to 60 minutes) and households receiving piped water 90 minutes per day (range: 60 to 120 minutes). These assumptions give 30.4 and 91.25 hours saved per individual per year, for improved access and piped water, respectively, assuming six members per household (range: eight members for low cost assumption and four members for high cost assumption). For improved sanitation, no data were found in the literature for an estimate of time saved per day due to less distant sanitation facilities and less waiting time. Therefore, after consultation with sanitation experts, an assumption was made of 30 minutes saved per person per day, from improvements along the above lines. This assumption gives 182.5 hours per person per year saved.

To summarise we can say that life expectancy and infant mortality are strongly associated with income generation or growth, as a result poor facilities for sanitation and hygiene are likely to have economic consequences. Bloom and Canning, 2000 have presented their arguments in favour of the fact that healthier people can increase the economy in several ways:

1. Productivity: Healthy workers are more energetic, take fewer sick days for themselves, family members, hence they are more productive. People without toilets or taps at home spend a lot of time each day queuing up for public toilets or seeking secluded spots for open defecation, or for collecting water. Improved sanitation would give every such household an additional 1'000 hours in a year to work, study, care for children, engage in collective efforts, and rest. This time has an estimated annual economic value of well over US$ 100 billion each year.

2. Education: Healthy workers invest more in education, because their longer lives, reap its benefits. Childrens health also promotes their school attendance and their cognitive abilities.

3. Physical capital investment: longer life expectancy means more savings, especially for retirement. Increased savings means more investment; some of this will be in capital, thereby increasing income. A healthy workforce may also attract foreign investment.

4. Demographic dividend: low mortality is associated with lower fertility, but the initial baby boom reaps economic benefits from workforce enlargement before parents adjust fertility.

The provision of sanitation can affect all four of these factors in particular ways. For example, a reduction in sanitation-related morbidity can increase worker productivity, as caregivers take fewer working days caring for sick infants (Rijsberman, 2004). Moreover, healthcare costs associated with treatment can instead be spent elsewhere, potentially in income-increasing investment. As well, mortality from diarrhea and other diseases reduces the future number of productive members.

There are other benefits which may not be directly related to affect the economy but contribute to its development. Children in households with no access to toilet are twice more likely to get diarrhoea than those who have one. By increasing the access to water and sanitation it is likely to lead health benefits and therefore significantly reducing the financial burden on health systems in the developing world. A WHO study in 2012 calculated that for every US$ 1.00 invested in sanitation,

there was a return of US$ 5.50 in lower health costs, more productivity, and fewer premature deaths.

1.3 Personal and Domestic Hygiene

Good hygiene is an important barrier to many infectious diseases, including those that are transmitted by the faecal–oral pathway. These practices (hand washing, bathing and laundering) promote better health, well-being and lead to great health benefits. Handwashing is one of the most effective ways of preventing the spread of diarrhoeal diseases. As pathogens cannot be seen on hands, it becomes even more difficult to tell people that if they do not wash their hands they will become sick. An important point to note here is that water alone may not be enough to remove them. In rural and low income groups use of ash has been reported to be used for cleansing hands and utensils. Disinfecting agents when used with water, can be used to kill pathogens on hands and utensils. The most important times that hands should be washed with soap and water are:

• After defecating.

• After cleaning a child who has defecated.

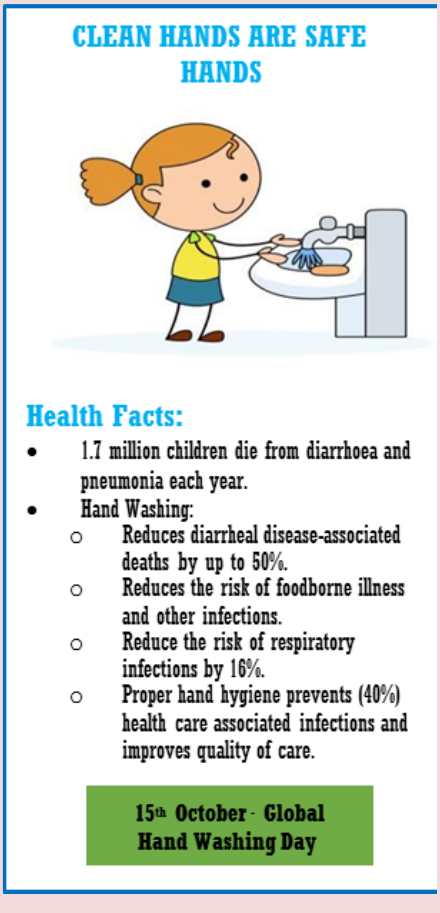
• Before eating or handling food.

Unlike household access to drinking-water and sanitation, no global mechanism exists to monitor hand washing practices in homes and communities. Furthermore, it is difficult to obtain reliable global estimates on hand washing with soap. However, according to a recent systematic assessment of 42 studies of observed handwashing with soap in 19 countries, just 19% of people wash their hands following possible contact with excreta (Freeman et al., 2014). Despite the fact that food and environmental hygiene practices are important for health and nutrition, there are few rigorous statistics on them.

Promoting good personal hygiene Figure 1.6 often requires participation of community members, who are mobilized towards this goal and are aware about how to achieve it. Education programmes to promote good hygiene, should be made to sensitize members and facilitate methods that maximize community participation. To encourage that these handwashing habits become part of the daily routine, suitable facilities must be located near to the latrines and kitchens. The availability of running water if available, optimizes these habits. The facilities should include a tap, a sink, as well as soap.

Households should be encouraged to practice hand washing at regular intervals and at critical times. Children and members of the community need to be trained on the importance of hand washing as a hygiene practice. Sessions of proper hygiene and sanitation practices should emphasize on hand washing before and after eating, after use of the toilet, using sanitary latrine etc. Hand washing practices that need to be taught as a regime of personal hygiene that

Box 1.5 Health Facts



should include personal cleanliness, use of soap while washing of the hands, cleaning of teeth, rinsing of mouth, trimming of nails, and washing ones clothes. It needs to be ingrained as a good practice and hence requires firm measures of adoption and consistent reminders at home, school and in health care centers. Targeting the physiological elements important for habit development (e.g. risk, attitude, ability, or maintenance beliefs) is an efficient way to create and maintain such a habit (Mosler, 2012; Newson et al., 2013). Handwashing should be done properly to ensure that germs, grime, and sweat are removed from the hands. These goals can be met if water and soap are available in sufficient quantities. Hand rubbing with an alcohol-based solution or sanitizer may also be recommended. To be successful, a handwash should last 40–60 seconds (for water and soap) or 20–30 seconds (for hand rubbing with an alcohol-based solution) and the action should follow the recommended steps (WHO, 2014a).

To ensure good results and routine practices of hand washing to be ingrained in a population we need to set up dedicated handwashing stations or kiosks with necessary supplies (soap and water or alcohol-based handrub solution). These need to be placed at key locations in households, schools, health care facilities and public spaces thus serving as a reminder for handwashing. The most important placements of these handwashing stations are near food preparation sites and latrines.

Figure 1.5 Tipy tap arrangement for hand washing

The critical times for hand washing with soap are:

1. Before eating
2. After using latrine
3. After cleaning baby bottoms
4. Before cooking food
5. Before feeding babies

Wherever possible, there should be roadmaps for locating latrines in relation to residences and wells:

- The toilet should be placed at least 20 meters away from any water sources.
- To ensure that groundwater flows away from a well, latrine should be built on the lower side of sloped terrain
- It may be necessary to highlight that the privacy of the entry is especially important here, as many people do not like to be seen entering a latrine.

- To keep foul odour and flies away, some standards propose building a latrine approximately l0m from the home.

To Do Activity

Celebration of special events to enhance community and stakeholder engagement Promoting and actively participating in global WASH related celebrations such as world water day or world toilet day provides a platform to raise awareness while engaging with the various stakeholders (e.g. beneficiary community, other aid actors, local authorities, etc.) in synergy and with the aim to leverage further involvement.

1. World Water day, 22 March
2. World clean-up day, 15 September
3. Global hand Washing day, 15 October
4. World Toilet day, 19 November

The level of personal and household hygiene in rural and unserved urban areas is extremely poor. The major contributing factors are inadequate housing, lack of access to adequate quantities of potable water and facilities for waste disposal make it difficult to obtain an adequate standard of domestic and personal cleanliness. In contrast, the level of personal and domestic hygiene is relatively better among those people of greater socio-economic standing. The socio-economic status of the people actually dictates the kind of practices they follow for sanitation and hygiene. Handwashing with soap and water after defecation is practically common in the urban high-income segment. However, just 25% of this same group uses soap and water to wash their hands before and after meals, while the rest use merely water. Water and ash/mud were used by 61 percent of the surveyed population in rural and peri-urban regions for handwashing.

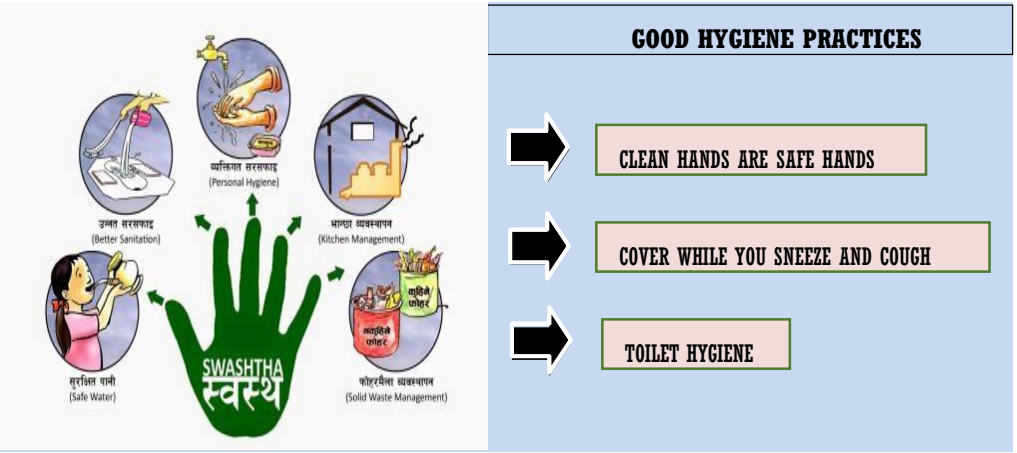


Figure 1.6 Good Hygiene practices

Regular bathing and laundering are also important for prevention of hygiene-related diseases. These are scabies, ringworm, trachoma, conjunctivitis and louse-borne typhus. Educational and promotional activities need to be designed and implemented for a behavioural change that encourages bathing and laundering. It is imperative that there are adequate number of washing facilities and locating them conveniently. Sufficient water should be available, clean personal or community facilities and separate arrangements for men and women will encourage a regular habit of bathing.

The most important parameter to consider here is the Quality of water for domestic use, which dictates both personal and domestic hygiene. Access to adequate water supply is a vital part of the sanitation service chain and it is needed for the efficient function. This includes operation, maintenance, cleaning of the facilities and for the purpose of personal and domestic hygiene. In a sample survey conducted in Calcutta, it was observed that most of the population in urban and rural areas use piped water or ground water (tube well) for drinking. The quality of water from these sources is variable as depicted in Table 1.4.

Table 1.4 Quality of water sources tested in Calcutta

Water Source	Proportion of samples faecally contaminated
Municipal/community piped water supply (72 samples)	>20 %
Hand pump tube wells (81 samples)	>20 %
Open wells (20 samples)	85 %
Village ponds (20 samples)	100 %
Household water reservoirs, household taps, in-house water containers, etc. (80 samples)	*>60%*

Source: IFH study, Calcutta, 2000

In rural areas, washing of utensils and clothes is often carried out in pond water, which ishighly polluted (faecal coliforms >1000 mpn 100 ml $^{-1}$). The cloth used for wiping floors or drying utensils maybe dirty and serves as a possible source of infection and cross-infection. Utensils that are cleaned with potable water and detergents in the majority of cases among the urban middle class and higher income groups of the population. This is to emphasise that the current state of personal and home hygiene in rural areas is appalling. This might be a major source of infection for all diseases that transmit via faeces, saliva, or skin contact, and the scenario is similar in unserved sections of the city.

One of the primary risk areas in terms of domestic hygiene is the collection, storage, and management of drinking water. Water was carried out of the storage pot using a container without handles in 68 percent of rural households in India, according to a representative survey. As a result, hands are frequently dipped in the water, polluting it. All groups of people in both rural and urban regions have repeated hand contact with drinking water during collection, storage, and serving, according to observations. People's perceptions of the relationship between community health and personal, household, and environmental hygiene are likewise unscientifically based. In a survey of the rural population, it was discovered that 75% were unaware of the link between exposed excreta and negative health effects. This is further supported by the methods used to dispose of children's faeces (Table 2). Most people attempted a minimal level of personal hygiene and a lesser level of household hygiene, but almost no effort was put towards environmental hygiene, which no one wants to be responsible for. The majority of people are aware of the link between hygiene and health, but their lack of conviction stems from years of tolerating unsanitary conditions.

Table1.5 Means of disposal of children's stools (% of families)

	High-income group	Middle-income group	Slum inhabitants	Rural inhabitants
Within the yard	–	–	–	20
Outside the yard or on the roadside	15	3.30	30	70
In drains or on garbage dumps	–	6.70	70	8
In latrines	85	90	–	–
Buried in the ground	–	–	–	2
Source: IFH study, Calcutta, 2000				

In planning for national development in India, programmes for improving water supply and sanitation have received low priority. In the first five 5-year plans allocation for the water supply and sanitation sector was less than 1.5%. In the sixth 5-year plan (1980 – 1985), during the international decade for water supply and sanitation, the allocation was increased to more than 4%. Even now, the priority for this sector is low, particularly when one considers the impact of unsafe water and lack of sanitation and hygiene on community health and economic productivity.

In a study by the World Bank, the health impact due to contamination of water sources and the lack of sanitation and hygiene in terms of disease burden and premature deaths brought about by diarrhoea and other water, sanitation and hygiene-related infections, was reported to be between US$3 and 8 billion per year. This is equivalent to 1.5 to 3% of the gross domestic product of the country. When considering that the economic and developmental planners in the country are struggling to achieve an economic growth rate of 5 – 6%, the futility of their economic logic becomes apparent. Clearly, investments in hygiene promotion along with community water and environmental sanitation would be cost-effective and beneficial in the long term.

Box 1.6- Ebola crisis in West Africa a threat to global health

The Ebola virus pandemic broke out in West Africa in late 2013, starting in Guinea and quickly spreading across the continent, affecting multiple nations (Liberia, Sierra Leone, Nigeria, Senegal, and Mali). Guinea and Liberia, the first countries to be afflicted by the outbreak, have put in place measures to stop it spreading, with the help of international organizations, and the rest of the countries have followed suit. The geographical spread of the virus in the current EVD outbreak has taken a unique path: the achievement of vast urban areas at an early stage of the epidemic has resulted in unprecedented dissemination, with the greatest EVD outbreak in history. This has sparked widespread worry around the world: the risk of endemic disease spreading to far-flung countries, primarily via quick transportation, has prompted numerous countries to issue information materials and health surveillance for those travelling to or returning from at-risk places. This issue in West Africa highlights the critical role of proper sanitation, water, and hygiene services in disease prevention and infection control. We must draw lessons from this unfortunate situation.

In order to achieve the primary objective of improving the health status of the community there is a need to improve attitudes, both with respect to hygiene in home and general health education, and implement these in conjunction with community water supply and environ- mental sanitation programmes. Most waterborne diseases spread through exposure of food and drinking water to

human faeces. Hence, the rate of infection may be reduced by improving practice for disposal of human waste, as well as improving hygiene in the home and water quality and food hygiene. After all, a supply of safe water would be of little benefit if it became contaminated because of unhygienic practices in the home. Correct storage and handling of food and drinking water should be an important component of any programme for promoting domestic hygiene. On the other hand, improvement in the hygiene behaviour of a community cannot be sustained without a concurrent improvement in the quality of environmental sanitation and the supply of safe drinking water.

1.4 Sanitation Ladder

The importance of sanitation to safeguard human health is an undisputed fact, as it known to cause millions of deaths each year through diarrhoeal disease and insufficient access to sanitation services. These in turn have been found to have a strong association with environmental degradation and corresponding poverty levels around the world. The UN in 2000, has included sanitation in the Millennium Development Goals (MDGs), which are intended as a guide towards reduction of extreme poverty, with time-bound targets. Point 7 of the Millennium Development Goals focuses on water and sanitation, and challenges the globe to reduce by half the proportion of people without access to safe drinking water and sanitation in 1990 by 2015. UNICEF and the World Health Organization (WHO) launched the Joint Monitoring Program (JMP) in the 1990s with the purpose of reporting on the worldwide state of water supply and sanitation and assisting nations in their efforts to monitor these sectors. To address this issue household surveys with a defined questionnaire have been designed, as an attempt to improve on the comparability of data between countries (WHO & UNICEF 2006). In the year 2000 the MDG assessed the progress towards the water and sanitation targets, in terms of existing sanitation facilities versus improved ones. This kind of assessment led them to understand that technology-based assessments would not lead the end user to benefit. For example, from the above assessment one did realize that sanitation systems that are not used and maintained properly will not provide the intended health and environmental benefits for the target population. This led the JMP in 2008 to design a tool commonly used in the sector: the sanitation ladder, it was based on their own analysis.

Table 1.6 Sanitation ladder in the Joint Monitoring Programme

(Adapted from WHO and UNICEF, 2012)

Rung	Description of what counts towards achievement of rung
Improved	Facilities that ensure hygienic separation of human excreta from human contact. They include: • Flush or pour-flush toilet/latrine to: – piped sewer system – septic tank – pit latrine • Ventilated improved pit (VIP) latrine • Pit latrine with slab • Composting toilet
Shared	Shared sanitary facilities of a generally acceptable sort between two or more households. Public restrooms are among the shared amenities. Unimproved
Unimproved	Facilities that do not separate human excreta from human interaction in a sanitary manner. Pit latrines without a slab or platform, hanging latrines, and bucket latrines are examples of unimproved facilities.
Open defecation	Defecation in fields, forests, shrubs, bodies of water, or other open areas, or the disposal of human faeces alongside solid garbage.

Within the water and sanitation industry, the sanitation ladder is a well-known concept. The tool is

extensively used to illustrate how people can move from simpler sanitation solutions to more advanced ones, by moving up one step at a time as if moving up, rung-by-rung on a ladder. It is used, generally as a tool to choose latrine types in community-based water and sanitation projects and in a variety of situations. Applicable to developing countries the sanitation ladder as defined by the JMP in 2016, starts with the open defection at the base and moves towards safely managed as the last rung or step of the ladder. In between the ladder uses the terms as climbing steps "unimproved", "limited", "basic" to reach the best practice. So, the bottom of the ladder is represented by the simple or basic latrine, which is constructed using local material by the user with some help. This latrine on the first rung is usually not considered sustainable over a longer period and thus needs to be replaced as the pit gets full. As one moves up the ladder from a basic model to a much more sophisticated or better managed one, skilled labour, knowhow may be required that may not be available to the end user. The owner thus needs assistance in the form of technical knowhow, funds not only to make this viable but also to maintain the same. The JMP has thus inspired countries to adopt a function-based approach for sanitation monitoring. It has been suggested that the latter be open to evolution by including indicators of how these facilities are used in actual and also add other hygiene related practices like hand washing, use of soap, tippy tap etc. At the all-India level more than 70% cities are entirely dependent on on-site sanitation systems.

Recognising this, the Government of India (GoI) has emphasized on-site sanitation and has issued a special advisory. This aspect is also included in the guidelines of the Swachh Bharat Mission for urban areas.

Table 1.7 Classification of cities

City Class	Population definition	Nos. Cities	Urban Population (Millions)
MC	>300,000	26	38.2
Class A	100,000-300,000	12	2.1
Class B	40,000-100,000	59	4.4
Class C	<40,000	147	4.3
NP	**As notified**	15	0.4
Total		**259**	**49.4**

Source: PAS Project (2013-14)

To understand this concept better we discuss here a live example of Maharashtra. Maharashtra is one of the most urbanized states in India, with approximately 23% of its population living in small towns and cities. Maharashtra is the 3rd most urbanized state in India, with 45% of the population living in urban areas, far higher than the national average of 13%. The state has experienced rapid urbanization in the last decade with the urban population growing by nearly 24% between 2001 and 2011 to reach population of nearly 50 million. Around 23% of the population lives in Municipal Councils (small towns and cities) that have a population below 300,000 people. The Figure 1.7 gives a detailed description of 240 Urban Local Bodies (ULBs) in Maharashtra, highlighting the methods of disposal that include basic pour flush latrines, night soil disposed in open drains and latrines serviced by humans/animals. The analysis presented here is that for personal toilets only (data not available for method of disposal of waste by community toilets). Slum sanitation issues need special attention in Maharashtra as 36% of the urban population resides in slums and makes good use of public or community sanitary complexes.

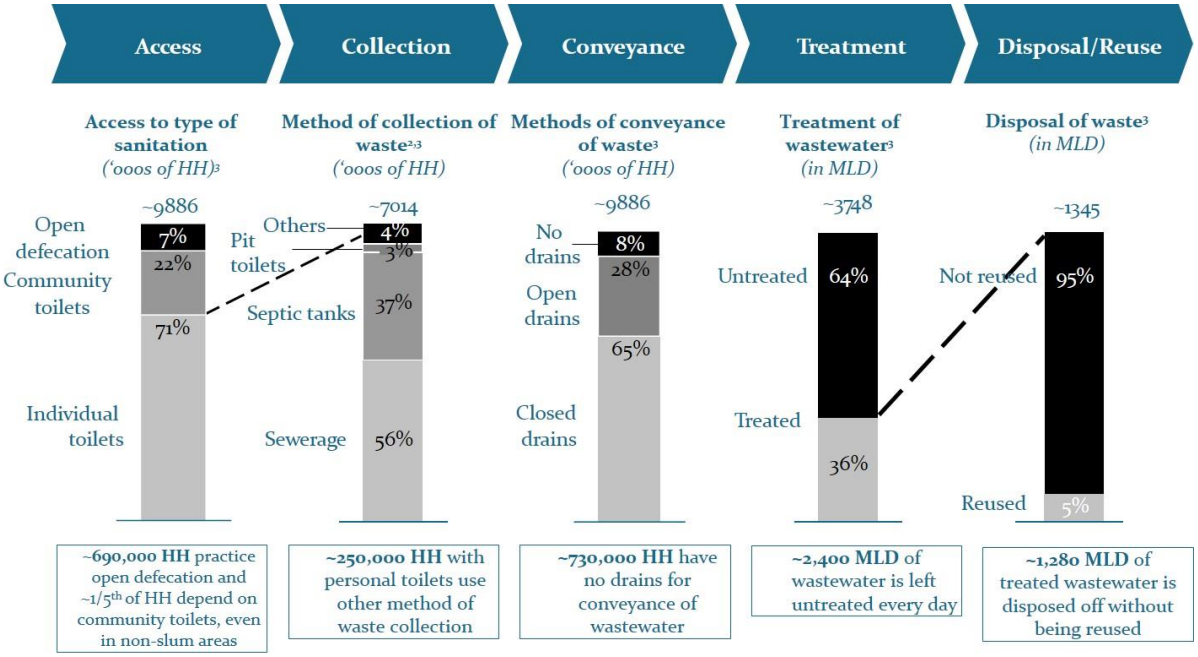


Fig 1.7 Sanitation value chain in urban Maharashtra, 2011 Source: CEPT PAS data 2011, Census of India.

Just about two-thirds of the urban population (67 per cent) have household latrines and about 20 per cent use shared facilities that are inadequate and not well maintained. About one-third of the households connect to sewerage systems and another one-third are connected to septic tanks. The state has much ground to cover in achieving a full scale sanitation chain that includes good user interface systems, collection (septic tanks), conveyance, treatmentand disposal of faecal sludge and sullage. Most of the septic tanks leach out the effluents into drain systems, which are disposed of into the environment without any treatment. Data available from the PAS Project indicates that less than a third of urban faecal load is safely treated and disposed; the remaining is disposed of into the environment without anytreatment.

Box 1.7 - Rules to be adopted by state/cities for improved septage management

An Advisory on Septage Management in Urban India (MoUD) recommends that the state and ULBs should take steps to adopt details on the following aspects in respective Acts and Building by-laws:

- Design of septic tanks, pits, and other septic systems (according to local conditions), as well as techniques for approving building plans or retrofitting existing installations to conform with regulations.
- Provisions specific to new real estate developments.
- Desludging frequency, as well as installation operation and maintenance. Operating procedures for desludging, including safety procedures.
- Licensing and reporting.
- Methods and locations of transport, treatment and disposal.
- Tariffs, cess/taxes, and other fees for the city's septage administration.
- Penalty clauses for untreated discharge for households as well as desludging agents.

The Advisory further emphasises the need for effective communications in implementing septage management plans– awareness needs to be created amongst authorities, households, communities and institutions which are part of the city's fabric, about sanitation and its linkages with public and environmental health. CSP implementation strategies and the communication component of this should also seek to promote mechanisms to bring about and sustain behavioural changes aimed at adoption of healthy sanitation practices.

1.5 Sanitation Technologies and Concepts of ODF

Sanitation technologies- The specific infrastructure, methods, or services designed to support the process of managing faecal sludge and/or wastewater through the stages of containment, emptying, transport, treatment, and end use/disposal. Sanitation technologies can also determine behaviour through, for example, ease of use, location and cost. Adequate technologies are required to form the basis for meeting the requirement of better facilities in sanitation and hygiene. The emphasis has been focused on improving the design and dissemination of technology and, specifically for sanitation, on lowering the costs of toilet construction and providing access to toilets for more people (e.g., through subsidies). The selection of technology is influenced not only by the technical elements of each technology under consideration, but also by other variables. These are the settlement's long-term viability, financial costs and affordability, design life, end-user expectations and preferences, institutional capacity, job creation possibilities, and environmental issues. The key objective of SBM(G) Phase II is to sustain the ODF status of villages and to improve the levels of cleanliness in rural areas through solid and liquid waste management activities, making villages

ODF Plus

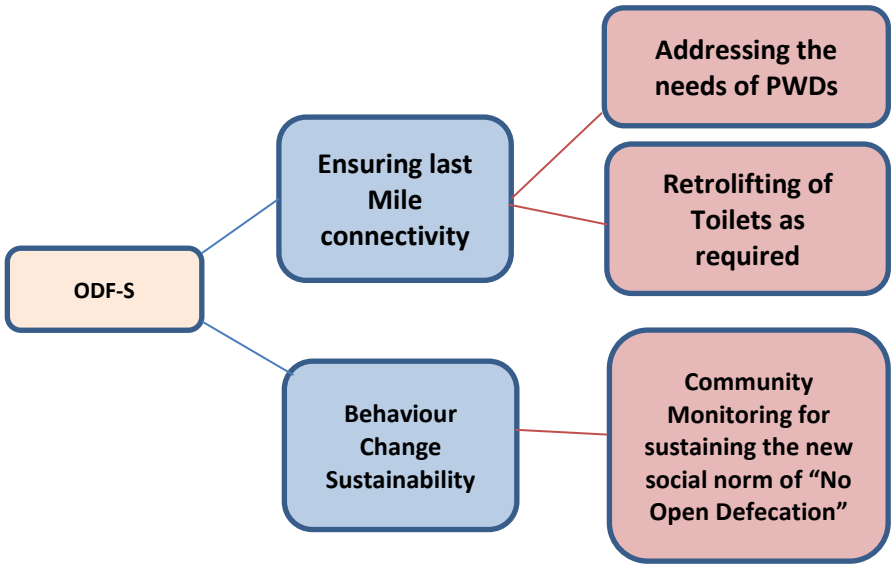


Fig 1.8 ODF Sustainability (*ODF-S*) interventions

While it has been found that twin pit pour flush toilet technology is the most responsive technical option in most geographies, cost implications need to be considered in order to meet the user preferences and location-specific needs.

The key to any facility's successful and long-term operation is the selection of an appropriate technology from a variety of options. Choice of technology is often considered a simple process, but is usually quite complex requiring careful assessment of factors, consultation with the beneficiaries and the operating authority, and an understanding of the integration of factors affecting the sustainability of a system.

Box 1.8- Rural Sanitary Marts (RSM) in India

In 1991, UNICEF launched a new Rural Sanitary Marts concept (RSM). This plan aimed to market the provision of sanitary amenities and encourage private initiative (Global meeting of UNICEF WES professionals). The RSM has a dual purpose. RSMs sell both construction components for latrines, such as pans, traps, various types of footrests, and pit covers, as well as things linked to latrines' use, such as soap or cleaning brushes. RSMs, on the other hand, act as a reference centre, advising consumers on which sanitation method to utilise. RSMs also preserve a list of addresses for trained masons, so that households can contact them if they need assistance building a latrine. A RSM could be founded by the government, the business sector, or established non-governmental organisations. An implementing agency, on the other hand, should have business experience and be placed in strategic locations to reach the rural hinterland. The first investment in beginning an RSM is subsidised by UNICEF. The sum is set at 25% of the estimated first-year turnover, with a maximum of 50,000Rs (1575USS) (Visscher, van Wijk, 1994). In 1993, the GNP per capita was US$330. UNICEF also offers retailers management training. RSMs were initially established in Uttar Pradesh in 1991, and they are now prevalent in other states as well. The Indian government is supporting the new policy by providing financial aid to RSMs.

Before we make choice of a sanitation technology it involves careful assessment of factors, consultation with the beneficiaries and the operating authority, and an understanding of the integration of factors affecting the sustainability of a system. The process involves a step-wise sequence as shown in the layout below Table 1.8

Open defecation refers to the act of defecating in public places that is when people go out in fields, forests, near water bodies or other open spaces rather than using a toilet. This is a dangerous practice as contact with the human waste can result in spreading of diseases like cholera, typhoid, hepatitis, polio, diarrhoea, worm infestation and under nutrition. India has the largest number of people defecating in the open. more than 564 million as being an agrarian economy has led to a large population being untouched by sanitation and hygiene practices. Currently, 1 in 7 people, or 946 million people, practice open defecation. Of those who do, 9 out of 10 live in rural areas. A big challenge that we face to end this open defecation is being unable to provide basic sanitation facilities (clean and safe toilets), but changing the behaviour of entire communities towards this practice. A large part of work in ending open defecation is to generate awareness, share information and to spur behaviour change in an effort to bridge the gap between building toilets and their proper use. The key expected outcome of ODF-Sustainability is no visible faeces in the village.

Table 1.8 Factors used for the Assessment of a Sanitation Technology

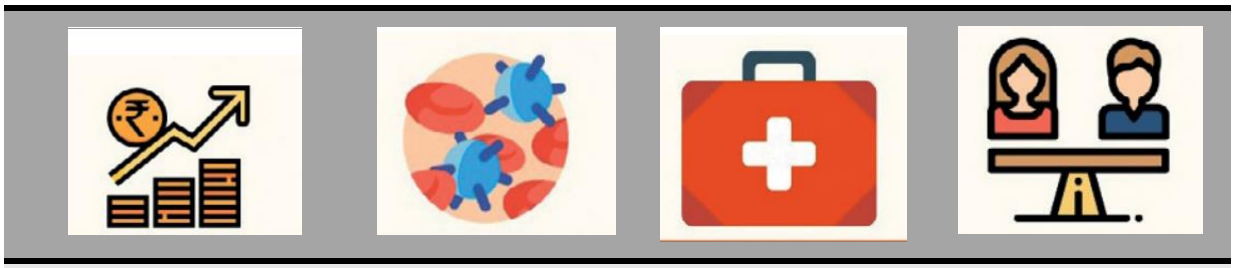
Issue or factor	Effect or implication	Output or impact
Step 1: Goal and objectives		
Goal: Improve the health and dignity of residents	Minimum basic sanitation for settlement type and effective H&H education	
Objectives (e.g.): 1. Ensure acceptable sanitation service 2. Ensure affordable sanitation service 3. Maximise social benefits 4. Protect the environment	1. Consult with residents prior to selecting technology option 2. Assess operation and maintenance costs at planning stage 3. Assess potential for job creation and skills development 4. Assess environmental impact through application of Groundwater Protocol	1. Residents are informed and participate in decision making 2. Financial requirements and tariffs are known beforehand 3. Local employment is maximized 4. Environmental impacts are well managed
Step 2: Analysis of constraints and promoters	• Capital costs • Recurrent costs • Job creation potential • Availability and reliability of water •Ground conditions (construction and/or drainage aspects) • Operational requirements • Environmental protection • Settlement location and layout •Past experience and preferences •Existing Infrastructure	• Ensure affordability of capital and O&M costs •Maximize employment benefits for local residents • Ensure ongoing operational viability • Prevent pollution of surface or ground water • Ensure appropriate level of service for each community • Maximise links to existing infrastructure and services.
Step 3: Output Selection of technology Specification of implementation methodology Plan for ongoing operation, maintenance and hygiene awareness Economic plan including sustainability of jobs and financing of O&M	• All stakeholders involved in technology selection • Technology is most appropriate for specific application • Implementation approach ensures participation and maximizes local benefits including job creation, support local material suppliers, strengthens local management capacity. • Ongoing sustainability ensured • Health benefits maximized	•Acceptable sanitation solution •Sustainable sanitation systems •Short and longer term local employment creation • Local skills development •Reduction in sanitation related illness

Case Study 3: Kishinchand Chellaram College, Swachh Bharat Abhiyan

Because millions of Indians lack access to toilets, the process of creating India Open Defecation Free (ODF) must begin at the micro level, reaching every home in the hamlet. Students from Mumbai's Kishinchand Chellaram (KC) College have built toilets in the Karvale village near Saphale in Palghar district, with one toilet built for each family. Kishinchand Chellaram (KC) College's NSS unit The phrase "Not me, but you" inspired college students to participate in the incomparable "Swachh Bharat Abhiyan" effort proclaimed by Honorable Prime Minister Narendra Modi during their holiday. The NSS unit held a camp in Karvale village in 2005 to build one toilet for a school because none of the homes in the community had one. After touring the village, the students understood the seriousness of the problem and decided to expand the project. The volunteers began raising awareness about the need of cleanliness and hygiene among the locals after gaining the trust of the villagers through frequent visits. The answer was slow at first, but they were eventually able to persuade the villagers of the value of having a toilet in their home. Principal Manju Nichani and NSS Program Officer Dr Satish Kolte set a target of delivering sanitation to all residents in the adopted village of Karwale by December 2016. Shri. Niranjan Hiranandani, the HSNC board's immediate past president, offered financial support for the project. In 2016, students laid the toilet slabs with the help of former volunteers and local villagers, completing the building of 67 toilets. On the 15th of January, 2017, the villagers were honoured by dedicating the amenities to them. Dr. Manju Nichani is an accomplished principal who has successfully implemented the "Dattak Gav Yojana." They have also facilitated numerous initiatives to enable socioeconomic growth of the community, such as kitchen farming, fruit tree cultivation, women empowerment, and cataract surgeries, after establishing their confidence among the residents.

Table 1.9 Check-list to declare a village ODF Plus

1	All households in the village have access to a functional toilet facility.	5	At least 80% households, and all schools, Anganwadis, panchayat Ghar have arrangement for managing biodegradable waste and liquid waste
2	The villages with more than 100 Householdsshould have a CSC.	6	The village has a plastic segregation and collection system
3	All schools/ Anganwadi Centres (AWC)/ Panchayat Ghar in the village have access to a functional toilet, with separate toilets for maleand female.	7	The village should prominently display at least five ODF-PlusIEC messages through wall-paintings/billboards etc on eachon the following themes: ODF Sustainability and continued toilet usage; Handwashing with soap; Biodegradable WasteManagement through use of compost pits; Plastic Waste Management; and Liquid Waste Management through soak pits.
4	All public places in the village are observed to have minimal litter, minimal stagnant wastewaterand no plastic waste dump.		



Financial and Economic Impact	Impact by way of lives saved	Health Impact	Impact on gender equality
In an Open Defecation Free village, each family saves over Rs. 50,000/- per year on account of avoided medical costs, time savings, lives saved. Source: Unicef Study, 2017	Over 3 lakh lives saved by 2019 due to improvement in sanitation under the Swachh Bharat Mission. Source: WHO Study, 2018	46% higher cases of diarrhoea among children in non-ODF areas Source: Sanitaion Health Impact Assessment Study 2017 by Bill & Melinda Gates Foundation	Reports published by International Monetary Fund (IMF) in 2017 & 2018 • 10% reduction in time spent by women involved in household and child care • 1.5% increase in the proportion of women in the workforce

Fig 1.9 Some of the impacts of Swachh Bharat Mission-Gramin (Rural)
Source Training of Swachhagrahis on ODF Plus: Keeping our Villages Clean, 2019

The main goal of SBM(G) Phase II is to keep villages ODF and improve the cleanliness of rural areas by implementing solid and liquid waste management operations, thereby making villages ODF Plus. An ODF Plus village is one that maintains its Open Defecation Free (ODF) status while also managing solid and liquid waste and being visually clean.

This includes

a. **ODF-Sustainability:** That all families in a village, as well as Primary Schools, Panchayat Ghars, and Anganwadi Centers, have access to a toilet, and that the village maintains ongoing behaviour change communication. At least five IEC messages on specific themes (as listed in the following checklist) should be publicly placed in the community. A Community Sanitary Complex should be built if the hamlet has more than 100 houses (CSC).
b. **Solid Waste Management:** At least 80% of households and all public spaces must manage solid waste effectively (including the Primary schools, Panchayat Ghar and Anganwadi centre). Individual and community compost pits are used to handle biodegradable waste from livestock and agricultural activities, and a sufficient segregation and collection system is used to control plastic garbage.
c. **Liquid Waste Management:** At least 80% of households and all public spaces must manage liquid waste effectively (including the Primary schools, Panchayat Ghar and Anganwadi Centre). This involves the treatment of greywater generated by cooking and bathing, as well as storm water, using channels and/or individual and community soak pits, and any black water resulting from septic tank overflow.
d. **Visual cleanliness:** If 80 percent of residences and all public locations are found to have little trash and stagnant water, and there is no accumulation of plastic garbage in the form of a dump in the village, it will be classed as visually clean.

Summary of the Chapter

India represents one of the worlds most populated countries, this creates an unreasonable pressure on all the resources available, notable among them are accessibility to water, food, sanitation and hygiene. As a result of the limited resources, facilities available for hygiene and sanitation take a back seat forcing the population to indulge in open defecation procedures. This in turn results in poor hygiene and other issues like managing the waste generated and its effective disposal. The open defecation practice also pollutes nearby water bodies or runway water that leads to diarrhoea and associated deaths especially among young children. As the population lives in make shift arrangements/jhuggis. there is no provision of hand wash post the wash room use resulting in unsanitary environments and contaminated water. The practice of not washing hands before eating further makes the population susceptible to diarrhoeal diseases and respiratory ailments. In many sub populations these lead to severe malnourishment, stunting and even death of young children and adults. A large part of the malnutrition burden is owing to the unhygienic conditions in which children grow up. Recurrent diarrhoeal outbreaks impair the ability of these children to absorb nutrients and as a result lower the immunity of these children as they grow into adults. Children weakened by these frequent outbreaks are also more susceptible to opportunistic infections such as pneumonia and infection from worms. The situation is even more complex for the adolescent females who lack the essential facilities, products and education to allow for proper menstrual hygiene. As a result many girls drop out of school as managing the menstrual cycle becomes even

more difficult in school with improper toilets, lack of adequate washroom facilities, lack of water in these toilets and efficient ways to dispose of the menstrual waste. Many a times schools do not have separate washroom facilities for boys and girls, this again secludes the young female population from dropping coming to school. Add to this the open defecation practice makes them vulnerable to exploitation, violence, shame and humiliation. Inadequate hygiene and sanitation facilities in schools are health hazards and affect school attendance, retention and educational performance. Measures need to be taken to give girls the knowledge and facilities for good menstrual hygiene which is key to their dignity, privacy, educational achievement and their health thus empowering adolescent girls are through improved menstrual hygiene management. There is a need to estimate and compare major economic costs and benefits associated with sanitation improv ementimprovementprograms.

Monetized costs include household financial and time investments in building and maintaining toilets , and government's investments on subsidies and campaign activities. Monetized benefits included re ductions in medical costs and mortality associated with diarrheal diseases, productive time saved fro m fewer diarrhoea cases and accessing outside defecation options, and increase in the property valu e of having a toilet.

Model Questions

1. In your local area (Village/Town/City) can you outline the barriers to sanitation?
2. Outline the areas of progress in India with reference to Sanitation and Hygiene, in the last 50 years.
3. As an observer to the barriers observed to sanitation practices, outline What to measure – installations or behavioral impact? Make a report or presentation.
4. With specific reference to your own home or locality, enlist the motivating factors to build or have access to toilets (Personal/Community)?
5. Explain the faecal oral route of infection, with specific reference to your locality/area of residence.
6. Tabulate the infectious agents that have been reported at the PHC or the local hospital.
7. Enlist the motivating factors for users of the CLTS approach.
8. Describe the important interventions in the sustainability of ODF places in your Village/City (location)

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Chapter 2 Toilets

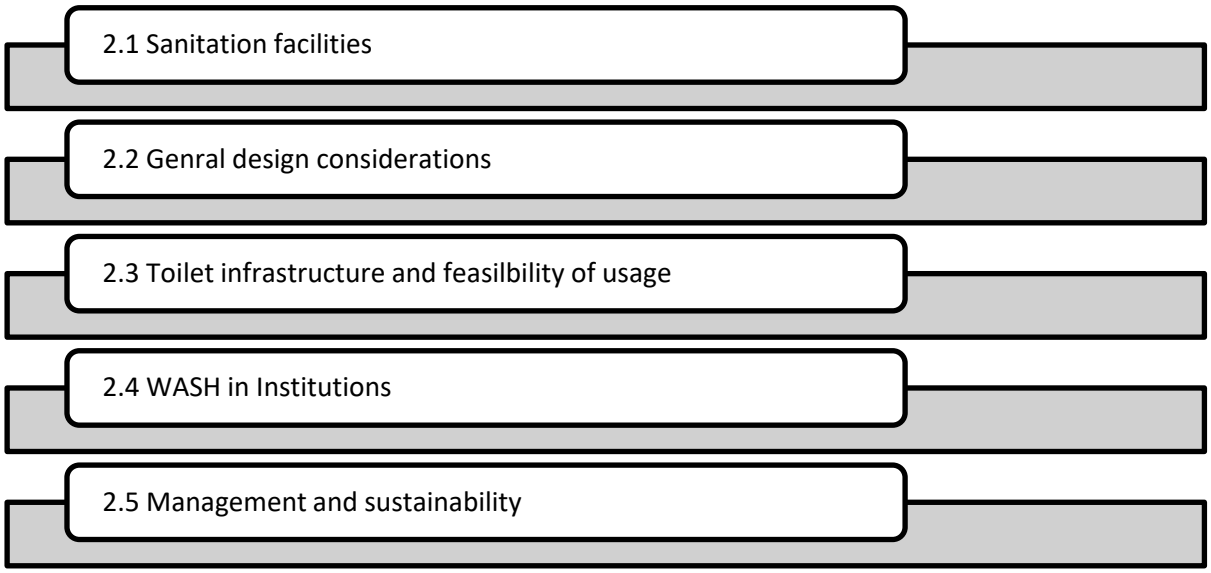
Introduction

In a world of limited resources it becomes essential to develop an approach to promote sanitation and hygiene such that it yields maximum benefit. The guiding principles of toilet management include critical interventions required not only to increase access to toilets but also to eradicate practices of open defecation and manual scavenging; adoption of scientific waste management methods; facilitating appropriate behavioral changes; capacity augmentation of service providers; and creating enabling environment for private sector's involvement. A close relationship exists between design and management, infact innovative design components can ensure the ease of management but they also strive to reduce operation and maintenance costs. These cater to the apparent need for a toilet facility that accommodates design choices, such that they allow for easy cleaning and management, have high resistance to vandalism, and have low maintenance requirements.

Objectives

- To provide description of sanitation facilities and their appropriation in response to gender, age, differently abled.
- To know of the specific design considerations in both Indian and Western prototypes
- To understand the feasibility of usage and infrastructure requirements for optimal use of the facility
- To understand the role of WASH in Institutions-MHM in schools
- To provide an overview of sustainable sanitation systems

Chapter Structure



2.1 Sanitation Facilities

The presence of a latrine is one of the most relevant and crucial sanitary interventions that has been recommended to improve sanitation and health outcomes. Inadequate toilet coverage, use, and maintenance, as well as inefficient faecal sludge management techniques, resulted in a mixed result. However, there is a rising need to take a systematic and evidence-based approach to toilets, their management, and upkeep. The Swachh Bharat Mission considers community toilets as one of the possibilities for reducing open defecation and, with government assistance, totally eliminating it.

It intends to provide explicit standards to assist administrators in planning for public and communal toilets in cities and villages, with proactive participation from all stakeholders to ensure the facilities' efficient planning, implementation, and upkeep. A user survey of at least 5% of the population will assist in determining the facility's requirement, the required number of facilities, the type of facility required, and the frequency of usage. Consider the local terrain, ground conditions, and groundwater and surface water levels throughout the process, taking seasonal variations into account to avoid contaminating local water sources.

Toilets are to be constructed based on the needs assessment of a local area that must include data on the following attributes:

- Number of potential users/ people assembling
- Duration and timing of assembling
- Gender ratio
- Willingness to pay
- Type of toilet preferred

In the case of an existing facility, we require survey data highlighting the following characteristics:

- Number of people using the bathroom on a daily basis
- Number of people using the facility age wise and gender wise
- Toilet usage pattern
- Utilization of the facility (urinal, WC, bathing facility etc.)
- Waiting time to use the facility
- Payment fee for usage
- Preferred toilet type
- Toilet condition

To do Activity

Organise a group discussion/meeting at the Primary Health Centre/Clinic of caregivers, feeding mother, parents. Engage them in a discussion of what they practice for disposing child faeces and make them aware of why safe disposal of child faeces is important, ways to dispose child excreta safely (dispose in a toilet; bury at a safe distance from home) and risks related to unsafe practices.

Regardless of the technical prototype, an ideal toilet should possess the following criteria.

- It should be reasonably priced
- It ought to consume less water
- It should take up less space
- It should be clear from odour and mosquitoes
- It should be capable of safeguarding the public's health
- It should be capable of converting faeces to manure
- It should be simple to use and maintain
- It should have a longer life span

Only by utilising an economically viable safe technology, that suits the the local terrain, is easy to maintain, and treats waste on site can ODF be made sustainable.
Before the toilet is built or planned, many models must be examined based on the number of users and user kinds, demand, and the facility's location. Depending on the situation, the following types of toilets may be considered:

- Stations, railway stations, bus depots, and so forth. (Extended peak hours/high load)
- Areas of the market (low load/long peak hours)
- Institutions of higher learning (high load/limited users)
- Miscellaneous locations (low load/limited peak hours)

Based on the results of the user survey, the toilet model must be finalised.

- Number of toilets to be built
- Number of seats/urinals as per the survey
- The type of facilities to be supplied, such as toilets and urinals only/ toilets and urinals plus washing facilities, and so on.
- SBM stipulates a minimum of one seat every 100 to 400 males and 100 to 200 women, with a gradual increase of seats dependent on footfall.
- The ULBs must identify tourist attractions, public meeting areas, train stations, bus stops, marketplaces, and other locations for public restrooms using spatial analysis.

Case study 4: Good Practices in Swacch Bharat Mission (Gramin) implementation

"Rajasthan has introduced "Smart Village" Yojana on the lines of "Smart Cities" where villages with more than 3,000 population are selected and 5,000 Sanitary complexes at public places and SLWM projects are sanctioned to achieve ODF plus GPs, apart from other rural development works". Electronic Fund Management System (e-FMS) for DBT, Branding of districts, and Online application/ Online Sanction are other proactive initiatives undertaken by the State.
Telangana Community involvement in sustainability being the key to achieving the objectives of SBM(G), Maintenance of IHHLs and Community Sanitary Complexes and monitoring the usage of toilets is made the responsibility of Self Help Groups (SHGs) with a one-time fee of Rs. 900 per household in Nizamabad district of Telangana"

The term 'toilet' refers to an area with sanitary hardware (a huge bowl with a seat) connected to a water pipe that can be used to dispose of waste from the body. It gathers and disposes of human urine and excrement. Toilets that are flushed use water, whereas toilets that are not flushed do not. Any type of toilet seat, latrine slab, pedestal, pan, or urinal can be used. Toilets come in a variety of designs, including pour- and cistern-flush toilets, dry toilets, and urine-diverting toilets. A toilet can be an independent structure or one that is part of a larger structure (e.g. private house, a school, health care facility, work place or other public setting).

The factors influencing households' ability to build and use toilets, as well as the difficulties sanitation programmes confront in reaching specific groups, are numerous. One-size-fits-all techniques have been ineffective, so we need more nuanced, tailored, and targeted approaches to capture the universality part of the Sustainable Development Goals (SDGs).

TABLE 2.1 Sanitation Requirements for Various Location Types (Source: IS 1172:1993)

Sl. No	Locations of public toilet	WC for Males	WC for Females	Urinals for Males Only
1	Railway station, bus station or bus terminal and seaports	3 for first 1 000 persons and 1 for every additional 1000 persons or part thereof	4 for first 1 000 persons and 1 for every additional 1000 persons	4 for every 1000 persons and 1 for every additional 1000 persons
2	Terminal stations and bus terminals	4 for first 1000 persons and 1 for every subsequent 1000 persons or part thereof.	5 for first 1000 persons and 1 for every subsequent 2000 persons or part thereof.	6 for first 1000 persons and 1 for every subsequent 1000 persons or part thereof.
3	Fruits and vegetable markets	Not less than 2 and an additional one for every 50 persons	Adequate provision of water-closets shall be made	Not less than 2 for every 50 persons.
4	Office Buildings	1 for every 25 persons or part thereof	1 for every 15 persons or part thereof	1 for 7-20 persons 2 for 21-45 persons 3 for 46-70 persons 4 for 71-100 persons From 101-200 persons add at the rate of 3 percent. For over 200 persons, add at the rate of 2.5 percent
5	Factories	1 for 1 to 15 persons 2 for 16 to 35 persons 3 for 36 to 65 persons 4 for 66 to 100 persons	1 for 1 to 12 persons 2 for 13 to 25 persons 3 for 26 to 40 persons 4 for 41 to 57 persons	1 for 7 to 20 persons 2 for 21 to 45 persons 3 for 46 to 70 persons 4 for 71 to 100 persons
6	Art Galleries, Libraries and Museums	1 per 200 persons up to 400 persons; and for over 400 persons, add at the rate of 1 per 250 persons or part thereof	1 per 100 persons up to 200 persons, and for over 200 persons, add at the rate of 1 per 150 persons or part thereof	1 per 50 persons
7	Restaurants	1 for 50 seats up to 200 seats; and for over 200 seats, add at the rate of	1 per 100 seats or part thereof. 1 for 50 seats up to 200 seats; and for over 200 seats, add at the rate of 1 per 100 seats or part thereof.	1 per 50 persons

Gender- Because women's sanitation demands differ greatly from men's, it's important to consider gender when planning and designing public and communal toilets, as well as devising institutional procedures for their management and upkeep. Women often restrict their food and water intake and control their bladder and bowel movements in locations where toilet facilities are lacking or

where the provision (in terms of number of seats) is insufficient, making them exposed to illnesses and diseases. They wait until dusk to defecate in the open, when the darkness provides some privacy. Harassment and sexual assault are genuine dangers for women who defecate in public as well as those who have to go long distances to get to a toilet.

Water and power are essential for ensuring that women utilise public / community restrooms. If the block does not have electricity, women frequently avoid using the restroom at night for fear of sexual assault. The provision of a constant supply of water is critical for ensuring that women use bathrooms and maintain personal hygiene. Broken doors and missing latches are common in most toilet blocks due to inadequate maintenance. This is a breach of women's and adolescent girls' right to dignity, as well as a threat to their safety. Menstrual hygiene management is currently unavailable in the majority of public and community bathrooms.

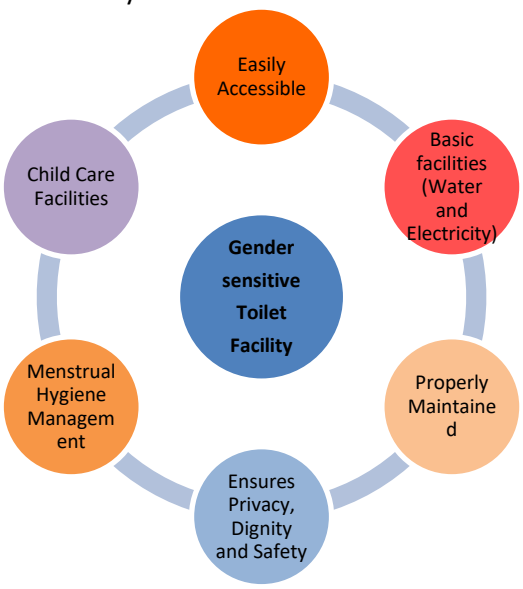


Figure 2.1 Gender Sensitive Toilet Facility

A toilet that is gender-neutral Figure 2.1 is a facility that is easily accessible for women, has basic facilities such as water and electricity, is clean and well-maintained, has design elements that ensure women's privacy and dignity, is safe for women to use at all times (with lighting and adequate security provisions in terms of caretakers, etc.), and has provisions for child care and menstrual hygiene management. Integrating women's menstrual hygiene needs is a critical component of maintaining gender-sensitive toilet facilities. In each block, there should be at least one WC for differently abled males and girls.

Ramps for differently abled- Access to water and sanitation facilities is challenging for people with disabilities due to technical hurdles or structural constraints. For years, the needs of disabled people have been overlooked, greatly to the detriment of both impaired persons and the general public. Environmental (such as steps and narrow doorways), institutional (such as a lack of information from authorities and exclusion from consultative procedures) and attitudinal barriers all play a role (such as prejudicial attitudes from the community and service providers).

Disabled persons and their caregivers' health, dignity, education, and work are all harmed as a result of these limitations. In addition, people with disabilities encounter social challenges such as stigma and prejudice from others when accessing public or private facilities. They may be excluded because they require more time to utilise the facility, and families may be required to make additional investments in order to provide access to the impaired member. It is critical to have a thorough grasp of the disabilities that exist among the target group. For example, toilets and washstands must

be modified to satisfy the diverse needs of children with disabilities. Although low-cost choices may be available to assist such persons, external assistance or cost-sharing options may be required.

Box 2.1 -Toilets for Special Needs

Physically differently abled using a wheel chair need sufficient space to move their wheel chairs inside the toilet. A grab bar is needed to provide support to such persons to use the toilet. Taking all these factors in consideration following are the elements that a public toilet for physically differently abled persons must incorporate;

1. One special WC should be provided for the use of physically differently abled men and women with a wash basin near the entrance.
2. Normal toilets are to have an average height of around 32-40cms while toilets for the physically differently abled should not be less than 38 cm and not more than 45 cm (CPWD, 2014). The minimum size of a toilet cubicle should be 1500mm x 1750 mm.
3. Minimum clear opening of the door shall be 900 mm and the door is to swing outwards.
4. Suitable arrangement of vertical/horizontal handrails (with 50 mm clearance from the wall) shall be made inside the toilet.
5. Toilet floor should have a non-slippery surface.
6. Guiding block near the entry should have a textural difference.
7. Additional options for toilets for the physically differently abled include adding a handicap bidet.
8. There should be at least one WC in each block catering to transgender persons. This should be located near the entrance of the women's toilet block. This facility should be mandatory for public toilets located at crowded places like railway stations, bus stands.
9. Handrails or grab bars should be provided for at least one urinal to cater to differently abled users.

Children

Squatting pans should be available for tiny children who have difficulty using toilets. Squatting pans should be positioned in the women's part of the toilet block (minimum of two small WCs / squatting pans) because children are always accompanied by their mothers to the toilet. The door fixtures, as well as the sink or hand wash pans must be placed at half the height of regular doors. This will encourage children to wash their hands at the sink and will also make it easier for the child to handle the door while under the supervision of the parent.

Figure 2.2 Height Adjustable Washbasin

Figure 2.2 depicts the concept of making the complete wash basin, drain, and mirror assembly vertically adjustable so that persons of various heights can use it without difficulty. Pauri Garhwal, Uttarakhand's Akansha Guha designed it (Ignite, 2014 Award winner). As a result, sanitation facilities must be designed in a universally accessible manner to accommodate people with disabilities, older citizens, and anyone with specific needs arising from sensory, motor, and other impairments, as well as women and children.

2.2 General Design Considerations

It is critical to design a toilet that is universally accessible and simple to use. The structure's life requirements must be taken into account when designing and selecting materials. It should appropriately handle the various sanitation needs of particular user groups such as women, children, the elderly, the infirm, and the differently abled. We need to categorise the different sorts of toilets that are required when developing cities so that they can be built based on the needs of the end user and local conditions. Toilets are divided into categories based on their location and the types of people that use them. Based on the placement of the facility in relation to its utilisation, the toilets have been divided into five types (Table 2.2).

TABLE 2.2 Categorization of Public Toilets

Type of toilet	Typical Location	Typical users	Typical hours ofoperation	Typical User charges	Revenue potential
Type 1 Transit Area toilets	• Bus stands • Railway stations • Metro stations • Bus stops • Fuel stations • Taxi / auto stands • Roads / walkways /intersections	Tourists, Locals, Travelers	24 hours	Per use	High revenue
Type 2 Institutional Area toilets	• Commercial areas • Markets*, Shopping malls • Education institutions • Hospitals / Healthcare centers • Offices • Choultries / Dharamshalas • Theatres • Convention centers • Hotels / restaurants • Marriage halls • City infrastructure**	Office goers, Shoppers, Tourists, Travelers, Locals, Business	Minimum 12 hours (toilets at offices may be open 24 hours depending on the operational hoursof the institution)	Per use or free usage (depending on the location and institution)	-

Type of toilet	Typical Location	Typical users	Typical hours ofoperation	Typical User charges	Revenue potential
Type 3 Public Space toilets	• Parks • Playgrounds • Recreational areas • Parking areas • Religious places • Historical places	Children, Adults, Locals, Pilgrims, Tourists	8 to 12 hours (mostly during the day)	Per use	Low revenue
Type 4 Community toilets	• Slums • Low income areas	Families with children	24 hours	Per use or Monthly Pass	Low revenue
Type 5 Event linked toilets	• Functions • Fairs • Exhibitions	Organizers, Visitors, Patrons	8 hours (or depending on theduration of the event)	Free usage	-

Single toilet units (like E-toilets) are covered under Type 1 & 3 toilets above. Standalone Urinal facilities as an option are covered under Type 1, 2, 3, 5 toilets above. Infrastructure requirements are as listed below in Table 2.3, 2.4 and 2.5.

TABLE 2.3 Norms for Sanitary Facilities in Public Toilets

(Source: CPHEEO Manual on Sewerage and Sewage Treatment, MoUD, 2013)

NO	Sanitary Unit	For Male	For Female
1.	Water Closet	One per 100 persons up to 400 persons;for over 400 add at the rate of one per 250 persons or part thereof.	Two for 100 persons up to 200 persons;over 200 add at the rate of one per 100 persons or part thereof.
2.	Ablution Taps	One in each W.C.	One in each W.C.
3.	Urinals	One for 50 persons or part thereof.	Nil
4.	Wash Basins	One per W.C. and urinal provided	One per W.C. provided

The type of infrastructure and facilities provided for each type have also been arrived from various guidelines and presented in Table 2.3. They are categorized as mandatory / recommended / optional based on past sector experience and operational convenience

TABLE 2.4 Norms for Community Toilet

(Source: Guidelines on Swachh Bharat Mission-Urban, GoI, 2014)

Toilet Seats	Bath units	Urinal units	Clothes washing Area
One seat for 35 men	One unit per 50 users	One unit per 200–300 users	4 to 5 sq. meters per 10 toilet seats; Min. 1.5 m x 1.2 m
One seat for 25 women			

TABLE 2.5 Size of Toilet Cubicle, Bathroom, Urinal & Washing Area

(Source: Guidelines on Community Toilets, GoI, 1995)

Description	Optimum (mm)	Minimum* (mm)
Toilet cubicles	900 x 1200	750 x 900
Bath rooms	1050 x 1200	900 x 1050
Urinals (divided into units by partition walls)	575 x 675	500 x 600
Washing area	1750 x 1500	1200 x 1500

It is important to note that the minimum sizes may be adopted whenever there are space constraints. While these proportions may be appropriate for family toilet cubicles, they may not be acceptable for community toilet cubicles.

Psychological research must be incorporated into the basic principles of toilet design, as these are places where one is required to relieve oneself in new surroundings amid strangers of the same sex. There are numerous thorough design recommendations on the precise dimensions of toilets, squat pans, and urinals; nonetheless, it is critical to consider who will be the end user; there is no one-size-fits-all model that is appropriate for everyone. It's critical that the model chosen meets a minimal standard that's acceptable to all users. Design and management have a close relationship, with design components ensuring ease of management and lowering operating and maintenance expenses. Design decisions should be made in such a way that they are easy to clean and manage, have a high resilience to vandalism, and require little maintenance. The toilet should be designed to be universally accessible and simple to use. According to research, the lack of clean and accessible restrooms has the greatest impact on women and adolescent girls of all population groups. Women (and adolescent girls) are discouraged from using public / community toilet blocks due to poor location, improper design, and poor upkeep. They also confront a variety of obstacles and risks when utilising public and community restrooms. Women and girls are more motivated to improve sanitation than men since they confront more issues. The size of the toilet block (i.e. the number of seats) and its location are two important factors to consider.

Figure 2.3 depicts three levels of 'inclusion' that can be used in a variety of situations:

- Mainstream products for everyone, including people with disabilities;
- mainstream products that can be 'customised' to meet the needs of people with disabilities;

- Specially-designed items that are 'adapted' to meet the needs of persons with severe disabilities.

This enables a more personalised approach, resulting in tailored goods to solve situations when it is difficult to expand the design parameters of mainstream offering to encompass everyone.

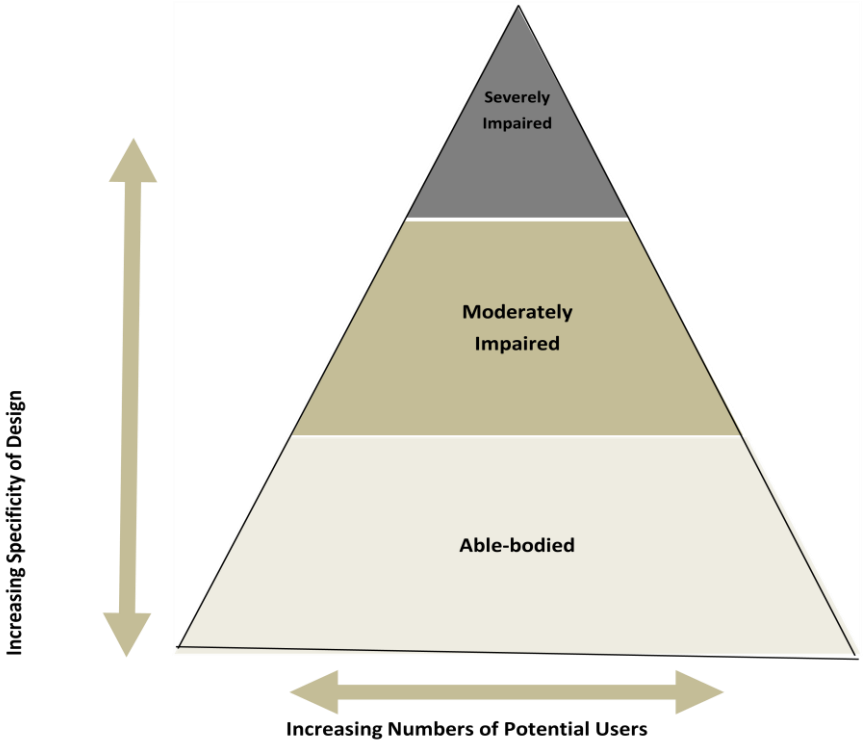


Figure 2.3 Design pyramid (adapted from Benktzon, 1993).

Figure 2.4 Types of toilet Indian vs Western model

In comparison to Western toilet closet pans (Figure 2.4), which are wall-hung and equipped with a manual or automated flushing system, Indian toilet closet pans are of standard design and made of ceramic or an analogous material.

Separate entrances for men and women must be provided at the restrooms, leading to their respective areas of the facility. This design element is critical for ensuring women's privacy and safety. In the event that the WCs / bathing facilities are occupied, the design must incorporate a waiting place for women where they can queue. It is preferable to provide access so that guys do not have to use the women's restroom.

Sustainable design concepts must be implemented and managed in public sanitation facilities. The goal should be to reduce their environmental impact and enhance sanitary conditions in low-income neighbourhoods by providing safe trash disposal.

The following objectives should be considered throughout the design stage:

- reducing the use of water and non-renewable resources
- encouraging good health and sanitation
- lowering the cost of the initial investment without sacrificing functionality
- satisfying the needs of the intended audience
- Increasing the material and equipment's durability
- Safe waste disposal that is easy to extend, improve, and replicate, with an emphasis on possible reuse alternatives
- decreasing pollution by giving choices for reusing waste items while taking up the least amount of space

To do Activity

Organise a get together in the community centre or initiate a group discussion/meeting on the benefits of using toilets regularly and acknowledge need for toilet, describe the different sanitary options available and awareness of the cost, awareness about government sanitation programme and spread awareness of understanding the processes involved in building a toilet, preferably in the local language.

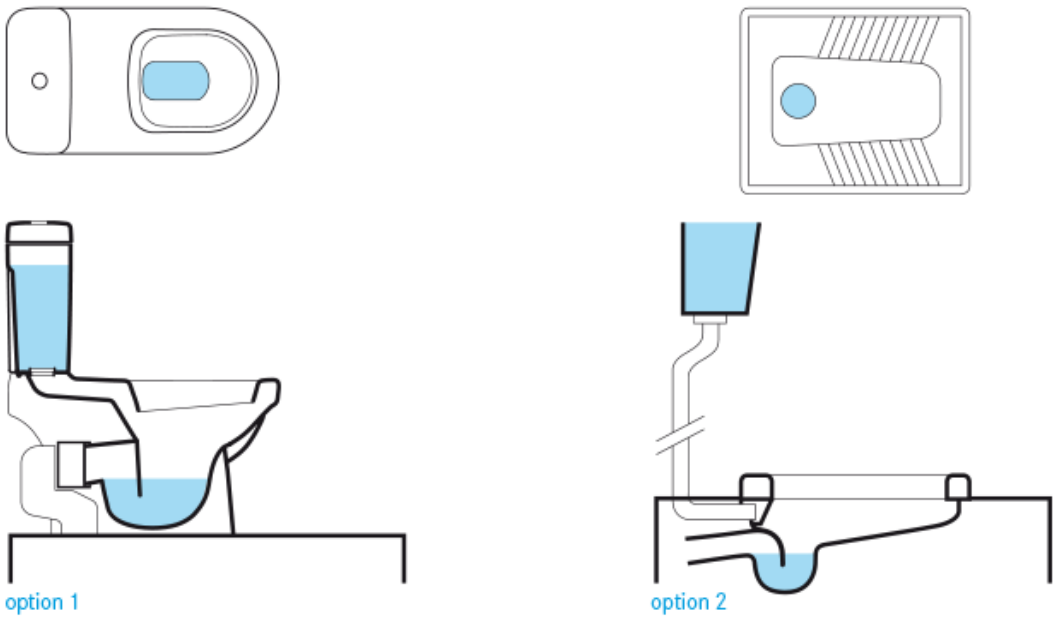


Figure 2.5 Cistern flush toilet

Water is poured into the toilet bowl to flush excreta away in pour flush toilets; 1 to 3 L is sufficient. The amount of water and the force of the water must be adequate to propel excreta up and over the curved water seal (pouring from a height typically helps). The design of the cistern flush toilet in Fig. 2.4 includes a water seal to prevent odours from rising back up into the toilet. The amount of water used can range from 6 to 9 litres, however there are some types that utilise as little as 3 litres. This design ensures that the excreta of one person is flushed away before it may be used by another.

Mobile toilet vans (MTV) may be an option when land is not accessible but ongoing demand is great or for a limited time. MTV could be an alternative during events and in the case of temporary CTs. MTVs are provided on a daily basis in various cities. ULBs also install these toilets in slum areas where there isn't enough space for CTs to be built. It's critical to look at and understand PT/CT facilities from two perspectives: the demand side (user-related) and the supply side (supplier-related) (infrastructure and institution related). An integrated assessment determines the extent to which toilet service is required.

Box 2.2- Mobile Toilet Van

Mobile toilet vans (MTV) – are temporary toilets / urinals (5-10 WCs/urinals) mounted on wheels. There is one sludge tank of required volume below the WCs and on chassis of the van. It is equipped with water storage and wash hand facilities. Such MTV is installed at required site. After the sludge tank is filled or is about to fill, it is moved to the site where sludge is disposed. Normally sludge is removed at manhole of nearby sewer network. After removing sludge is it put again at the site. For cleaning purpose, one cleaner is attached with the system with cleaning materials. The system is more suitable for short gathering and functions.

It is important that PT / CT facilities are viewed and understood from two sides - the demand side (user related) and the supply side (infrastructure and institution related). An integrated assessment provides the extent of requirement of toilet service provision.

2.3 Toilet Infrastructure and Feasibility of Usage

Toilets are classified according to their location, user demographics, revenue possibilities, operating hours, and amenities. Based on the facility's location, the toilets have been divided into five categories. In addition, each user type has been established, as well as the prospective operating hours, normal user charges, and revenue potential. Table 2.1 lists the kind of amenities given for each, including restrooms for the disabled, transgender, caretaker, storage, waiting/ circulation space, and washing area. In order for users to recognise the cubicle doors, appropriate signage must be posted on them.

Categorization of Toilets

Type 1 toilets can be found at transit hubs such as railway stations and airports.
Type 2 toilets are located in high-traffic institutional spaces such as markets and religious buildings.
Type 3 toilets are located in open areas, recreational spaces (public areas), and other public areas.
Type 4 toilets are designed for a specific group of people, such as communal toilets.
Type 5 toilets at events, fairs, and exhibits

Box 2.3- Essential Features of Toilets

- Compatible with current and predicted future water availability for flushing (if required), cleaning and hand hygiene.
- Compatible with the subsequent containment, conveyance and treatment technologies (onsite or offsite) for safely managing excreta generated through toilet use.
- Suitable, private and safe to use for all intended users, taking into consideration their gender, age and physical mobility (e.g. disabled, sick etc.).

The slab (or pedestal) should be designed and constructed:

- From a durable material that can be cleaned easily (e.g. concrete, fibreglass, porcelain, stainless steel, or durable plastic).
- So that the size and arrangement is appropriate for all intended users (including e.g. children and older people).
- So that storm water is prevented from infiltrating the containment technology.
- For flush toilets – fitted with a water seal or trapdoor to control odour and prevent rodents or insects entering the containment technology.
- For dry toilets – fitted with a removable, closely fitted lid, to prevent rodents or insects entering the containment technology and, if fitted with a ventilation pipe, a corrosion resistant fly screen.

The superstructure should be designed and constructed so that it prevents intrusion of rainwater, stormwater, animals, rodents or insects. It should provide safety and privacy with doors that are lockable from the inside for public toilets, or toilets shared between households.
Culturally-appropriate anal cleansing materials should be available within the toilet (i.e. water supply and container for washing, or materials for wiping – with a disposal container where required) and accessible handwashing facilities with soap and water should be available nearby in a location that encourages use.

All stakeholders should be able to use the toilet with ease. If the toilet facilities meet the following requirements, they can be termed adequate, appropriate, and acceptable:
They are suitable for all members of the public, including children, the elderly, pregnant women, and those with impairments; transgender people

- are easily accessible to users, particularly women and girls, as well as those with disabilities
- provide privacy to users
- are easy to operate and maintain (keep clean)
- do not pose a threat to the environment;
- have adequate space for different users
- have inside locks
- have easy access to water for handwashing, anal cleansing, and flushing

- allow for dignified women's menstrual hygiene management (materials and disposal facilities), as well as child and adult incontinence materials;
- are safe for children
- reduce insect breeding
- reduce odour

Table 2.6 Suggestions for Design Considerations/Solutions For Accessible Sanitation*

Guidelines for public and community toilets management by cities in Andhra Pradesh, 2016

Type of disability	Identified difficulties faced in accessing/using toilets	Examples of design considerations/solutions being envisaged
Physical disability/mobility impairments (such as Cerebral Palsy, Locomotor Disability, Muscular, Dystrophy, Multiple Sclerosis, etc.)	Difficulties in maintaining balance Difficulties in squatting, getting up &/or turning Difficulty in finding and/ or holding objects such as doorknob, water container etc. Extreme pain while movement	Path leading to toilets smooth and free of barriers Handrail along path for support Ramps with adequate slope Floor made of non-slippery material Toilet entrance adequate for wheelchair to enter Toilet cubicle space adequate for a person with a wheelchair to move and close door comfortably Handrail/grab bar inside toilet cubicle Raised seat Height/level of fixtures adjusted as per requirement Modifications in the door to ensure privacy and ease of use
Vision impairments (blindness or low vision)	Difficulty in finding path Difficulty in maintaining balance Difficulty in finding and/or holding objects such as door knob, water container etc.	Landmark posts/guide string along the path leading to toilet Handrail/grab bar inside toilet cubicle Floor made of non-slippery material Toilet and area outside toilet well illuminated Adequate colour/tonal contrast between walls floor and fixtures
Intellectual disabilities or sensory impairments	Sensitivity to sight/ smell Fear in dark/closed space	Adequate space and ventilation in toilets Toilet and area outside the toilet well illuminated
Elderly persons also face similar barriers and difficulties, for which suitable design/modification of toilets is advised. Short-term arrangements can also be made for enhancing accessibility for pregnant women. *This list does not cover all types of disabilities and specific challenges.		

There are numerous criteria for selection based on the local land terrain, hydrological circumstances, environmental issues, economic position, and end user or people's habits. These are grouped under the following categories:

A. Soil conditions:

a) Normal soil/sandy soil/permeable soil-Twin Pit Toilet

b) Semi-permeable soil-Modified Twin Pit Toilet

c) Impermeable soil-Ecosan toilet/Biogas connected toilet/Vermiculture based toilet/Septic tank with adequate treatment system/Septic tank with proper treatment system

B. Hard stratum:

a) Hard strata beyond 1.2m depth-Twin Pit Toilet;

b) Hard strata beyond 0.75m-1.2m depth-Modified Twin Pit Toilet;

c) Hard strata before 0.75m depth-Ecosan toilet/Biogas connected toilet/Vermiculture based toilet/Septic tank with adequate treatment system

C. Groundwater conditions:

a) Water table 3m depth-Twin Pit Toilet

b) Seasonal high-water table-Modified Twin Pit Toilet

c) Permanent high-water table/Water logged condition-Ecosan toilet/Biogas connected toilet/Vermiculture based toilet/Septic tank with adequate treatment system

Swachh Bharat Mission (G) advocates Twin-leach Pit Pour Flush Water Seal toilets at the household and community level where ground water levels are below 3 m and soil conditions are normal/ sandy/permeable/hard stratum beyond 1.2 m deep in the interest of sustainability.

Toilets are classified into several categories.

1. Twin Leach Pit Pour Flush Toilet

A Y junction connects two leach pits (twin pits) to a pour-flush toilet. Because the Y connection is blocked for the other, only one pit can be used at a time. When the pit is full, it is sealed and the other is used. This method (Figure 2.6) is cost-effective, uses minimal water, avoids the spread of unpleasant odour by absorbing it, and aids in the anaerobic decomposition of faeces in one pit while the other is in use.

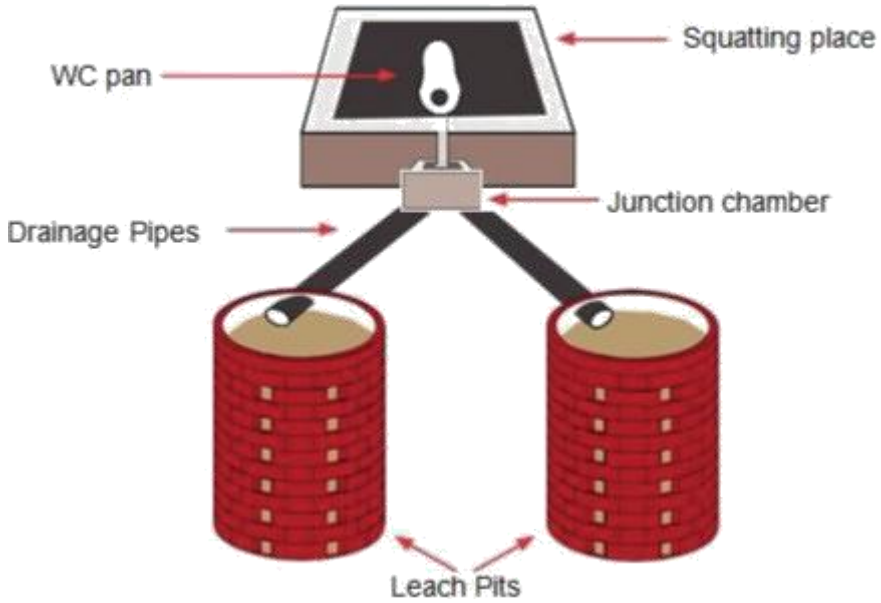


Figure 2.6 Twin leach pit pour flush toilet

For the facility to be convenient for the end user, there must be criteria to consider. One of these is having a closed toilet in the backyard, which demands the user to adjust their behaviour. Because

most Indian rural households have historically performed open defecation away from human habitation, having a toilet on the premises is a departure for many. Avoid constructing the toilet in a low-lying area to avoid any form of water stagnation. Another key criterion is to keep a safe distance from the source of drinking water (hand pump, well, river, pond etc). Because water from the pit is constantly leaching, it is critical that this distance be maintained to minimise contamination of drinking water (Figure 2.7). The facility must be located distant from a large tree, as the tree's expanding roots may crack the pit's walls. When building the twin-pit system, it's best to stay away from rough ground.

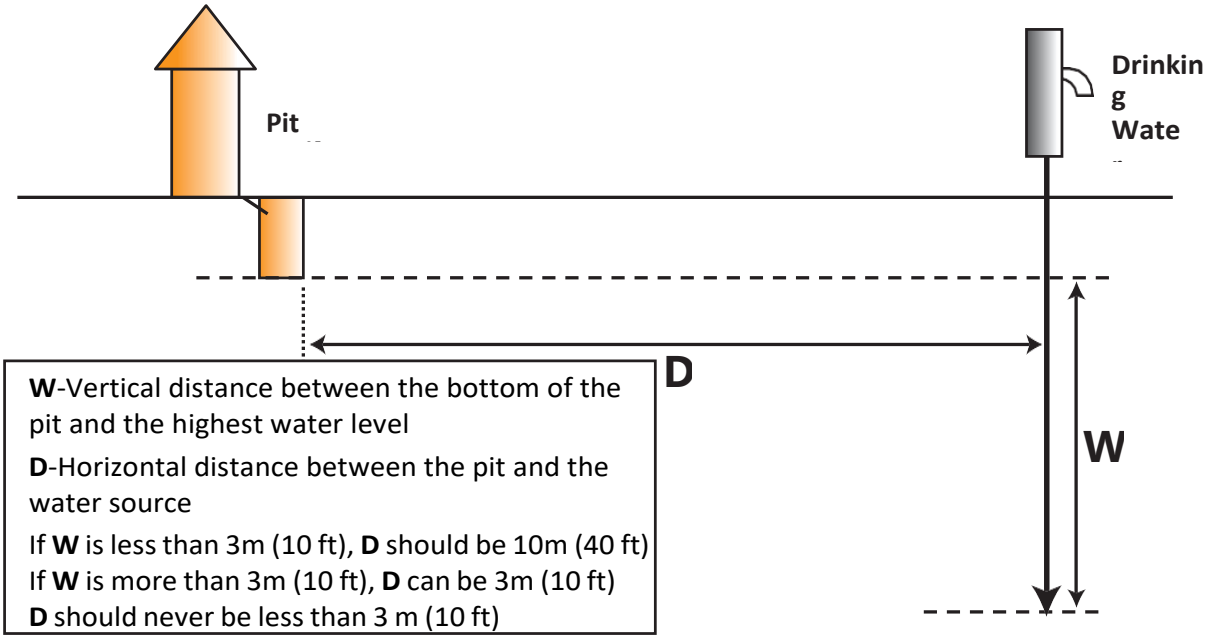


Figure 2.7 Distance between toilet and drinking water source

2. Single Leach Pit Pour Flush Toilet

These are simple, dry latrines with a pit dug in the ground and a cover slab or floor over the hole; the cover slab or floor may be lined, but the bottom remains open.

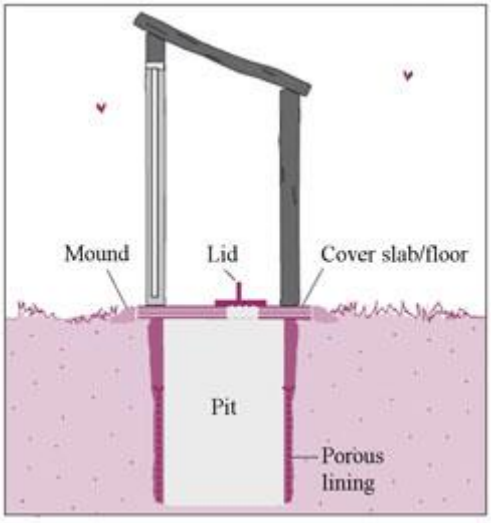


Figure 2.8 Single leach pit pour flush toilet

3. Septic Tank

This is a two- or more-chamber underground system constructed of bricks, cement, and concrete. The sewage is collected in several chambers at random, and the cleaned effluents are discharged via

the septic tank's exit pipe. The floating solid waste is disposed of after the faeces and water have been held for a period of time.

4. Eco San Toilet

Ecosan's main goal is to stop the nutrient loop between sanitation and agriculture, with the following goals in mind:

- decreasing the risks of sanitation, unclean water, and trash to one's health
- enhancing the quality of surface and groundwater
- increasing soil fertility
- enhancing the quality of surface and groundwater

The trash created by this toilet decomposes. Human faeces, urine, and waste water are separated in this, and dry stool decomposition is conceivable. This approach relies heavily on maintaining dry generation and allowing for breakdown.

Ecosan's main goal is to stop the nutrient loop between sanitation and agriculture, with the following goals in mind:

Ecosan's main goal is to stop the nutrient loop between sanitation and agriculture, with the following goals in mind:

- increasing the quality of surface and groundwater
- enhancing soil fertility
- optimising the management of nutrients and water resources
- increasing the quality of surface and groundwater

5. Bio Toilet

This is a two-part environmentally beneficial method for disposing of human sludge: a fermentation tank and a cold active anaerobic microbial inoculum (AMI). Human sludge may be biodegraded at a faster pace with the help of both of these, and human waste can be disposed of completely free of charge. This toilet is a mechanised defecation system that converts human faeces into methane, carbon dioxide gas, and water using unique high-grade bacteria (aerobic and anaerobic).

6. Toilet Linked to Biogas Plant

When a biogas plant is connected to a toilet, it produces more biogas than one that is not (Figure 2.9). The rate of biogas production is affected by the number of toilet users as well as the amount of cow manure and human waste present.

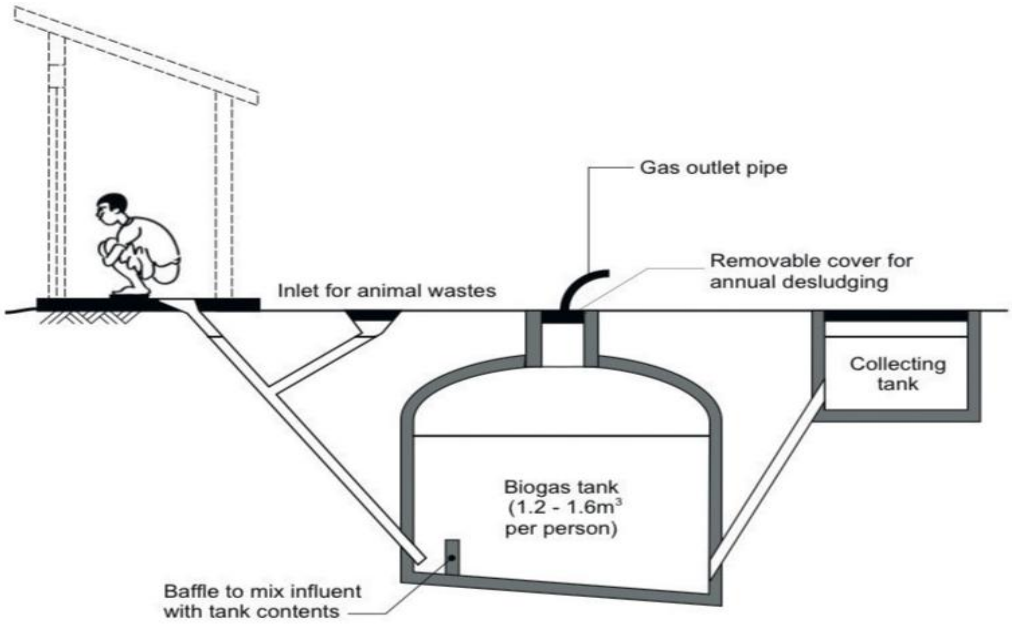


Figure 2.9 Toilet linked to bio gas plant

2.4 WASH in Institutions

Every child has the right to a quality education that includes access to drinking water, sanitation and hygiene (WASH) during school time. Children spend a large portion of their day in school, where WASH services can have an impact on pupils' learning, health, and dignity, particularly among girls. Basic WASH services are crucial for meeting the Sustainable Development Goals (SDG) goals in education and health in institutions such as schools, healthcare facilities, and workplaces. WASH's main mission is to provide basic sanitation and hygiene to communities and schoolchildren, with a particular emphasis on girls' education and gender equality as an essential complement to the success of water and sanitation infrastructure projects. Furthermore, women are underrepresented, if at all, in decision-making processes involving toilets, sanitary programmes, or projects, which frequently leads to a disregard for feminine concerns on sanitary practises. However, in order to accomplish SDG 6 (as well as SDGs 4 and 5), half of the population's requirements must be addressed. Working Group 7's goal is to mainstream gender in such initiatives and to incorporate men and women in equal partnerships in the implementation of these projects.

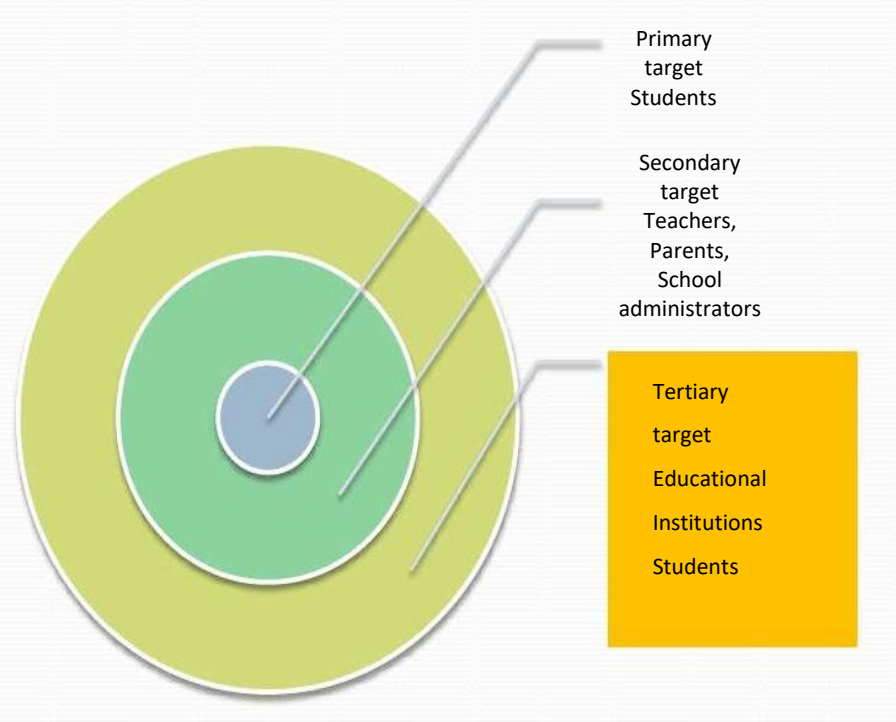


Figure 2.10 Agents of Change

WASH is the sixth unique sector target of the Sustainable Development Goals, which calls for universal, sustainable, and equitable access to safe drinking water, sanitation, and hygiene, as well as the eradication of open defecation by 2030. The provision of these facilities in settings such as schools, healthcare facilities, and workplaces contributes to UNICEF's Sustainable Goal Targets. There is sufficient research to demonstrate a link between WASH in Schools (WINS) and improved equity, education, and health outcomes for children. Acute upper respiratory infection, soil-transmitted helminths, and diarrhoea have all been found to be reduced when students have access to water, sanitation, and handwashing with soap (hygiene). Hygiene and sanitary facilities are frequently viewed as a woman's responsibility. Women's hygiene requirements are frequently disregarded or silenced: menstruation, for example, is taboo in many societies, resulting in insufficient menstrual hygiene management (MHM). As a result, WINS places a high priority on gender equity, because

access to sanitation and hygiene facilities (during the menstrual cycle) gives girls and female instructors' dignity and privacy.

To do Activity

A local farmer, consults you about building a latrine in the compound of his house. He is family man who is keen to improve life for his family. He has a wife and three young children and his elderly mother also lives with them. They get their water from a well in the compound. The area has a heavy soil and the rock below is impermeable.

a. Which types of latrine are possible choices for him?
b. Which types of latrine would you recommend, and why?
c. What other advice would you give him about the location, design and construction of the latrine?

It is critical to recognise that in a school setting, clean drinking water and a secure restroom are equally as crucial as teachers, classrooms, and literature. Simple handwashing techniques, which we take for granted, will have a ripple effect across the community. This will be helpful on many levels, as it will empower kids with better hygiene knowledge and awareness, allowing them to witness their own health improve. These students subsequently work as change agents in their communities (Figure 2.10), passing on what they've learned to their families and encouraging behavioural improvements.

UNICEF has proposed the "3As" method to accelerate progress in this direction for all children: awareness, action, and accountability.

Box 2.4-WASH in Schools

The RTE, 2019 requires that schools have separate toilets (child friendly, gender specific, universal, inclusive and adequate number) for boys and girls with adequate hand washing facilities. Safe and adequate drinking water facilities for children, Operation and maintenance of toilet block from the School Maintenance Grant, teachers training on WASH monitoring in schools, incinerator for the girls toilets. Personal hygiene materials to be provided by the school water, soap, pads, nail cutter, comb, bucket, mug, mirror etc. To include hygiene education in the curriculum and provide supplementary reading material, provision of student cabinets for day to day activities of WASH in schools and celebration of GHD (Global Handwash Day). Hygiene promotion through regular class transactions and teaching learning materials.

Menstrual Hygiene Management

Menstruation management (Figure 2.11) is difficult in a resource-poor environment, especially when women are gone from home all day. Menstrual humiliation, social taboos, and privacy concerns all add to the difficulties. Girls and women confront considerably larger barriers to managing menstruation in catastrophes, including a lack of privacy and safety that is commonly associated with life in a crisis. Changes and additions to a range of sector-specific measures, including Water Sanitation and Hygiene (WASH), Safety, Reproductive Wellbeing, Nutrition, Non-Food Items (NFIs), and Accommodation, are provided via Menstrual Hygiene Management (MHM) emergency training. Females' fundamental needs during menstruation include largely a variety of goods that can be used to capture blood, such as a sanitary pad (disposable or reusable), a tampon, or a piece of fabric in

their socks. Menstrual periods are unpredictable, and their beginning can catch women off guard. This causes a lot of anxiety about finding a bathroom and supplies quickly. It's critical to emphasise menstrual hygiene behaviours because they affect women at home and can have major consequences for maternal health.

'Women and adolescent girls using a clean menstrual management material to absorb or collect blood that can be changed in privacy as needed for the duration of the menstruation period, washing their bodies as needed with soap and water, and having access to facilities to dispose of used menstrual management materials' (UNICEF and WHO, 2014). Menstrual hygiene, on the other hand, encompasses not only the management of menstrual periods, but also the necessity to confront societal ideas and taboos around the topic.

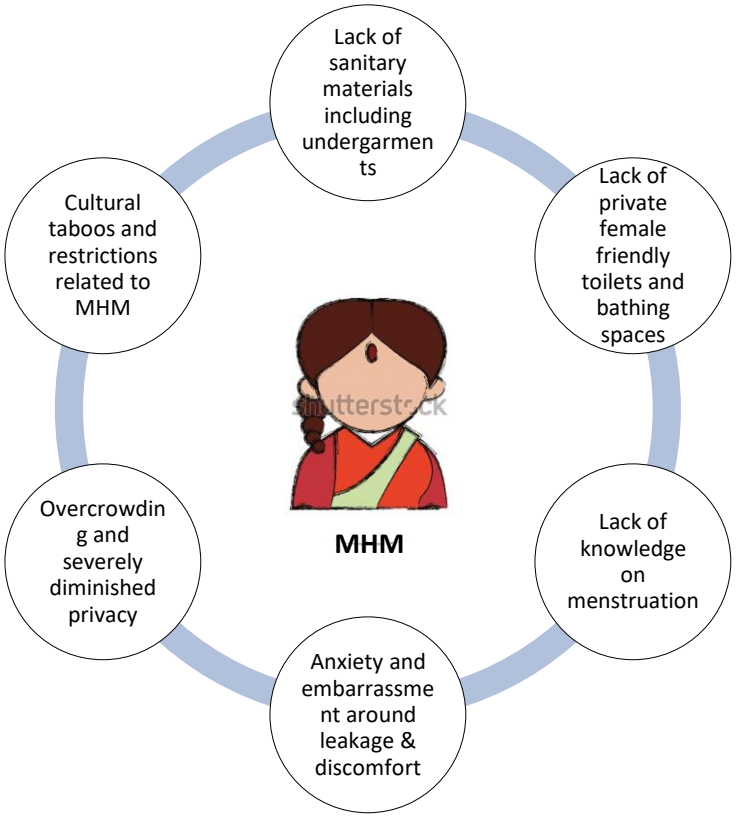


Figure 2.11 Menstrual hygiene challenges faced by women in emergencies

Source: MHM in Emergencies Mini Guide

Three critical elements of a comprehensive MHM programme

1. MHM Material & Supplies

- Menstrual products that are acceptable (pads, cloths, underwear).
- Additional packaging, washing, and drying supplies (such as soap and a bucket).
- This video shows how to use MHM materials.

2. MHM Supportification Services

- Menstrual materials can be changed, cleaned, and dried in a clean and private shower and laundry.
- Menstrual waste disposal is simple and private.
- Menstrual waste management mechanisms are in place.

3. MHM INFORMATION

- Basic feminine hygiene promotion and protection.

- Menstrual health education at the basic level (especially for girls of going through puberty age).
- Menstruation should no longer be associated with negative cultural or societal expectations.

- **Figure 2.12** Essential Components of MHM program

❖ **Assessment of MHM needs:**

Menstruation treatment techniques for adolescent girls and women varied greatly among countries and societies. Understanding MHM's local activities is critical to its successful integration into emergency response.

Material and Equipment

1. Preference

What are the expectations of girls and women for the menstrual materials? In this case, what is feasible? Any special type / brand?

2. Target Population

Who is to obtain MHM resources and services (identify the range of needs)

3. Distribution

How can MHM products and services be delivered securely and privately to the target population?

4. Facilities

What do girls and women like or require in terms of menstruation facilities?

5. Disposal and Cleaning

How do women and girls dispose of used items privately or wash and dry?

Information

6. Awareness of GAPS?

Girls and women are familiar with this MHM equipment and products, storage solutions and safe hygiene practises?

To do Activity

Form a team with a female member student as a leader and generate a report that covers the following questions:

1. Does the rate of attendance drop among the female students in age 8-15 years in the local school.
2. Are menstrual hygiene products available in the school campus or with the teacher or counsellor in school?
3. Are adequate facilities available for hand washing available in the school premises?
4. Are adequate facilities for disposal available in the school premises for the discard of the MH products?

Consultation of Adolescent Girls and Women: Qualitative Methods

1. Meetings with women and girls in focus groups (FGDs)
2. Conversations with influential people in a formal setting (e.g. members of the WASH Team, girls and women, service workers, etc.)
3. Conversations with residents (if they come from the same population as recipients)

Methods of Observation

- Checklists are useful for many things (i.e. physical examination of facilities)
- Take a walk around public restrooms with a few women or girls who are really utilising the facility to get feedback.
- Consumer assessments are used to look into the supply of items on local markets and to keep track of current needs.

Train and Sensitize Personnel on MHM: Workers who are required to participate in assessment activities should be informed and willing to give information with MHM. Male employees do not specifically negotiate MHM with clients, but they may be included in the preparatory process.

❖ **Menstrual Hygiene and sanitation facilities**

In a humanitarian sense, attempting to maintain security and dignity while utilising sanitation facilities remains a common problem. Women and girls, especially when it comes to menstruation, require greater privacy for sanitation than boys and men. The majority of MHM criteria for women and girls are the same as basic sanitation and hygiene needs. This must include the following:

- A clean, secluded room where they can change their menstrual materials (at least three times a day), sometimes even in the middle of the night.
- After changing menstrual products, they need a private place to wash their hands with soap and water.
- Once a day, a clean, private bathing location.

1. **Consult and Coordinate:**
   On the location and building of sanitation facilities, women and girls should be consulted especially. They'd provide unique viewpoints on privacy, security, and convenience. Collaborate with other businesses that are installing WASH facilities to ensure that the design reflects customer feedback.
2. **Construct Female Friendly Sanitation Facilities**
   Construct structures in homes and businesses (i.e. schools, wellness centres and shelters).
3. **Washing and Drying of Menstrual Products Supportive Supplies and Knowledge**
   It's also difficult to wash and dry menstruation materials. Girls and women have various tastes when it comes to where they want to do this. Few of them will use public restrooms, residences, kitchens, toilets, or other public areas.
4. **Monitoring and Feedback**
   Monitoring access and coverage should be supplemented with regular meetings with women and girls to solicit feedback and verify that programmes are recognised and implemented correctly. Examine the sample markers that are connected.

❖ **MHM WASTE DISPOSAL**

- Menstrual products are a major source of waste in colonies and other settings. The following are the main considerations:

- Vaginal waste is also considered as shameful, and there may be definite taboos around its processing.
- Women and children who use sanitary products must be allowed to dispose of the menstrual products in a secure and safe manner.
- The treatment of waste in institutional and public toilets differs from that in private homes and communal bathrooms.

Taking into account the unique demands of both men and women in terms of sustainable sanitation so that both accept the solutions: Factsheet: Incorporating a gender viewpoint into long-term sanitation solutions. Addressing WASH in Schools, for example, to demonstrate the link between improved school cleanliness and academic performance, especially among girls and the rural poor.

2.5 Management and Sustainability

This section covers the most important issues of toilet facility management and sustainability in both PT and CT. This includes contingency planning for various project hazards, service level monitoring and reporting, asset updating, occupational health and safety vigilance, user awareness, and, most significantly, future planning concerns.

User Charges -Usage fees for public toilets are usually established so that the revenue is sufficient to keep the facility in excellent working order (application of the user-paid approach). Look into ways to cover the costs of setting up the facility or cross-subsidize it for a period of time if possible. The fees for usage, on the other hand, must be computed using the formula that the user pays and the ability to pay approaches. Fees are normally set by the ULB for certain uses, which the operators are contractually obligated to follow and which are also posted in all restrooms. Although ULBs examine user fees from a welfare perspective (e.g., no pay for the use of urinals in all PT/CT facilities), operators frequently charge greater rates if there are no adequate monitoring systems in place. It is sometimes conceivable for ULBs to enable various prices at different locations in a competitive procurement system in order to leverage user readiness and also to cross-subsidize specific internal operations.

Service level monitoring and reporting The monitoring of PT / CT systems is a necessary activity to ensure that the user public is satisfied with the services after each use. This can be accomplished by (a) ULB service monitoring, (b) operator self-disclosure, (c) customer satisfaction surveys, and (d) Swachh Survekshan.

ULB service monitoring—As the ULB is bound and liable for the contract, it is required to monitor its performance. While the toilet is in use, ULB employees should do unannounced checks as needed - daily, weekly, monthly, bi-monthly, semi-annually, or annually. The inspections can be focused on one or more of the following:
Daily: Toilet cleanliness outside and inside, utility availability, health and safety issues, and other annoyance elements
Weekly: Site security and safety
Monthly: Provision of consumables and tools, public health awareness, management, and an operations plan
Quarterly: Repairs, structural integrity, utilisation rate, and user satisfaction
Occasionally Required: Precautions for sewage treatment and disposal, sludge levels, and desludging

The purpose of the inspections varies depending on when they were conducted. The operator is contractually obligated to allow ULB staff access to the restrooms for routine inspections, repairs, and improvement ideas, among other things.

Operator self-disclosure- In order to promote responsible services, it is preferable that operators use their own monitoring method for the actions conducted to keep the toilet facility clean and safe. The monitoring can occur during various daily shifts, daily, weekly, or monthly, which the cleaner and caretaker typically record and certify by the toilet's caretaker / supervisor.

User satisfaction surveys-The purpose of these surveys is to determine what users want and expect to be met while they are being charged. ULBs can conduct such surveys on a regular basis to better understand and address problems that are frequently reported in toilet facilities but have not been addressed by the operator. Table 3 shows a typical user survey format that ULBs can utilise. Various ULBs (for example, NDMC) have begun installing customer satisfaction consoles in various toilet facilities in order to monitor service quality in real time with the help of national telecommunication facilities.

Swachh Surveillance-It is vital to offer a platform where ULBs and other stakeholders can regularly monitor the cleanliness of toilets by gathering direct input from users in order to maintain proper maintenance and cleanliness.

A sanitation system that is designed to meet certain standards and perform well over time is known as sustainable sanitation. "Sustainable sanitation," on the other hand, considers all aspects of the system, including waste collection, transportation, treatment, and disposal (or reuse).

1. Any sanitation strategy should prioritise human dignity, quality of life, and environmental security at the family level.
2. In accordance with good governance principles, all stakeholders, particularly consumers and service providers, should be involved in decision-making.
3. Waste should be treated as a resource, and its management should be connected with water resources, nutrient flow, and waste management procedures.
4. The size of the domain in which environmental sanitation issues are addressed should be maintained to a bare minimum (household, neighbourhood, community, town, district, catchments, city).

The approach to SBM-G itself was structured to allow for additional flexibility in execution, and it had a few distinctive features:

1. A powerful public and political will
2. Sufficient financing
3. Flexibility at the district level in implementing the necessary activities and campaigns to enhance coverage,
4. Increasing the ratio of financial investment in hardware to strong investment in software (i.e. behaviour change communication) with a focus on community-level results (like-ODF status) rather than single households.
5. Using the CAS technique (Community Approaches to Sanitation).
6. Prioritization of women-headed families, Scheduled Castes and Tribes in the programme
7. At the same time, the Ministry of Panchayati Raj stepped up its efforts to improve Gram Panchayats' (GPs') ability to offer services, including SBM-G targets.
8. There have been initiatives to strengthen the 3 Fs available to GPs: Funds, Functionaries, and Functions, in response to the push to shift to GP ownership.

Table 2.7 Public / Community toilets: User Feedback Format

Sr. No.	Parameters	Ranking (Tick as appropriate)				
		1	2	3	4	5
	General					
1	Access of toilet from outside					
2	Condition of toilet seats					
3	Condition of urinals					
4	Condition of bathing units					
5	Cleanliness					
6	Water availability					
7	Smell (Ventilation)					
8	Lighting					
9	Water logging					
10	Amenities (bucket, cups etc.)					
11	Wash basins					
12	Condition of floor and walls					
13	Condition of doors					
14	Timings					
15	Waiting period					
16	User charges					
17	Behaviour of caretakers andcleaners					
18	Complaint mechanism					
	Gender					
19	Safety					
20	Privacy					
21	Usability for children					
22	Garbage bin for napkins					
	Differently abled					
23	Ramps & Rails					
24	Space for movement					
25	Facilities					

The Ministry of Panchayati Raj has worked to ensure that GDPDs are adequately convergent in reflecting how WASH investments and interventions can be mainstreamed into current budgetary considerations through the national Gram Panchayat Develmopment Plans (GPDP) guidance of 2018.

Box 2.5- Sustainable Development Plan

- Identification of households without toilets
- Toilet use and maintenance
- Facilities for solid and liquid waste management
- Water-use efficiency by rationalizing water use
- Inclusion of water and sanitation issues in GPDP (Gram Panchayat Development Plan)
- Compliance with environmental safeguards of all GPDP activities

Central Role- Gram Panchayats

1. When compared to the roll-out of previous programmes, this progressive investment in Gram Panchayat leadership and ownership shone out under SBM-G in States where GPs played a key role.
2. Furthermore, rural families were more likely to follow the advice of their local leaders. This notion has been included into India's efforts to move from its recent achievement of meeting its objective of providing safe sanitation to 100 million households to the next phase of programmes.
3. To set the tone for the next phase, the Ministry of Justice presented a freshly drafted 10-year Rural Sanitation Strategy in September 2019, outlining the activities that must be taken from now until 2029 to guarantee that sanitation access is maintained and expanded.
4. India is striving toward the ODF Plus long-term vision. This is necessary for India to maintain its progress toward SDG 6, especially SDG 6.2, which states, "By 2030, achieve universal access to adequate and equitable sanitation and hygiene for all and eliminate open defecation, with special attention to the needs of women and girls, as well as those in vulnerable situations."

A sanitation strategy must be both socially and economically viable in order to be sustainable. In this way, sustainable sanitation is fundamentally different from the present linear waste water management ideas. It acknowledges technology while also taking into account social, environmental, and economic factors, resulting in. Integrated sanitation for a long-term solution It recognises that human excrement and wastewater are valuable resources rather than waste products. This viewpoint is supported by the fact that wastewater and excreta contain a large quantity of energy, plant nutrients, and water that can be recycled and reused, hence conserving natural resources.

A sanitation system's principal goal is to protect and enhance human health by creating a clean environment and breaking the disease cycle. A sanitation system must be not only economically viable, socially acceptable, technically and institutionally adequate, but it must also safeguard the environment and natural resources in order to be sustainable. The requirement for sustainability necessitates resource conservation and environmental protection, as well as innovation and rethinking. This is impossible to achieve using traditional approaches. Also, in our rising communities, paying for sanitation and water services will not suffice; citizens must be partners in order for sanitation to be sustainable.

Sustainability criteria linked to the following factors should be addressed while enhancing an existing sanitation system and/or constructing a new sanitation system:

• **Health and Hygiene**: This category includes the risk of pathogens and hazardous substances affecting public health at any stage in the plumbing system, from the toilet through the collection and treatment system to reuse or disposal, as well as downstream populations. Hygiene, nutrition, and the improvement of livelihoods accomplished via the use of a particular sanitary system, as well as downstream repercussions, are all included in this topic.

• **Environment and Natural Resources**: This category comprises the energy, water, and other natural resources required to construct, operate, and maintain the system, as well as any environmental emissions that may result from its use. This encompasses the extent to which recovery and reuse are implemented, as well as the effects of these practises (e.g., wastewater reuse, return of nutrients and organic material to agriculture), as well as the protection of non-renewable resources, such as by creating renewable energies (such as biogas).

• **Technology and Operation**: this refer to the ease with which the complete system, including collection, transportation, treatment, reuse, and/or disposal, can be set up, run, and monitored by the local community and/or local businesses. Furthermore, the system's robustness, susceptibility to power outages, water scarcity, floods, earthquakes, and other natural disasters, as well as the flexibility and adaptability of its technical elements to existing infrastructure and demographic and socio-economic changes, are important considerations.

• **Financial and Economic Issues**: concern household and community sanitation solvency, including system installation, operation, and maintenance, as well as necessary reinvestment. In addition to these direct expenditures, external costs and advantages, such as those from recycled goods (soil improvers, fertilisers, energy, and treated water), must be considered. Pollution and health concerns are examples of external costs, whereas benefits include higher agricultural output and subsistence farming, employment creation, enhanced health, and fewer environmental dangers.

• **Socio-cultural and Institutional Factors**: System acceptance and appropriateness, convenience, gender aspects and consequences on human dignity, contribution to food security, legal compliance, and stable and efficient institutional frameworks.

Table 2.8 What will it take to Improve Sanitation?

Social dimensions	**Urban Development dimensions**	**Cross-sectoral dimensions**
Awareness raising and capacity building	Public health	Water supply and drainage
Participation	Environmental protection	Solid waste management
Cultural acceptance	Natural resource	Housing
Gender and equity considerations	Land use management	Energy
Ownership	Poverty reduction	Transport
Affordability	Business and employment	Green area management
Improved livelihoods		Agriculture

Chapter Summary

If each member of the home has equal and ready access to the facility and the toilet is kept clean, a single toilet shared by two or more households or a public toilet can provide a good option. Separate cubicles for men and women, or gender-neutral cubicles with handwashing and menstrual hygiene management facilities; suitable modifications for all users, such as an access ramp and handrails for those with disabilities; and a management system.

Showers and laundry facilities may be available in shared and public restrooms. A well-run shared or public bathroom can serve as a focus point or meeting place for the community, which can benefit users indirectly.

The management and maintenance of a public toilet can be more difficult than that of a shared or public toilet, especially in popular or busy areas where the high use and distributed responsibilities necessitates more frequent cleaning to keep each toilet in good working order. If costs are imposed, they should be reasonable for all users to ensure that access to the facilities is not restricted, which could encourage open urination and defecation.

Model Questions

1. How do you assess whether a given location needs a Community toilet or a Public toilet?
2. What is the user pattern in these toilets?
3. From the know-how of the local mason, calculate the average cost of constructing a toilet seat/ urinal in your premises.
4. With specific reference to your own home or locality, enlist the limiting factors to build or have access to toilets (Personal/Community)?
5. Consult women, girls and people with incontinence on the design, siting and management of facilities (toilets, bathing, laundry, disposal and water supply) and make a report on how these can be incorporated.
6. Explain the difference between an ecosan latrine and a standard pit latrine.
7. What are the potential risks posed to the environment in using dry pit latrines?
8. How would you help families select appropriate sanitation technologies, outline the factors on a fact sheet and discuss.
9. Describe standard construction techniques for latrines with handwashing facilities.
10. How would you ensure that there is provision of appropriate facilities inside toilets for washing and drying or disposal of menstrual hygiene and incontinence materials, explain in detail?

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Chapter 3- Faecal Sludge treatment

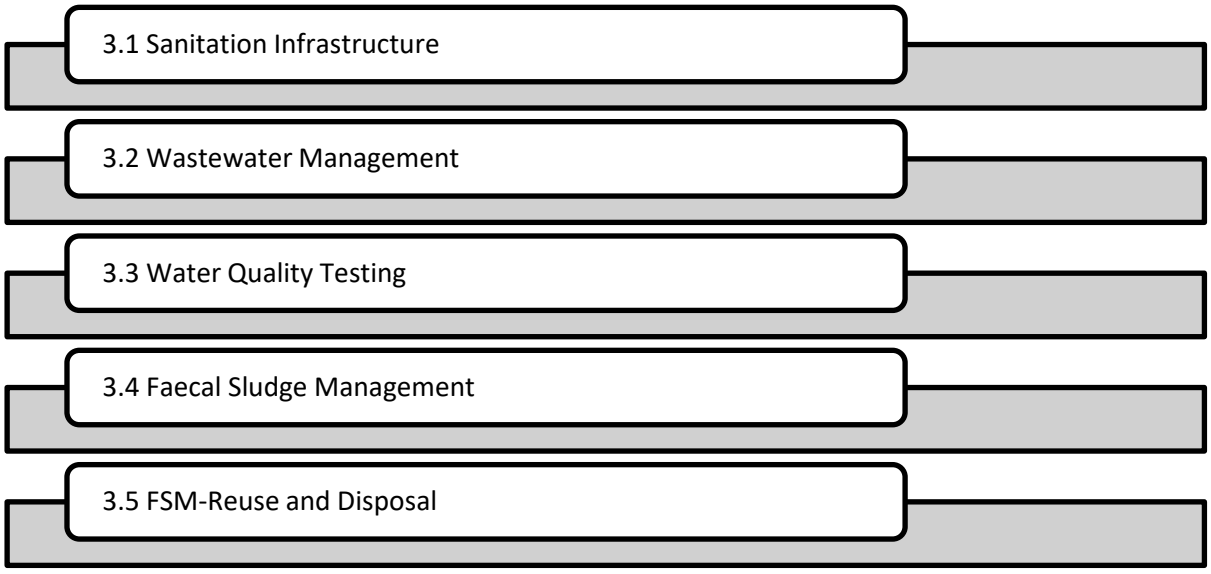
Introduction

Solid and liquid waste has a direct impact on human health and far- reaching consequences if not managed properly. In India, solid waste is burnt, dumped or allowed to flow into water bodies. Such unhygienic approaches cause air pollution, degradation in soil quality, contamination of water bodies and diseases like cholera, typhoid and dysentery. A robust waste management system prevents this and positively impacts communities. Solid and Liquid Waste Management (SLWM) is a key component of Swachh Bharat Mission (Gramin), with the objective of improving cleanliness, hygiene and quality of life in rural India. Liquid waste can be treated and used productively or safely disposed of. However, while SLWM is an urgent need, panchayats and local governments do not have the necessary capacity or expertise. Building this capacity is the first step towards tackling waste management issues. Rural India generates huge quantities of bio-wastes of which human excreta forms the bulk, managing this waste needs a systematic approach that helps to reduce this at the site of generation itself. Septic tanks and single pit systems partially treat the black water that is generated but need to be desludged regularly. It is important to note that indiscriminate disposal of faecal sludge can cause the spread of diseases and lead to environmental pollution.

Objectives

- To provide description of Sanitation with reference to Single /twin pit, EcoSan, Septic tank, Formal sewerage facilities
- To understand the composition of wastewater, its characteristics and management from different sources
- To know about the composition of the waste water
- To understand the management of faecal sludge generated
- To Provide an overview of ways and means to reuse and disposal the sludge generated as part of the FSM

Chapter Structure



3.1 Sanitation Infrastructure

The generation of liquid waste from human activities is unavoidable and not all humans produce the same amount of liquid waste. The type and amount of liquid waste produced in households is influenced by behaviour, lifestyle and standard of living of the population as well as by the governing technical and juridical framework (Henze and Ledin 2001). The different sanitation systems generate the products as listed in Box 3.1.

Box 3.1-Different Waste Products

Households produce different waste products. A sanitation system must deal with all products generated.

Blackwater is the mixture of urine, faeces and flushing water along with anal cleansing water (if anal cleansing is practised) or dry cleansing material (e.g. toilet paper).

Greywater is used water generated through bathing, hand-washing, cooking or laundry. It is sometimes mixed or treated along with blackwater.

Urine is the liquid not mixed with any faeces or water. Brownwater is blackwater without urine. Beigewater is anal cleansing water. It is generated by those who use water rather than dry material for anal cleansing. **Faeces** refer to (semi-) solid excrement without any urine or water.

Excreta is the mixture of urine and faeces not mixed with any flushing water (although small amounts of anal cleansing water may be included).

Faecal sludge is the general term for the undigested or partially digested slurry or solid resulting from the storage or treatment of blackwater or excreta.

Domestic wastewater comprises all sources of liquid household waste: blackwater and greywater. However, it generally does not include stormwater.

Stormwater in a community settlement is runoff from house roofs, paved areas and roads during rainfall events. It also includes water from the catchment of a stream or river upstream of a community settlement.

The objectives of a sanitation system are as listed below:

1. Protect and promote health – it should keep disease-carrying waste and insects away from people, both at the site of the toilet, in nearby homes and in the neighbouring environment.
2. Protect the environment – avoid air, soil, water pollution, return nutrients/ resources to the soil, and conserve water and energy.
3. Be simple – the system must be operational with locally available resources (human and material). Where technical skills are limited, simple technologies should be favoured.
4. Be affordable – total costs (including capital, operational, maintenance costs) must be within the users' ability to pay.
5. Be culturally acceptable – it should be adapted to local customs, beliefs and desires.
6. Work for everyone – it should address the health needs of children, adults, men, and women.

Lack of good liquid waste management causes sickness and disease, and is a major environmental threat to global water resources and a fundamental barrier to human dignity. Thus management of the liquid waste generated is a major area of concern the world over. Wastewater Management is divided into five groups based on its infrastructure, method and services. Any system can have single multiple functions. User interface is the access to sanitation system. This is dependant on water availability and land availability. There is various collection, storage systems and conveyance methods until it is ready or taken for disposal or treatment. Treatment steps can be exhaustive and performed until the desired stage is accomplished. At this stage, the treated waste can either be re-

used as biogas and fertilizers or safely disposed of.

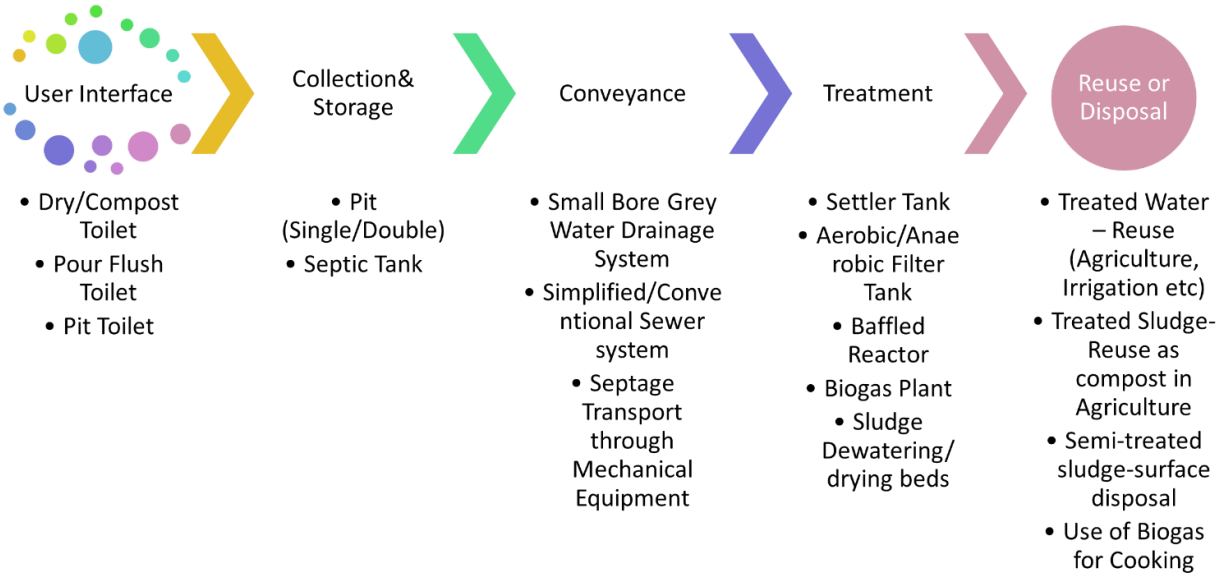


Figure 3.1 Overview on Components' Involved in Wastewater Management and Treatment

Twin-pit Toilets

Two underground pits alternately used, a pan, water seal/trap, squatting platform, junction chamber, and a superstructure are the primary components. The pits are joined by a junction chamber in a honeycombed construction. Water percolates down to the soil since the pit bottom is earthen.

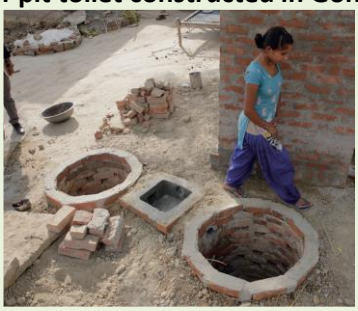
Once the first pit is full, excreta is sent to the second pit. The excreta in the first pit degrades to biosolids, which are pathogen-free and can be utilised as manure after two to three years. Alternately, the cycle continues. A single pit can last more than four years for a household of five to seven people, yielding around one cubic foot of compost each year per person. This approach is not appropriate for places that are flooded or have shallow water levels.

Following the building of the pits, each one is sealed with a moulded reinforced cement concrete (RCC) seal or any other locally available flooring material. Two pits should be utilised alternatively for complete and safe excreta breakdown (the second after the first is filled). Many regions employ concrete rings instead of brick lining due to financial constraints. Precautions should be made to ensure that the honeycomb holes in the concrete rings are of the same size. It's also important to make sure that the area above the invert level of the pipe and up to the bottom of the pit's cover is solid.

One pit will be filled by a family of five to seven members who use a twin leach pit latrine (a pit of roughly 3 foot x 3 foot) on a regular basis for six to seven years. Depending on the soil type or strata, the size of the pit, and the volume of water flushed during toilet usage, the period may vary.

When there is no wetness, the faecal matter has been transformed to a black or brown soil, and there is no bad odour, the manure is ready. It is necessary to ensure that there is no wetness in the soil before removing the manure. A hollow iron rod can be inserted into the pit until it reaches the hard strata, and the dirt inside the rod should be examined. If the faeces has decomposed, the hole should be left uncovered for a day to allow flies, insects, and other insects to exit. If there are symptoms of dampness in the faeces, ash should be sprinkled on top to absorb the moisture. To remove the manure, ordinary farming tools can be utilised. Manure from the pit's deeper levels can be manually removed by entering the pit.

Case Study 6: Twin-pit toilet constructed in Gonda, Uttar Pradesh



Situated 120 kilometers from Lucknow, Uttar Pradesh's Gonda district was ranked last in the 2017 Swachh Survekshan, a cleanliness survey conducted by the Ministry of Drinking Water and Sanitation. With many awareness activities and toilet constructions, over the last two years, urban Gonda managed to attain the Open Defecation Free tag in 2019 but when it comes to the rural parts of the district, there was a major gap in the sanitation coverage. As part of the campaign, the authorities are aiming to construct about 26,000 household toilets, Ashish Kumar, Chief Development Officer of Gonda district explained, Depending upon the size of the house, sewage connections and the locality we are aiming to construct either twin pit toilets or squat toilets with the traditional flush. This will be done by encouraging the families to opt for toilet constructions and providing them with a financial aid of Rs. 12,000.

Advantages:

- The cost is less.
- It is easy to maintain.
- No odour.
- Easy to control flies and mosquitoes
- Solids can be easily removed from pits because they are not very deep.
- The contents of the pit can be utilised as a soil conditioner and fertiliser.

EcoSan Toilet

Two above-ground tanks/vaults to be used alternately, a pan, squatting platform (with various squat/drop holes for pee and faeces), and superstructure are the key components of an EcoSan toilet. The tanks and vaults are completely watertight. Water does not seep down to the soil since the pit bottom is cemented. To keep the contents of the vault dry, urine is collected separately in a jerrycan. After each usage, a layer of absorbent organic material (ash, sawdust, shredded leaves, or vegetable matter) is added to the vault. This deodorises the faeces, absorbs excess moisture, and improves the carbon to nitrogen ratio, ensuring that enough nitrogen is maintained to generate effective fertiliser. Once the first tank is filled to two-thirds capacity, the second tank is opened. The excreta in the first tank degrades into pathogen-free biosolids that can be utilised as manure after two to three years. Urine can be diluted further and used as fertiliser. Alternately, the cycle

continues. Depending on pit maintenance and user numbers, the functioning life is five to six years. The design also depends on the number of households.

Advantages:

- Does not smell
- Water-scarce places and areas with a shallow water table will benefit from this product.
- Because the pits are shallow, solids can be easily removed.
- The contents of the pit can be utilised as a safe soil conditioner and fertiliser,
- Works well in disaster-prone locations.

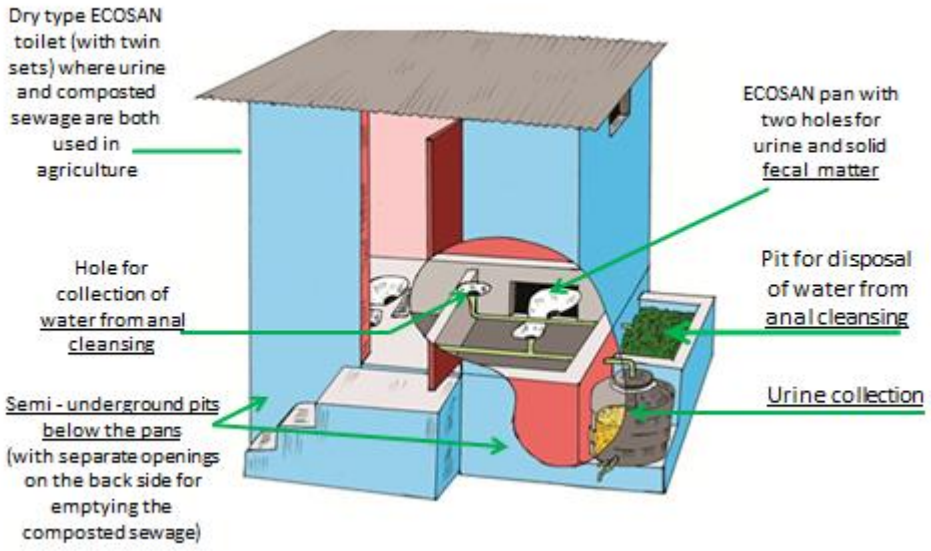


Figure 3.2 Features of EcoSan toilet-dry type with twin pit set (Nepal)

Figure 3.3 EcoSan toilet at Tiruchirapalli, Tamil Nadu

Septic Tank

In rural places, septic tanks are also extremely widespread. Septic tanks with soak pits are the most frequent technology in rural areas, according to the Ministry of Drinking Water and Sanitation (currently Department of Drinking Water and Sanitation under Ministry of Jal Shakti). The decomposition of black water is aided by a well-designed water-tight septic tank. Heavy solids settle to the bottom of the black water as sludge, while lighter solids float on the surface. Scum is formed as a result of this. The least solid is found in the middle layer, which travels forward to the last chamber and is ejected from the tanks.

Case Study 7: Gram Panchayat Water and Sanitation Committee (GPWSC), Punjab

Community-driven demand for a solution to manage human excreta, led to the creation of a rural Water supply and sanitation project in Punjab, supported by the World Bank, the Government of India, and the Government of Punjab. It has undertaken sewerage management projects in rural areas of Punjab and has effectively addressed the sanitation problem in these villages in a sustainable manner. Two such projects currently under operation—one in Khadoor sahib village of Taran Taran district and the other in Baba Bakala village of Amritsar district—offer the promise of pursuing similar effective sewerage management projects in other villages.

Both of these sites are large villages with religious significance; houses are congested, in addition to the residents, there is a huge floating population that makes regular visits for religious purposes. The technology involved in this project includes the collection of sewage from households through UPVC pipes, its transportation to a sewerage treatment plant, where it is treated, and the subsequent drying of the sludge in a drying bed. Finally, the dried sludge is composted for use as fertilizer. These projects were planned and implemented by the Gram Panchayat Water and Sanitation Committee (GPWSC), with technical support provided by the Water supply and sanitation department of the Government of Punjab. The operation and maintenance of these facilities has been contracted out by the GPWSC to private operators. A tariff of `60 is being collected from each household and is used to pay the O &M charges.

The basic details of the two projects are presented below:

Indicator	Baba Bakala Village	Khadoor Sahib
No. of households	1,628	1,479
Population	9,726	12,461
No. of sewer connections	1,265	850
Capacity of STP	850 KLD	1,400 KLD
Sludge drying bed 3 4	3	4
Composting pit 3 3	3	3
Sludge curing platform 1 1	1	1
Project cost	`408 lakhs	`424 lakhs
O&M expenditure	`12.20 lakhs for 3 years	`38 lakhs for 7

Sedimentation and digesting take place inside the tank. The retention time for wastewater entering the tank is usually 24 hours, but it might be one to two days according to the Department of Drinking Water and Sanitation (DDWS) manual. Both the sludge and the liquid in the middle layer are digested anaerobically. As a result, the volume of sludge is reduced, biodegradable organic matter is reduced, and carbon dioxide, methane, and hydrogen sulphide are released. A vent pipe attached to the tank is used to release the gases. Because there are still dissolved and suspended organic materials and pathogens in the effluent, it should be sent via a soak away pit.

An underground tank (with a partition wall with a minimum of two chambers), a pan, water seal/trap, squatting platform, and superstructure are the major components of septic tank-based toilets. The tank is a watertight masonry wall with an inlet line that connects it to the toilet. The tank bottom is a cemented structure that aids in the settlement of heavy solid particles by achieving a hydraulic inactive state. The deposited muck on the tank's bottom must be removed on a regular basis. After a period of time, usually one to three days, the septic tank provides partial treatment of excreta. The system is 30–50% efficient in terms of biochemical oxygen requirement (BOD).

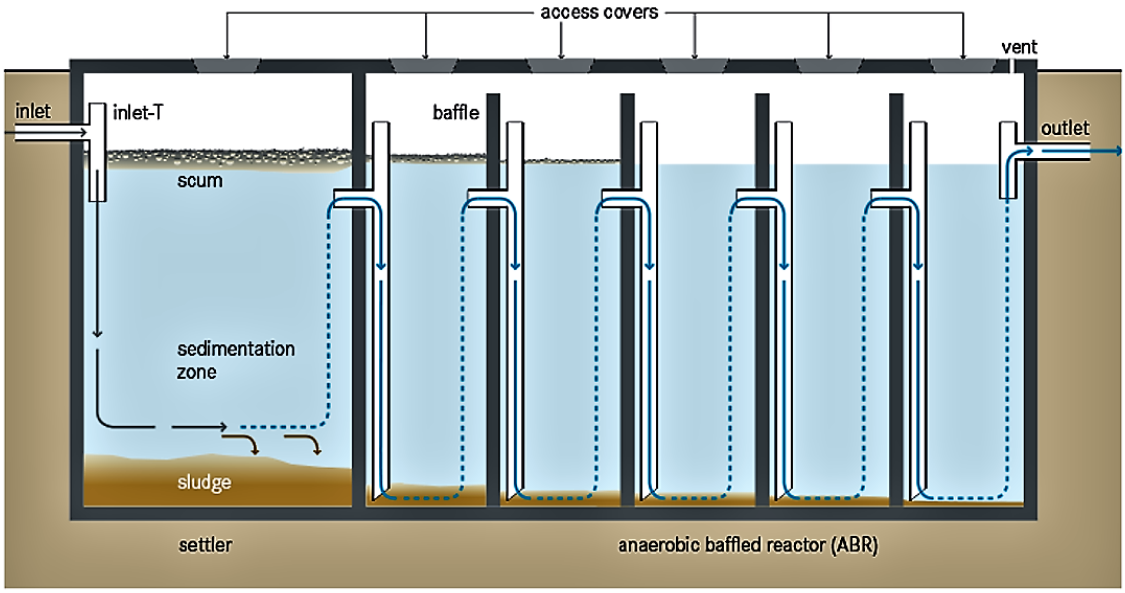


Figure 3.4 Schematic of an Anaerobic Baffled Reactor. Source: TILLEY et al. (2014)

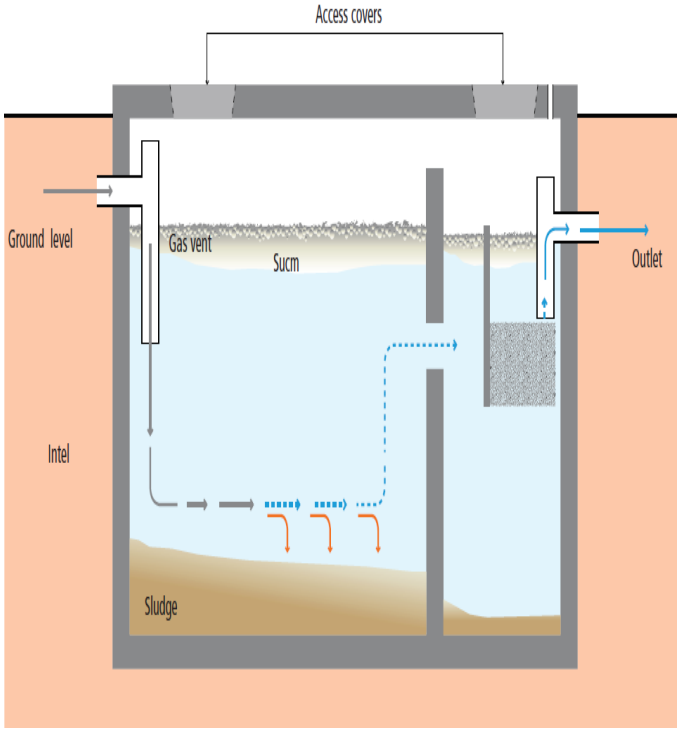


Figure 3.5 Schematic of Biogas Plant

An upgraded septic tank with a series of baffles (Figure 3.4) through which wastewater is forced to flow is an anaerobic baffled reactor with filter. It has one or more filtering chambers, where particles are retained and organic matter is decomposed by the connected biomass. BOD levels can be decreased by up to 90%, which is a far larger percentage than in a traditional septic tank.

Advantages

- Does not smell
- Long-lasting infrastructure
- Easily acceptable to the community

Biodigester Toilet

A biodigester's major components Figure 3.5 include a multi-chambered underground tank (which stores the bacterial culture), a pan, water seal/trap, sitting platform, and superstructure. The inflow pipe connects the tank to the toilet, which is a prefabricated and watertight building. The tank is designed to reach a hydraulically inactive state, which aids in the separation of solid particles. The settled material is subjected to anaerobic digestion. It partially treats excreta, and the partially treated liquid exits the tank and is disposed of, usually to the ground through soak pits linked to the tank. Inoculums are often used to fill up to one-third of the volume of these bio-toilets in order to begin the digesting process.

The biodigester technology was created by the Defence Research and Development Organisation (DRDO) as an environmentally benign, maintenance-free, and effective method of dealing with excreta. The size of the biotank is determined by the size of the family.

Advantages

- Compact size, simple installation,
- No odours,
- Long infrastructure life,
- Community acceptance,
- Temperature tolerance,
- Low maintenance cost,
- Minor sludge generation.

Biogas-linked Toilets

- The anaerobic biogas digester (Figure 2.9) is meant to process human waste, animal manure, and kitchen and garden waste in a rural household. Anaerobic breakdown of wastewater occurs in biogas-linked toilets. This is accomplished with the assistance of bacteria that can thrive in anaerobic environments.
- A specially built underground tank, a pan, water seal/trap, squatting platform, and superstructure are the key components of biogas-linked toilets. The waterproof tank that connects to the toilet via the input line can also be manufactured. Anaerobic digestion will take place in the tank. It treats excreta completely, and the small amount of treated liquid exits the tank and is disposed of, usually to the ground through the associated soak pits.

The biogas collected in the tank is made up of a mixture of 50–70% methane, 30–40% carbon dioxide, and other gases. At the domestic level, methane can be used as a fuel. A typical home

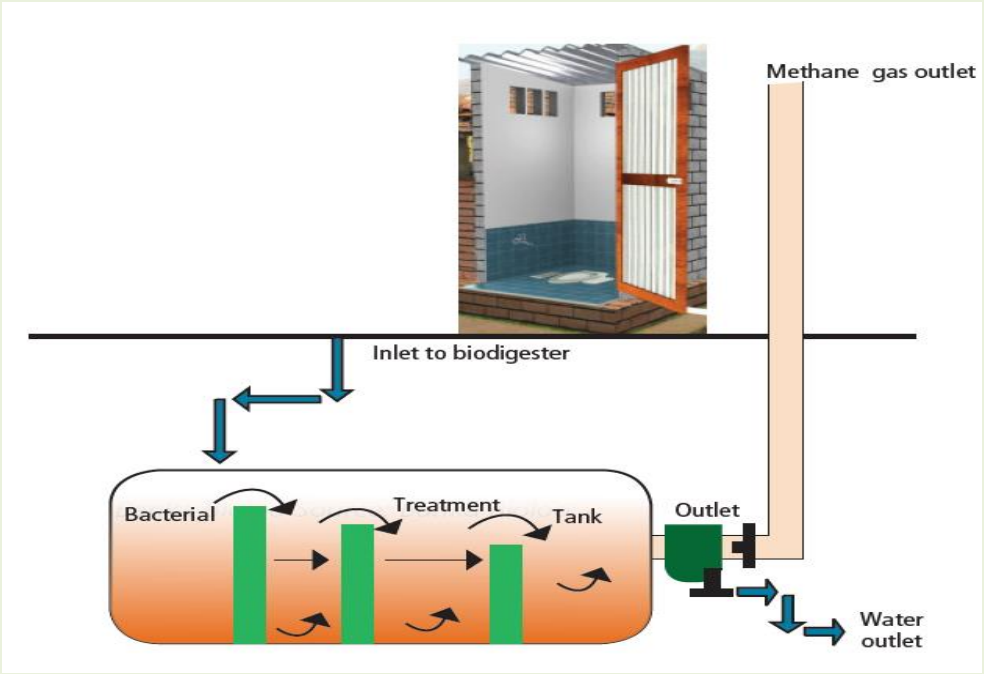
kitchen burner uses half a cubic feet of biogas each hour. Mantle lights can also be lighted with the gas. Each hour, a mantle lamp burns 2–3 cubic feet of biogas.

Advantages

- Highly efficient
- Does not smell
- Long-lasting infrastructure
- Sludge production is minimal. Sludge removal does not necessitate physical labour. Compared to other on-site sanitation solutions, effluent is odourless, cleaner, more effective, and easier to utilise.

Case Study 8- Biodigester toilets developed by Hyderabad-based Banka Bioloo

Banka Bioloo's biodigester technology, developed in partnership with the Defence Research Development Organization (DRDO), effectively decomposes 99 percent of human waste in a short amount of time and inactivates germs that cause water-borne diseases. In the Banka Bioloo workshop in an industrial region of Alwar, Rajasthan, one such system is in use. Ten people work in the toilet for nine to ten hours each day. The toilet has no odour, and the waste water is pumped into a soak pit. According to Banka Bioloo, more than 90% of BOD has been removed from this water. The methane gas that escapes from the outlet is evacuated.



Case Study 9 - Toilet-Linked Biogas Plants Tackle Faecal Sludge Problem in Gujarat's Villages

While poor faecal sludge management remains a problem in India, a few hundred homes in Gujarat's Valsad district have paved the way by connecting their toilets to biogas generators. 747 households from the five clusters of Chikhali, Gandevi, Navsari, Jalalpore, and Maroli in Valsad overcome reluctance and superstitions related with using human excreta in a 2013 project led by FINISH (Financial Inclusion Improves Sanitation and Health) Society and Vasudhara Milk Cooperative.

While the initial goal was to connect existing toilets with biogas units, the team encountered resistance due to religious concerns and psychological taboos around human excreta. People did not readily accept to combine human waste with cow manure to make biogas. Logistical issues arose in the few homes that decided to connect the plant to toilets, such as the toilet and biogas dome not being in close proximity to one another.

After that, a new plan was devised to approach families without toilets and build whole new biogas units and toilets. Vasudhara Dairy mobilised women-led mobilisation teams to raise awareness. This not only avoided open defecation and provided for the treatment of faecal sludge and septage, but it also provided people with convenient access to clean and affordable cooking fuel, as many of these homes previously relied on dung cake or firewood for heating and cooking. Biogas is a low-cost alternative to liquefied petroleum gas (LPG) for cooking and lighting, and it allows slurry to be used for crop production.

Selection of Technology

The ground/site conditions, which regulate the bearing capacity of the soil, self-supporting properties of the pits against collapse, depth of excavation possible, infiltration rate, and groundwater pollution risk, play a direct role in the selection and design of the most appropriate sanitation technology. The most appropriate technology best suited to the local conditions can be picked from the large array of onsite sanitation options based on the cost evaluation and comparative evaluation. The sort of toilet (both superstructure and substructure) that will be built can also be influenced by the ecological zones. Other factors that influence the beneficiary's selection include his or her social and economic circumstances. The major goal is to choose a technology that is both socially and financially acceptable, as well as simple to operate and maintain and has a low operating and maintenance cost.

However, various obstacles limit the optimal functionality of on-site sanitation systems, including a lack of qualified masons, neglect of operation and maintenance, logistics, insufficient performance, an incorrect institutional framework, inconsistent water service, and community non-involvement. The efficiency of on-site sanitation systems may be affected as a result of these limits. The limits have an impact on the goal of sustainable sanitation as well as become a source of pollution in the environment, since the risk of groundwater pollution from on-site sanitation should not be overlooked, especially in the case of pit toilets. Unsaturated sandy or loamy soil at least two metres deep is deposited below the pit to prevent groundwater pollution. This is expected to act as a barrier to groundwater pollution and prevent pollutants from spreading laterally.

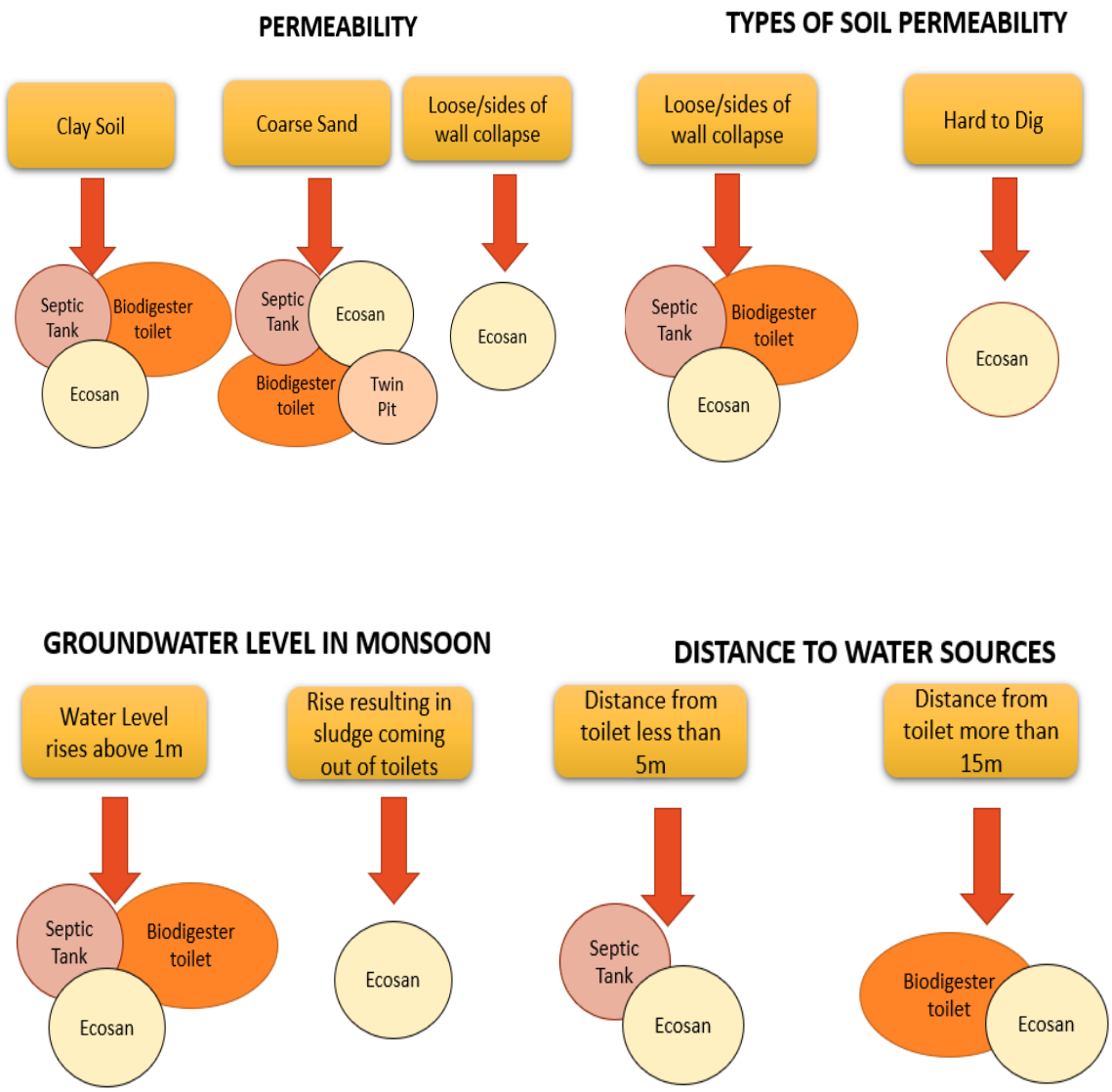


Figure 3.6 Choice of On-Site Sanitation based on Various Factors

Table 3.1 Comparison of Different types of Toilets and Systems

	TWIN-PIT TOILET	ECOSAN TOILET	BIOGAS PLANT-LINKED TOILET	SEPTIC TANK
Land requirement	Medium	High	High	Low
Water requirement	5-8 Litres/usage	1-2 Litres/usage (for cleaning purpose only)	5-8 Litres/user	10-12 Litres/usage
Piped-water connection	Not required	Not required	Not required	Not required
Degree of skilled labour	Medium	High	High	Low
Ground water table and terrain	Suitable for generally all areas except ones with high water-table or water logged areas	Suitable for any soil type	Suitable for any soil type	Suitable for areas with normal or high water table and rocky areas, but not water logged areas
Soil strength	Can be constructed on loose soil areas if pit is made up of perforated concrete rings	High soil strength required	High soil strength required	High soil strength required
Operation & Maintenance	Low	Low	Low	High
Construction cost	Medium	High	High	High
Waste disposal	Safe reuse of human waste in agriculture	Reuse of human waste and urine as manure	Waste converted to biogas, which is used as cooking fuel in households	Needs further treatment before reuse
Sociocultural acceptability	Acceptable	Acceptable in areas where water is scarce	Acceptable when properly demonstrated	Acceptable
Self-building potential	High	Low	Low	Low
Suitability	Areas with water scarcity	Areas with water scarcity or prone to water logging	Any area	Small towns with no centralized sewer systems and limited land availability

Sewerage Systems

Centralized Sewerage Systems:

Conventional Sewers (Combined Sewers): Large networks of underground pipes transport water (blackwater, greywater and stormwater) from individual houses to a Semi/Centralized Treatment Facility under gravity. For low-lying areas and flat landscapes, pumps may be utilized. Sewer lines are categorized into three, primary, secondary and tertiary networks. The main line lies in the centre and all adjacent sewer lines empty into the centre main line. With conventional gravity sewers, household water does not need to pre-treated or requires any onsite treatment. The sewers are designed in declination such that there is no stagnancy and water can flow easily. When steeping lines are not possible, pumping stations are installed. Because they can be designed to carry large volumes, conventional gravity sewers are very appropriate to transport wastewater to a (Semi-) Centralized Treatment facility. However, this system is suitable for urban areas that have the resources to implement, operate and maintain such systems plus provide adequate treatment to avoid pollution at the discharge end.

Decentralized Sewerage Systems:

Simplified Sewerage Systems: This sewerage system is fundamentally the same as the conventional gravity sewers except for the fact they are simpler. Since they are often laid within property lines, under the yards rather than beneath the road system, they are easier to install and can take into account resident landscape rather than having to account for road-traffic, landscape from household to the nearest central STP. The pipes can also be routed in access ways, which are too narrow for heavy traffic, or underneath pavements (sidewalks). Since simplified sewers are installed where they are not subjected to heavy traffic loads, they can be laid at a shallow depth and little excavation is required. This can work with almost all sorts of landscapes and are very efficient in densely populated areas where on-site management is harder. Since the setup is not centralized, it can be expanded on need basis. Occasional flushing of the pipes is recommended to insure against blockages. Blockages can usually be removed by opening the cleanouts and forcing a rigid wire through the pipe

Small Bore Sewer System: Small bore sewer system is designed to collect and transport only the liquid portion of the domestic sewage for off-site treatment and disposal. Septic tanks or aqua privies are constructed upstream of every connection to the small-bore sewers to remove the particles from the sewage. This method provides an alternative to conventional sewers when they would be unsuitable or infeasible. This method also offers a cost-effective solution to enhance existing on-site sanitation facilities to a level of service equivalent to that generated by conventional sewers. Because the small-bore sewer only gathers settled sewage, it requires less water and has lower flow rates. As a result, the cost of excavation, material, and treatment is reduced. Sewage that has been settled is referred to as settled sewerage. It can be used in both dense and sparsely populated areas. Interceptor tanks need to be desludged and will require heavy water load.

Shallow Sewer System: Shallow sewers are designed to receive domestic sewage for off-site treatment and disposal. They consist of a network of pipes constructed at flat slopes in places distant from heavy applied loads, and they are a derivative of the surface drain with covers (usually in backyards, sidewalks and lanes of planned and unplanned settlements). Inspection chambers on street pick-up sewers are supplied. If septic tanks are fitted in community at the outlet of the side sewers, the roads should be constructed as tiny bore sewers. The pumping are avoided in such cases.

Shallow sewerage system is suitable where adequate ground slopes are available. Since these sewers are laid at flat gradients the solids are likely to get deposited unless flushed at peak flow conditions. Otherwise, these sewers may get clogged and require frequent cleaning.

Twin Drain System: It is present on both sides of the road. The pipe towards the road side collects storm water and the pipe on the residential sites receives sewage. The design of the drain with removable cover slabs permits the daily scraping forward of sediments progressively by each house owner in the portion of the drain before his premises to the destination treatment site, something that the other options do not permit that easily.

Figure 3.7 Concepts of Centralized (Left) and Decentralized (Right) Sewerage Systems. The squares represent houses or individual sources.

3.2 Wastewater Management

Liquid waste or waste water is water that has been 'wasted' as a result of numerous human activities at home, at businesses, or in industries. Domestic waste water (black water and Greywater) from small scale industries, hotels, slaughterhouses, and laundries is divided into two categories in rural areas: domestic waste water (black water and Greywater) and commercial waste water (black water and Greywater) from small scale industries, hotels, slaughterhouses, and laundries.

Wastewater is characterised in terms of its physical, chemical and biological composition. Several relevant parameters, which are used to describe the specific wastewater characteristics, shall be briefly presented here. These parameters are useful when designing wastewater treatment facilities, monitoring performance and determining compliance with wastewater discharge standards. It should be noted that many of the physical properties and chemical or biological characteristics listed hereafter are interrelated. (Metcalf and Eddy 2003)

Greywater - is waste water from toilets or kitchens that hasn't been contaminated by faeces. Wastewater from the bath, shower, laundry, and kitchen sink are examples of greywater. Greywater production in India's rural areas is estimated to be between 15,000 and 18,000 million litres per day. Greywater is produced as a result of household activities, and its primary characteristics are influenced by cultural norms, living standards, household demography, and the types of household chemicals utilised. Greywater is the least polluted sort of wastewater and requires the least amount of treatment.

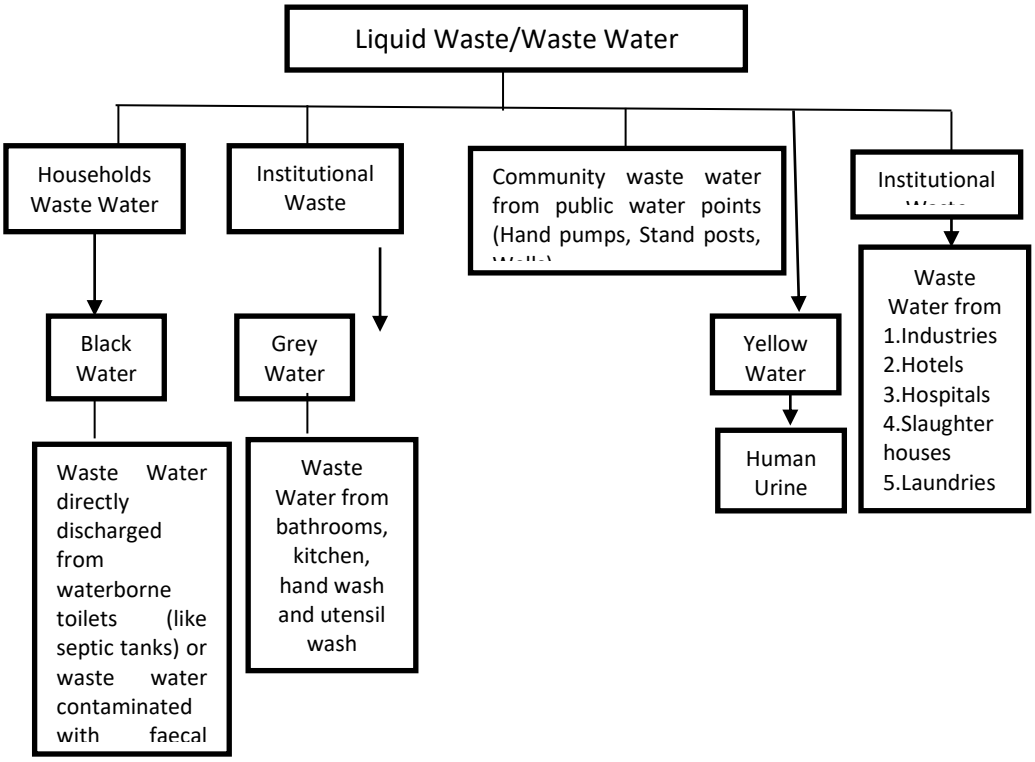


Figure 3.8 Liquid Waste or Waste Water

Basic Principles of Greywater Management

The following are some of the principles to keep in mind when planning a village's greywater management system. These must be evaluated against the target population's demands and preferences. At appropriate levels and in conjunction with these general principles, the most suitable and easy-to-use technology interventions with low operating and maintenance costs must be chosen.

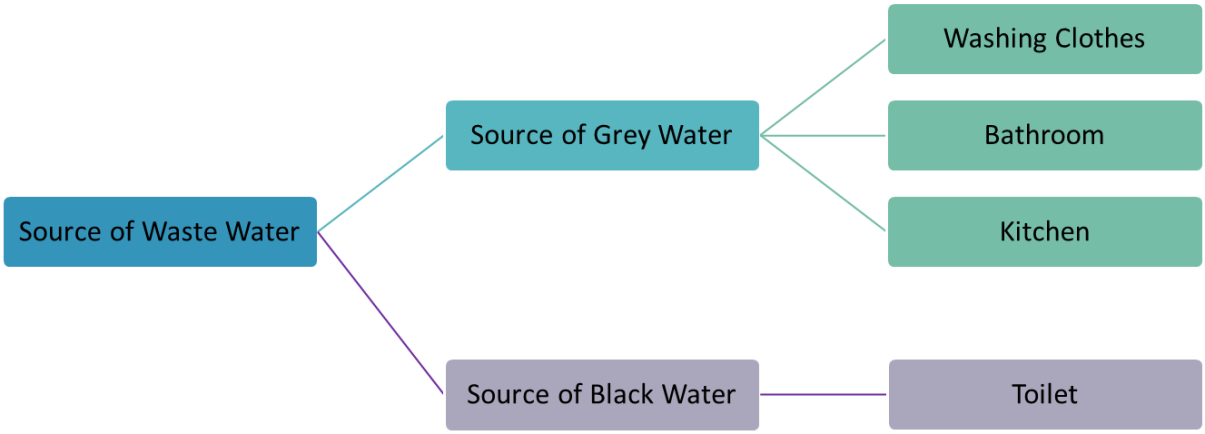


Figure 3.9 Sources of Wastewater

- **Reduce:** Careful use of fresh water results in the development of the smallest amount of Greywater possible.
- **Reuse:** Greywater should be reused as much as possible for things like the kitchen garden, vehicle washing, and toilet flushing.
- **Recharge:** Recharge of ground water with Greywater using technologies like soakage pits and leach pits

- Greywater should be separated from Black water if it is present
- Greywater should be treated as close as possible from where it was generated.

Wastewater management systems can be either conventional centralized systems or decentralized systems. Centralized systems are usually planned, designed and operated by government agencies which collect and treat large volumes of wastewater for the entire communities. On the other hand, decentralized wastewater management systems treat wastewater of individual houses, apartment blocks or small communities close to their origin. facilities. Wastewater treatment systems such as pit latrines, septic tanks, DEWATS etc., which are used for partially treating wastewater in individual residences or a small cluster of houses, are termed as "On Site Wastewater Treatment (OSWT)" systems. OSWT need not have any wastewater collection system, while a DWWM may have a small sewerage system. It may also be noted that any city or town can have a combination of centralized, decentralized and on-site wastewater management systems, to meet the overall city sanitation.

Centralized Wastewater Treatment

A wastewater treatment plant is designed for the influx of waste from domestic, commercial, and industrial sources and to eliminate materials that degrade water quality and endanger public health and safety when discharged into water systems. The prime objective of wastewater treatment is to allow human and industrial effluents to be disposed without danger to human health or damage to the natural environment. Conventional wastewater treatment consists of a combination of physical, chemical and biological processes that eliminate solids, organic matter and nutrient materials from wastewater.

Preliminary Treatment

The expected outcome of preliminary treatment is the removal of coarse solids and other materials found in wastewater. Removal of these materials is essential to enhance the O&M of subsequent treatment. It usually includes, coarse screening, grit removal and removal of large objects.

Primary Treatment

The objective of primary treatment is the elimination of organic and inorganic solids by sedimentation and removing floating material by skimming the surface.

Secondary Treatment

The outcome of secondary treatment is the treatment of the resultant effluent from primary treatment tanks to remove the residual organic matter and suspended solids. The primary method used is the aerobic biological treatment process. The effluent is aerated with aerobic microorganisms that metabolize the biological matter in the effluent and produce inorganic gases like CO_2, NH_3 etc. Common methods used are activated sludge process, trickling filter or bio-filter, oxidation ditches, and rotating biological contactors (RBCs). If a high concentration of organic material is seen, a combination of two processes is commonly used. The various treatment technologies used in India for the treatment of wastewater and industrial effluents are elaborated below.

Activated Sludge Process

This is the most common method used. The primary objective is lowering the Biochemical Oxygen Demand (BOD) removal. The removal of BOD is done in the aeration tank, where the wastewater is aerated with oxygen, aiding in the growth of bacteria that create flocs and gases, the flocs are removed by a secondary clarifier. In the activated sludge process, the dispersed-growth reactor is an

aeration tank containing a suspension of wastewater and microorganisms. The contents of the tank are mixed vigorously by aeration devices, supplying oxygen to the suspension. Commonly used aeration devices include submerged diffusers that release compressed air, and mechanical surface aerators that agitate the surface. Hydraulic retention time is usually about 3-8 hours, but maybe more in case of high BOD. After it has been completely aerated, the microorganisms are filtered out by sedimentation and the clarified liquid becomes the secondary effluent. A portion of the sludge is cycled to the aeration tank to retain a high mixed-liquor suspended solid (MLSS) level. The remainder is removed from the process and sent to sludge processing to maintain a constant concentration of microorganisms in the system. Variations of this process, such as extended aeration and oxidation ditches, are of similar principle.

Trickling Filters

A trickling filter, also known as a bio-filter, consists of a tower filled with support media such as stones, plastic shapes, or wooden slats. Wastewater is allowed to run over the media. Microorganisms are allowed to grow and form a layer or fixed film over the media. As the water passes over the media, the organic matter diffuses into the film where it is metabolized. Oxygen is supplies to the film by natural flow of air through the media. Forced air can be supplied using blowers. The thickness of the bio-film increases with increase in growth of bacteria. Periodically, portions of the film break off the media and into the water. The sloughed material is separated in a secondary clarifier and sent to sludge processing. The clarified liquid from the secondary clarifier is now the secondary effluent. A portion is recycled to the bio-filter to improve hydraulic distribution of the wastewater over the filter.

Rotating Biological Contactors

Rotating biological contactors (RBCs) are fixed-film reactors similar to bio-filters in the principle of organisms grown on the support media. In case of RBCs, the support media are slow rotating discs that are partially submerged in flowing wastewater. Oxygen is supplied through air when the film surfaces, and from the liquid when it is submerged through surface turbulence caused by rotation of the discs. Pieces of bio-film that break off are separated in the same method as described for bio-filters.

High-rate biological treatment processes, in combination with primary sedimentation, removes about 85% of the BOD and suspended solids (SS) in the raw wastewater. Activated sludge treatment usually produces higher quality effluent than those from bio-filters or RBCs. When combined with disinfection methods, these processes can bring about substantial removal of bacteria and viruses. However they remove only small amounts of phosphorous, nitrogen, non-biodegradable organics, or dissolved minerals.

Up-flow Anaerobic Sludge Blanket (UASB) Process

The UASB works by forming a blanket of granular sludge which is suspended in the reaction tank. Wastewater is made to flow upwards through the blanket and is processed by anaerobic microorganisms. Combined with the settling action of gravity, the upward flow suspends the blanket with the help of flocculents. The blanket reaches maturity in about three months. Small sludge granules are covered by aggregation of bacteria. In the absence of a support matrix, only those microorganisms which are capable of attaching to each other survive and proliferate. Eventually, the aggregates form dense compact bio-films which are called ‘granules’. The granular blanket filters the

solid material from the liquid. Though the hydraulic retention time (HRT) does not change from the usual 1-3 days, the solid retention time (SRT) can take upto 10-30 days or more for effective digestion. This means that the digester is more efficient without any increase in size, hence reducing costs. Standing and hanging baffles are used with a conic separation and small outlet at the centres. These are more effective in limiting the anaerobic blanket to the lower part of the digestion tank. It also serves to filter and retain the solids, thus increasing the SRT.

The biochemical processes in UASB digesters occur in three sequential phases:

- Hydrolysis or Solubilization: The first phases takes 10-15 days, and the complex organics must be solubilized before they can be absorbed into the bacteria and degraded by endoenzymes.
- Acidogenesis or Acetogenesis: The effluent from the first phase is used to form organic acids by another group of organisms.
- Methanogenesis: The effluent from the second phase is used by methanogenic bacteria to complete the decomposition process.

Water Stabilization Ponds

Water stabilization ponds are shallow man-made basins comprising of a single or a series of anaerobic, facultative or maturation ponds. It is one of the most important natural methods for wastewater treatment.

The primary treatment is done in the anaerobic pond which is designed to remove suspended solids and soluble organic matter to lower BOD. The facultative pond is the secondary stage where most of the remaining BOD is removed through the coordination of algae and heterotrophic bacteria. The maturation pond serves as the tertiary treatment and it removes pathogens and nutrient material.
Water stabilization ponds are the most cost effective method for the removal of pathogenic microorganisms through natural disinfection methods. It is useful in tropical and subtropical countries due to the intensity of sunlight and temperature that are key factors in the efficiency of the process.

- **Anaerobic Ponds**

  These are the smallest of the series. They are usually 2-5m in depth and receive high organic loads of about 100g BOD/m^3 per day which creates anaerobic conditions in the pond. Their function is similar to open septic tanks and is most effective in warm climates. A properly designed pond can achieve around 60% BOD removal at 20^{o}C. An HRT of one day is sufficient for wastewater with BOD of upto 300mg/L and temperatures higher than 20^{o}C. Possible odour problems can be minimized if the SO42 concentration is less than 500mg/L.

- **Facultative Ponds**

  They are of two types; primary ponds that receive raw wastewater, and secondary ponds that receive the effluent from the anaerobic ponds. Facultative ponds are designed for BOD removal on the basis of low organic surface load to allow development of an active algae population which generates the oxygen required to remove soluble BOD. The change of colouring of the water in facultative ponds from a healthy green is a qualitative indicator of an optimally functioning facultative pond. The concentration of algae in an optimal pond may defer depending on temperature and organic load, but is usually in the range of 500-2000µg chlorophyll per litre. The photosynthetic activity of the algae results in a diurnal variation of the concentration of dissolved

oxygen and pH values. Wind velocity can have an important mixing effect of the pond liquid.

- **Maturation Ponds**

  These ponds receive the effluent from the facultative pond. They are shallow (1-1.5m) and show less vertical stratification. Their entire volume is well aerated throughout the day. Their algal population is more diverse than that in facultative ponds. Hence it can be seen that algal diversity increases along the series of ponds. The removal of pathogens and faecal coliforms are facilitated by algal activity in conjunction with photo-oxidation. Maturation ponds only achieve a small amount of BOD removal, but are instrumental in removing nitrogen and phosphorous.

Aerated Lagoons

The purification of water takes place in one or more aerated lagoons according to the size of the plant and is followed by non-aerated sedimentation and a polishing pond. The sewage from the canalization is led directly into the first aerated lagoon without mechanical pre-purification. Coarse matter, sand, and heavy sludge settles in the inlet zone while dissolved contaminants are distributed throughout the first lagoon. Sludge at the inlet zone must be removed at regular intervals. It can be done by using liquid manure-vacuum-tankers. Floating solids are retained by a scum board in the inlet zone and must be removed once or twice a week using a rake.

Oxidation Ponds

They are also known as stabilization ponds or lagoons. They are used for simple secondary treatment of sewage effluent. They are usually 10ft deep to support algal growth. Heterotrophic bacteria degrade organic matter to produce cellular material and minerals. This supports the growth of algae in the pond, which allows further decomposition of organic matter by production of oxygen. This replenishes the oxygen used by the heterotrophic bacteria. Oxidation ponds are largely restricted to warm climates as they are influenced by seasonal temperature changes. The ponds also tend to fill up due to the settling of bacterial and algal cells formed during decomposition of the sewage.

Overall, oxidation ponds tend to be ineffective due to their large holding capacities and long retention times. The degradation is relatively slow and the effluents containing oxidants need to be removed periodically from the ponds.

Karnal Technology

Karnal technology involves growing trees on ridges 1m wide and 50cm high and disposing untreated sewage in the furrows between them. The discharge of effluent is regulated to achieve consumption in 12-18 hours and have no standing water left in the furrows. This technique utilizes the entire biomass as a living filter for supplying nutrients to the soil and plants. Furthermore, since forest plants are used in this system, which are later used for industrial purposes, there is no chance of pathogens, heavy metals and organic compounds entering the human food chain. Trees that are fast growing, have high water transpiration rates and able to withstand high moisture content in the root environment are most effective. Eucalyptus is the most popular species used. The other suitable species are poplar and Leucaena. Eucalyptus is most popular of the three as poplar remains dormant in the winter and cannot bio-drain effluents during those months.

This technology is relatively cheap and requires lower capital. The sole expenditure involves the cost of making ridges, cost of plantation and their care. The system generates returns from the sale of

fuel wood. The sludge accumulation in the furrows, along with decaying forest litter, can be exploited as additional revenue. Relatively unfertile wastelands can be used for this purpose as the wastewater provides required nutrients for plant growth. The technology is economically viable as it requires only the cost of transportation of water from source to field and does not require skilled personnel. It is most appropriate for rural areas, which can aid in restoring the environment and generating biomass.

Duckweed

Duckweeds are floating plants that grow on the surface of still or slow moving water during warm weather. Because they usually reproduce by budding, they can multiply very quickly and cover the entire pond surface in a small time period. Large numbers may block sunlight from entering the pond and change the oxygen balance, thus harming the marine population. *Lemna* spp are the most common species. *Lemna* grow upto 4mm wide and have a single root dangling from the leaf. Duckweeds do not have true leaves or stems; the round, flattened leaf-like part of the plant is called a frond. Watermeal (*Wolffia* spp) is the smallest of duckweeds. They are generally less than 1mm wide and are barely visible as individuals. They do not have roots. Control over duckweed population is necessary to avoid oxygen problems in water bodies.

Fluidized Bed Reactor

Aerobic fluidized bed reactors (FBRs) are a new technology in wastewater treatment. An aerobic FRB with granulated activated carbon (GAC) as carrier material can be operated under different conditions, including batch loading, semi continuous loading, and continuous loading. The principle of FBRs is to have a continuously operating, non-clogging bio-film reactor which requires: 1) no back-washing 2) low head loss 3) high specific bio-film surface area. This is achieved by having the biomass grow on small carrier elements that move with the liquid in the reactor. The movement in the aerobic reactor is facilitated by aeration. The bio-film carriers are made of special grade plastic with density close to that of water. The FBR uses the fixed film principle, making the treatment process easier, as it does not require sludge recycle as in the Activated Sludge Process. This eliminates the enormous task of measurement and monitoring of MLSS levels in the tank and continuously adjusting recycle ration due to fluctuating Chemical Oxygen Demand (COD) loads at the inlet. The FBR produces a small quantity of sludge that requires no further treatment.

FBRs are used in small STPS for treating city wastewater, industrial sewage from food waste, paper waste and chemical waste etc. Due to the fixed film nature, these plants accept shock loads much better than those that use suspended growth processes. The reactors are usually about 6m and above in height, reducing cross-sectional area.

Sequential Batch Reactor

In the process, the raw wastewater, after removal of solid waste, is biologically treated to remove organic matter, nitrogen and phosphorus. The activated sludge bio-system is designed using the Advanced Cyclic Activated Sludge Technology which operates on the extended aeration activated sludge principle for the reduction of carbonaceous BOD, nitrification, denitrification, as well as phosphorous removal using a fine bubble diffused aeration system with automatic control of air supply based on the rate of oxygen uptake.

The sequences of fill, aeration, settle and decantation are consecutively and continuously operated in the same tank. No secondary clarifier system is required to concentrate the sludge in the reactor. The return sludge is recycled and the surplus is expelled from the basin. The complete biological operation time is divided into 1) fill-aeration 2) settlement, and 3) decantation. These phases in a sequence constitute a cycle. During the period of a cycle the liquid volume inside the reactor increases from a set operating bottom water level. During the fill-aeration phase, the mixed liquid from the aeration zone is recycled into the selector. Aeration ends at a pre-determined period of the cycle to allow the biomass to flocculate and settle under calm conditions. After a specified settling period, the treat supernatant is decanted using a moving weir decanter. The liquid level in the reactor is returned to the bottom water level and the cycle is repeated. Solids are separated from the reactor during the decantation phase.

The system can achieve 1) bio-degradation of organics present in the wastewater by extended aeration 2) oxidation of sulphides 3) co-current nitrification and denitrification of ammoniacal nitrogen in the aeration zone, and 4) removal of phosphorous.

Tertiary Treatment

Tertiary treatment is used when specific wastewater constituents cannot be removed by secondary treatment. They are used to eliminate nitrogen, phosphorous, additional suspended solids, refractory organics, heavy metals, and dissolved solids. However, these advanced treatment processes are sometimes combined with primary or secondary treatment (eg. Chemical addition to primary clarifiers or aeration basins to remove phosphorous) or used in place of secondary treatment (eg. Overland flow treatment of primary effluent).

Decentralised /Centralised Solutions

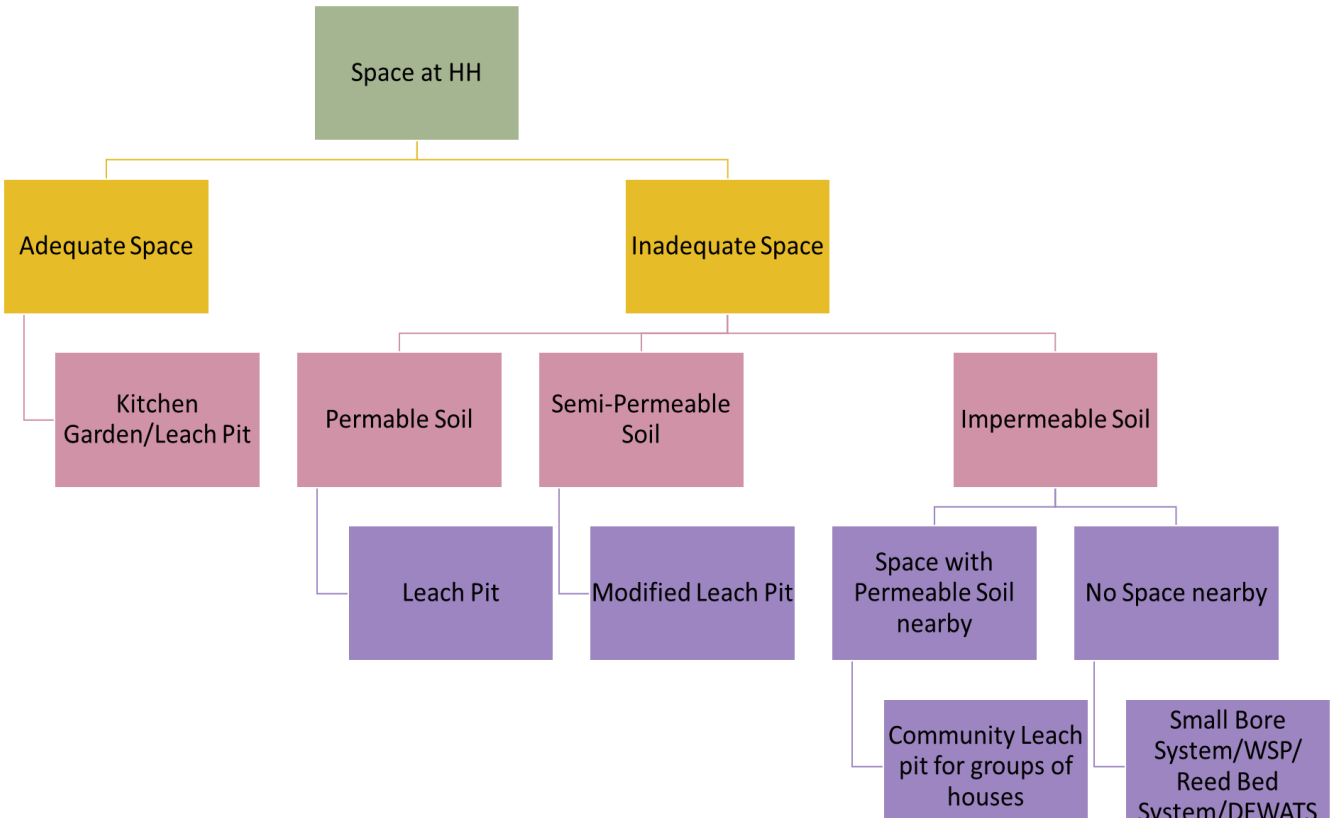
Decentralized Wastewater Treatment

Wastewater collection system for the decentralized wastewater management can be designed by (i) Micro scale conventional centralized system, (ii) settled sewage system, (iii) Small bore sewer system, (iv) Shallow sewer system, (iv) Twin drain system and (v) Incremental sewerage system.

Individual soak pits/leach pits/magic pits/kitchen garden techniques are more doable and desirable in smaller GPs / communities. Community level soak pits can be constructed based on location, groundwater level, and population density for larger villages with a population of less than 5000 people. Villages with a population of more than 5000 people should consider a conveyance system such as underground / small bore sewers / closed drainages, as well as treatment systems such as WSP / DEWATS / built wetlands and other treatment systems. States, on the other hand, will have

the ability to implement conveyance and treatment systems for smaller villages based on agro-climatic conditions, with additional money from the 15th Finance Commission and convergence from other State sources.

Technology Selection Criteria



(A) For General Area

Figure 3.10 Set-up Decentralized Water System for Generic Landscape

(B) For Areas with seasonal or permanent high-water table / Water logged areas

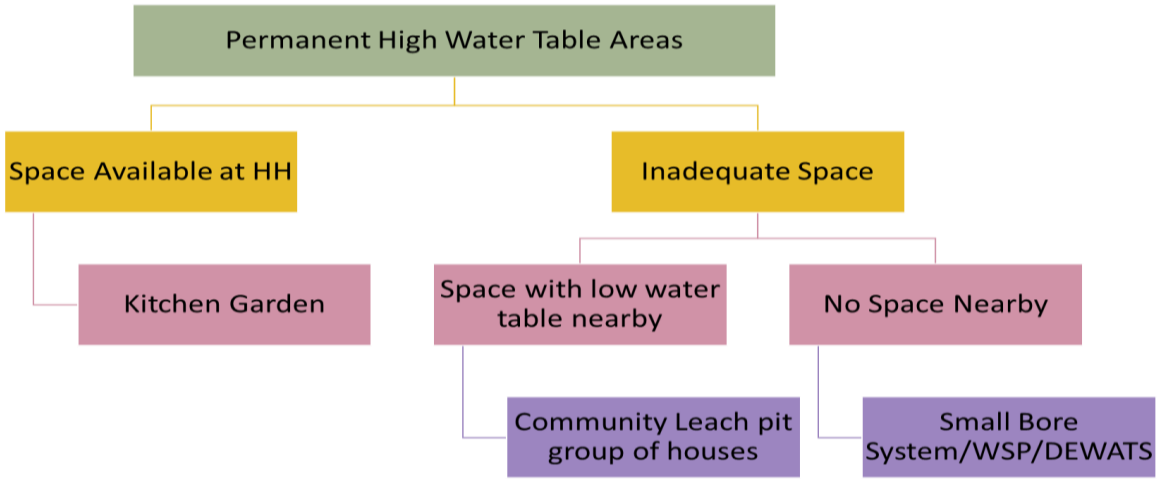


Figure 3.11 Set-up Decentralized Water System for Waterlogged Areas

(C) For Areas with hard strata (rocky strata)

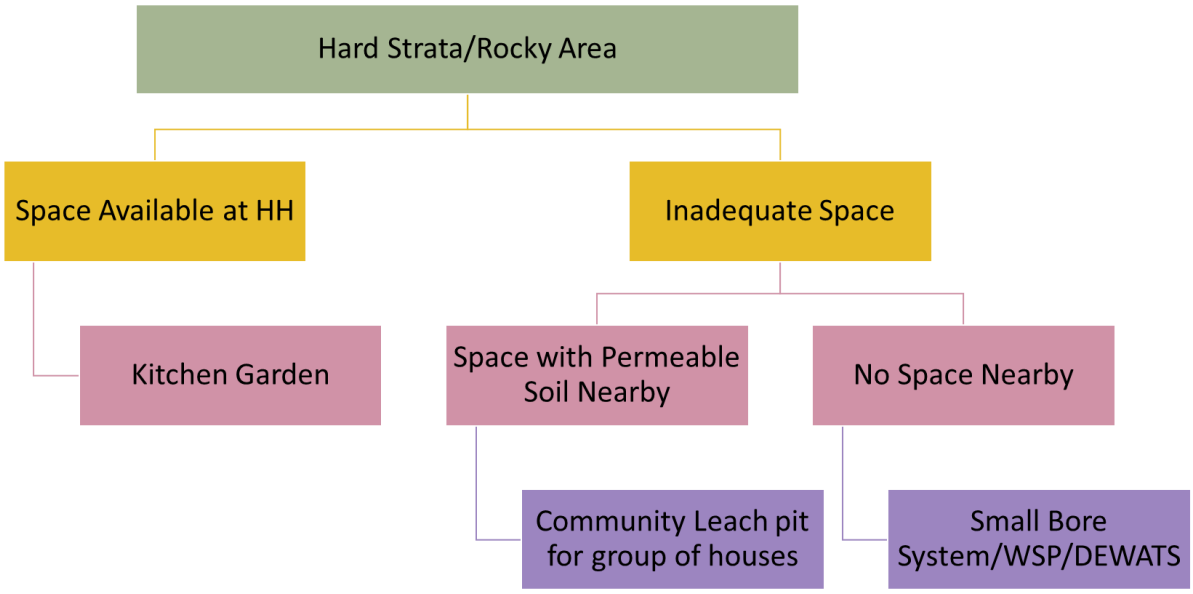


Figure 3.12 Set-up Decentralized Water System for Rocky Strata

Technological operations

(A) Household Level Interventions

- **Soak Pit** - A pit dug out of the ground and filled with stones or preferred over burning bricks. The enormous number of stones increases the amount of surface area available for biological and chemical action.
- **Leach Pit -** A brick-lined pit constructed in honeycomb masonry with a volume of roughly 0.75 cubic metres is known as a leach pit.

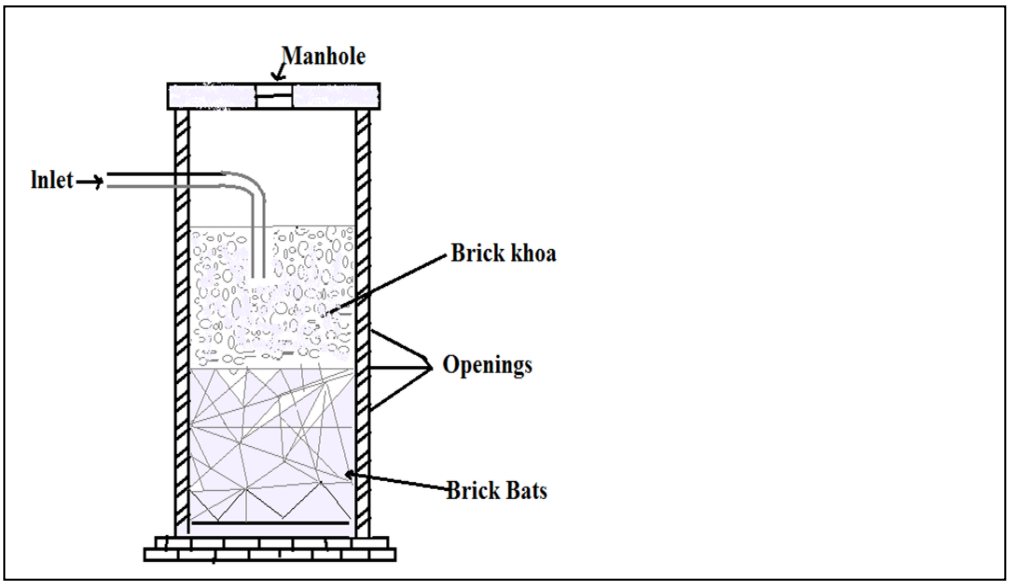


Figure 3.13 Schematic Representation of a Leach Pit & Household Leach Pit with Slit Chamber

- **Magic Pit-** A magic pit is a covered, porous-walled enclosure that allows water to soak into the earth over time. The underground chamber receives pre-settled wastewater from a collection tank.

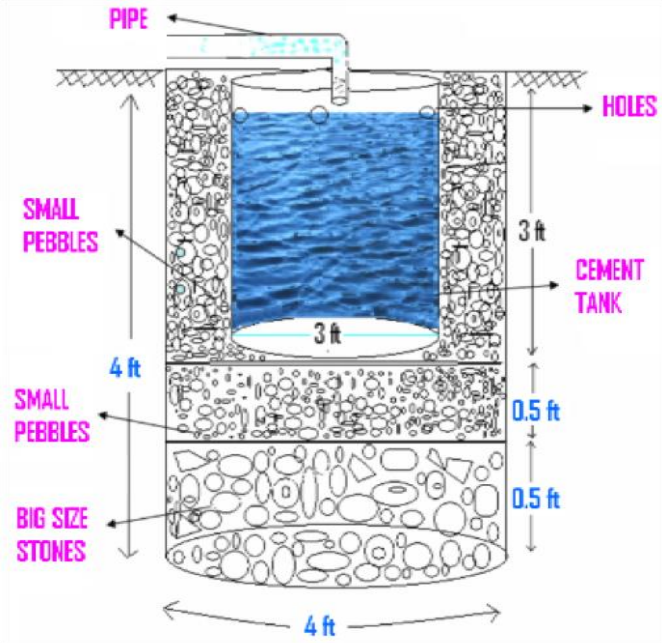


Figure 3.14 Schematic Representation of a Magic Pit

(B) Community Level Interventions

The conveyance of waste water from the source of generation to a point of treatment is required for community-level waste water management initiatives. Conventional drains (open/closed) or small-bore sewers can normally be used for this.

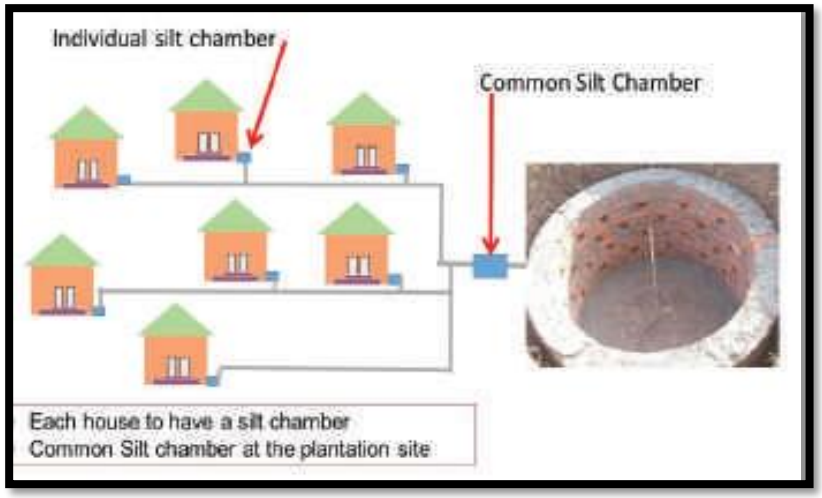


Figure 3.15 Community Leach Pit. Maximum number of Houses = 10. Quantity of Grey Water per day HH=300 Litres

(i) Community Leach Pit

This is a brick-lined pit built for a group of houses in a handy location. The number of residences that need to be connected should be determined by the amount of Greywater discharged from each home and the amount of space available for the community leach pit. Greywater from the homes should be carried to this pit (kitchen waste water, bathing water, washing water, etc.).

(ii) Waste Stabilization Ponds

Waste stabilisation ponds (WSP) are shallow manmade basins into which wastewater flows and from which a well-treated effluent is discharged after a few days of retention. WSP systems are made up of a sequence of ponds that include anaerobic, facultative, and maturation ponds.

The System's Essential Components

The system Figure 3.17 is made up of three fundamental elements called ponds, which are connected in a series and are distinguished by their size.

1. Anaerobic Pond – a single number
2. Facultative Pond – a single number
3. Aerobic Pond or maturation pond - more in number, depending on the pollutants in the Greywater

(iii) Constructed Wetland

A horizontal flow-built wetland (horizontal flow CW) is a planted filter bed for wastewater treatment (e.g., greywater or blackwater). A horizontal subsurface flow-built wetland is a big gravel and sand-filled channel with aquatic plants planted in it. The filter material filters out particles as wastewater travels horizontally through the channel, and microorganisms decompose organics.

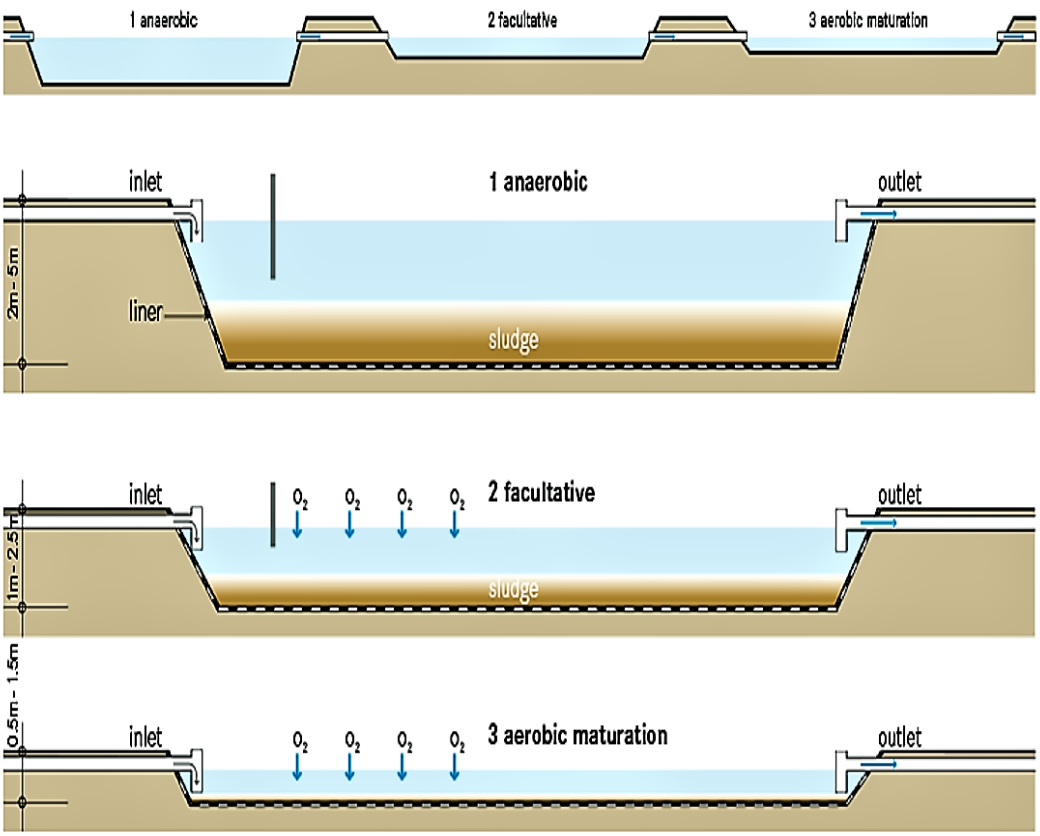


Figure 3.16 Schematic of the three main types of waste stabilization ponds (WSPs): (1) anaerobic, (2) facultative and (3) aerobic (maturation), each with different treatment and design characteristics Source-Compendium of Sanitation Systems and Technologies. 2nd Revised Edition, Tilley et al, 2014

Figure 3.17 Constructed wetland for wastewater treatment at Indian Agriculture Research Institute, Pusa, New Delhi

A combination of biological and physical techniques are used to treat the waste water. The wastewater from a well-functioning artificial wetland can be safely released to receiving water bodies or used for irrigation and aquaculture. Horizontal flow CW is generally inexpensive to construct when land is available, and it can be maintained by the local population because it does not require high-tech spare parts, electrical energy, or chemicals.

(iv) Decentralized Wastewater Treatment System (DEWATS)

DEWATS is a proven nature-based treatment system that is ideal for wastewater treatment, including greywater, and works under gravity, requiring no electromechanical components and hence requiring low maintenance. The DEWATS module Figure 3.18 can be tailored for any project/situation based on the quantity and quality of incoming wastewater parameters.

Box 3.2-The Decentralised Wastewater Management Approach

(a) Increases responsiveness to local demands and needs and, hence, enhances willingness of communities to pay for improved services (Parkinson and Taylor 2003).
(b) Broadens the technology options permitting tailoring the solutions to the prevailing conditions.
(c) Minimises the freshwater requirements for waste transport.
(d) Reduces the risks associated with system failure.
(e) Allows segregation of different wastewater fractions (greywater, blackwater, stormwater) at source.
(f) Increases local wastewater reuse opportunities.
(g) Allows incremental development and investment in the community wastewater system.

Kuchpura is a low-income peri-urban neighbourhood in Agra. The Kuchpura storm water drain, which brought untreated black water from Kuchpura and other upstream communities to the river, runs to the river Yamuna. The DEWATS is chemical-free and cleans water using natural processes, conserving resources and demonstrating the need of reusing and recycling water, particularly in locations where water is limited. It uses four phases of treatment, which can be customised based on the intake water's characteristics and the level of treatment necessary.

Figure 3.18 (DEWATS) was built by CURE over the Kuchpura drain.

(v) Phytorid Technology

Phytorid is a waste water treatment technique that has been scientifically created.
Physical, Biological, and Chemical processes are all combined in Phytorid. It is a gravity-based system that is cost-effective, requires no electricity, is scalable, easy to maintain, and enhances aesthetics.

Along with the basic treatment facility, a major treatment facility would be built for effective solids removal, lowering the marginal BOD. Emergent vegetation's root system is also supported by the porous media. The Phytorid system is designed with the assumption that the water level in the cells will remain below the filter media's top. The vegetation that will be used for the Phytorid system is crucial.

To achieve optimal effectiveness in the treatment of residential wastes, a variety of aquatic plant species have been used. *Phramites australis*, *Phalaris arundinacea*, *Glyceria maxima*, Typha spp., and other common grasses are among them. Because this technology is based on a natural system, it is essentially passive and requires little operator participation.

(C) Conveyance System

Covered surface drains are one of the cheapest and interim choices for disposing of Greywater, Greywater + septic tank effluent. Furthermore, open channels are common in rural regions and can be easily converted to covered drains.

The goal of a covered surface/storm water drain is to evacuate waste water/rain water from homes/businesses in a controlled and sanitary way, hence reducing public health and environmental dangers. A pipe has less friction than an open drain/channel. Pipe flow may be improved in reasonably flat regions; an alternative is to place the pipe into an open channel and cover it.

Figure 3.19 Developing water conveyance system in Tube Well command area (UP)

(D) Small Bore Sewers

Small bore sewer systems are intended to collect only the liquid portion of household wastewater for treatment and disposal away from the home. In interceptor tanks, similar to septic tanks, grit, grease, and floating materials are separated from the waste flow. According to the site conditions, such interceptor tanks are installed after each residence or group of households. Settled solids should be removed from interceptor tanks on a regular basis, depending on the size of the interceptor tanks and the amount of waste water inflow.

Sewers are tiny bore pipes (with a minimum diameter of 100 mm) trenched into the ground at a depth sufficient to collect settled wastewater from most connections by gravity. Small bore sewers, unlike conventional sewers, are not always placed on a consistent gradient with straight alignment between manholes and cleanouts. These conveyance systems should lead to treatment facilities such as community leach pits, Waste Stabilization Ponds, Constructed

Wetlands, DEWATS, and Phytorid technology, among others.

Figure 3.20 Laying down of Bore Lines

In properly-constructed toilets, sewage is carried off by drains into a waste collection 'tanks', called as septic tanks. The contents range from completely raw to moderately degraded semi-solid waste, termed as faecal sludge. Systems set up for management of faecal sludge include collection of the waste materials, transportation to treatment plants, subsequent treatment, and the final disposal of the treated matter into respective sites. Care has to be maintained to ensure the procedure is carried out without errors, to ensure appropriate safety for everyone associated with the area.

Case Study 10: WSP in Ludhiana

Ponds were once utilised to collect rainwater and store it for later use. These were excellent sources of recharging groundwater. Nowadays, ponds are clogged and filthy. They've turned into a nuisance, generating sanitary and hygiene issues. The Water Supply and Sanitation Department has taken the initiative to use the Waste Stabilization technology to rehabilitate clogged village ponds. Using earthen embankments, the pond is emptied, de-silted, and separated into three to four divisions. The grey water collected by the drainage system is directed to huge shallow basins or ponds excavated on suitable terrain and put serially as a grey water stabilisation system. Its pathogenicity is lowered, and the water is stabilised and used. Natural mechanisms involving algae, bacteria, and natural oxidation processes stabilise the collected grey water in this system. The hot environment, as well as solar radiation and light, are ideal for this system's efficient operation.

Components of the Renovated Pond

1. Anaerobic cum Sedimentation Tank

The Pond's water depth is kept at 10 feet to allow suspended materials to settle and organic matter to decompose under anaerobic conditions, reducing BOD/COD. The tank's surface area should be around 15% of the present pond's area, with a retention time of 2-3 days. The depth should be set at 3-5 metres.

2. Facultative Pond

The overflow from the anaerobic pond is emptied into this tank, and BOD/COD will decrease under aerobic conditions. The water depth is maintained at 1.5 metres. The tank's outlet is set at 1.5 metres from the tank's bed to ensure that the water depth does not exceed 1.5 metres.

3. Maturation / Polishing Pond: (2 numbers)

The overflow from the Facultative Pond is emptied into this tank, where pathogen burden, if any, will be minimised. The water depth is maintained at 1.0 metre. This tank's outlet is set at 1.0 metre from the tank's bed to ensure that the water depth does not exceed 1.0 metre.

4. Outflow

In most cases, treated water is absorbed in the pond in addition to evaporation. Farmers also utilise the treated water to irrigate their crops.

Improved sanitation in the Village. Filthy ponds have evolved into a recreational area. It serves as a rainwater collection structure. Irrigation can be done with treated water. Extra storage capacity offered by the refurbished pond collects extra rain water, preventing flooding in the village's low-lying regions.

Limitation

- Availability of open land held by GP in a favourable location may be a barrier
- Applicability of Waste Stabilization Pond
- The system is likely to be disrupted during the rainy season, and it may require maintenance following the wet season.
- Appropriate design and technical inputs are required.

A preliminary study of the entire state revealed that pond rehabilitation is required in 10396 villages with a total pond area of 24904.92 acres. The total amount of money required for this project is around INR 750 crores.

3.3 Water Quality Testing

In urban and peri-urban areas of low and middle-income countries, greywater is most often discharged untreated into stormwater drains or sewers – provided they exist –from where it normally flows into aquatic systems. This practice may lead to oxygen depletion, increased turbidity, eutrophication, as well as microbial and chemical contamination of aquatic systems. A number of physical, chemical and biological parameters are used to describe the properties of the wastewater. Parameters are used to design and monitor sewage systems. Some relevant parameters that serve to describe the specific wastewater properties are briefly presented here. These parameters are useful in designing wastewater treatment plants, monitoring performance, and determining compliance with wastewater discharge standards. It should be noted that many of the physical properties and chemical or biological properties listed below are interrelated.

Table 3.2 Potential risk factors and benefits of greywater, urine and faeces

	Grey Water	**Urine**	**Feaces**
Chemical contamination	Fats, oils and toxic substances (org. compounds, chlorides, metals)	Micro- contaminants (e. g. hormones & antibiotics)	Micro- contaminants (e. g. Heav y metals)
Biological contamination	Pathogens (bacteria, viruses, helminths, protozoa)	Almost sterile (i. e. cross- contamination from feaces)	Pathogens (bacteria, viruses, helminths, protozoa)
Value	Reuse potential (for irrigation or municipal and non-potable domestic use)	Nutrients (N, K and P etc.) => ideal fertilizer	Good soil conditioner, but only little nutrients

Need for Microbiological Testing

Water can be a major source of pathogens that cause infectious diseases and epidemics. This can occur if the water is contaminated with faecal matter or if it is untreated. Faecal matter harbours dangerous pathogens, emanating from individuals who were suffering from a particular disease. Even if an individual has recovered from a disease, they still might be carriers of the pathogen. Therefore, to avoid transmittance of dangerous pathogens and diseases, microbiological testing to estimate whether a water source is contaminated is of utmost importance.

Solids

- TS Total solids
- TSS Total suspended solids

Suspended solids are those solids that do not pass through a 0.2-um filter. About 70% of those solids are organic and 30% are inorganic. The inorganic fraction is mostly sand and grit that settles to form an inorganic sludge layer. Total suspended solids comprise both settleable solids and colloidal solids. Settleable solids will settle in an Imhoff cone within one hour, while colloidal solids (which are not dissolved) will not settle in this period. Suspended solids are easily removed through settling and/or

filtration. However, if untreated wastewater with a high suspended solids content is discharged into the environment, turbidity and the organic content of the solids can deplete oxygen from the receiving water body and prevent light from penetrating.

Organic constituents

- BOD Biochemical oxygen demand
- COD Chemical oxygen demand

Biodegradable organic matter consists mainly of proteins, carbohydrates and fats. Discharged into the environment untreated, its biological stabilization can lead to the depletion of natural oxygen and the development of septic conditions. BOD test results can be used to assess the approximate amount of oxygen required to biologically stabilize the organic matter present can in turn be used to determine the size of wastewater treatment plants, measure the efficiency of some treatment processes, and assess compliance with wastewater discharge permits.

Nutrients

- TN Total nitrogen
- TP Total phosphorus

Nitrogen and phosphorus, also called nutrients or biostimulants, are essential for the growth of microorganisms, plants and animals. If these nutrients get into the water bodies, they can lead to the growth of undesirable aquatic life, which deprives the water of dissolved oxygen. If excessively discharged on land, they can also lead to groundwater pollution.

Acidity/Basicity pH -log10[H+]

The concentration range suitable for the existence of most biological organisms is quite narrow (typically 6 to 9). Wastewater with an extreme concentration of hydrogen ions is difficult to treat biologically. If the concentration is not changed prior to discharge, the wastewater can change the concentration in natural waters, which could have negative effects on the ecosystem.

Alkalinity

- $Ca[HCO_3^-]2$ Calcium bicarbonate
- $Mg[HCO_3^-]$ Magnesium bicarbonate

The alkalinity in wastewater results from the presence of calcium, magnesium, sodium, potassium, carbonates and bicarbonates as well as ammonia hydroxides. The alkalinity in wastewater buffers (controls) pH changes caused by the addition of acids. Wastewater is usually alkaline due to the presence of groundwater (which contains high concentrations of naturally occurring minerals) and household chemicals. The alkalinity of the wastewater is important in chemical and biological cleaning, in biological nutrient removal and in the removal of ammonia by air stripping.

Electrical Conductivity (EC)

The measured EC value is used as a substitute measure for the total concentration of dissolved solids (TDS). The salinity (i.e., salinity) of purified wastewater used for irrigation is also determined by measuring its electrical conductivity.

Temperature

The sewage temperature is usually higher than that of the local water supply. Temperature has an impact on chemical reactions, reaction rates, aquatic life and suitability for useful uses. In addition,

oxygen is less soluble in warm water than in cold water

Pathogens

- TC (MPN) Total coliforms, most probable number
- FC (MPN) Faecal coliforms, most probable number

Communicable diseases can be transmitted by pathogenic organisms present in wastewater. The presence of specific monitoring organisms is tested to gauge plant operation and the potential for reuse. Microbiological assessment of every single pathogen is extremely tedious and expensive. Therefore, coliform group of bacteria are considered to be standards for routine water contamination assessment. They can be identified by isolating and growing the organisms on selective medium at 44.5°C.

1. Multiple Tube Fermentation Method

Total Coliform Test

This is perhaps the most primitive method of microbial estimation of coliform. It comprises of three tests known as presumptive, confirmed and completed. In the presumptive test, the sample is added to lauryl tryptose broth and incubated with inverted durham's tube. Positive result is interpreted by growth in the tube and gas formation. Confirmed test is then performed using Brilliant green lactose broth of EC broth, which is selective for coliforms only. If growth is observed, completed test is performed, wherein the highest dilution is plated onto Eosin Methylene Blue agar (EMB) which is highly selective and can differentiate between coliform groups (faecal or non-faecal).

Faecal Coliform Test

In this test, a presumptive test using lauryl tryptose broth is performed. If it shows positive, different dilutions are prepared and inoculated onto EC broth at 44.5°C ± 0.2°C. This test is called most probable number (MPN), in which number of coliform bacterial load in 100 ml sample can be determined by estimating growth in different dilutions and gas formation.

2. Membrane Filter Test

This test is performed to determine the actual number of coliforms present in a 100 ml sample. The sample is filtered through a membrane, which filters the bacteria. The membrane is then introduced to a selective medium and incubated at 37°C. A colony will develop after incubation on the areas where the membrane filtered the bacteria. The colonies can be counted to determine the number.

3. Colilert Test

In this test, a reagent known as colilert reagent is added to 100 ml of water in a sterile glass container and shaken vigorously and incubated at 35°C for 24 hours. The reagent contains salts, nitrogen and carbon sources that allow the specific growth of coliforms. It contains additional ingredients, such that the tube turns yellow due to presence of coliforms and starts fluorescing in the presence of *E. coli* which is indicative of faecal coliform. The colour obtained is compared with a comparator (which is part of the colilert test kit). If the yellow colour of the test is greater than the colour of the comparator, it confirms the growth of coliforms.

Rapid Faecal Coliform (FC) Test

This 7-hour test is useful for surface water examination and rapid analysis of water for determining faecal contamination of drinking water. The water is filtered through a membrane which uses a buffered medium containing lactose known as m-7-hour FC medium. It also contains a pH indictor to detect change in the pH.

4. Recommended Testing for Treated Sewage

Before making a standard recommendation for testing, there are many factors that require consideration. Firstly, maintaining a sterile microbiology testing facility is a very tedious affair for many urban local bodies (ULB) as part of the sewage treatment system especially in the rural settings. Secondly, it will be difficult to convince technical experts in the field of microbiology, as they will find better opportunities in other places. Also, there is no compulsion to perform these tests on a regular basis. The samples can therefore be transported to established labs for testing. In consideration of these factors, the MPN test will be the most suitable for testing treated sewage. Further confirmation can be carried out by plate count methods.

Quick and Approximate Measurement Methods

1. Test Paper Method

Test is performed by detecting the pH and sulphide. This is a qualitative test which will not give any exact value.

2. Cylinder Test

This test can be used to estimate the concentration of solute present in the solution in the absence of a colorimeter. Standard solutions of known solute concentrations are prepared in tightly corked 50ml Nessler's tube and stored, this gradient of concentration is used as reference to visually compare with the unknown samples.

3. Dissolved Oxygen estimation

An electronic meter and oxygen sensitive probe is required to detect the presence of dissolved oxygen in aeration tanks. However, the process is cumbersome and tedious. Instead, a tube method can be used to detect any residual dissolved oxygen. A 10 ml clean test tube can be held onto a weir overflow in a sideway manner to allow the tube to be filled with sewage. Once it overflows, the tube is taken and 2ml is procured. To this 2ml, few drops of manganous sulphate and potassium iodide is added and mixed. After keeping it for few minutes, a precipitate is formed. If the precipitate is yellow, it is indicative of dissolved oxygen and if it is white, it means dissolved oxygen is absent.

Processing Water Quality Test Data

There are certain key points to be remembered while evaluating the water quality data from the tests performed. Its important that the tests should be first verified before making any conclusions. Criteria for biological oxygen demand (BOD) state that the BOD for a unit should not be higher than BOD of any upstream unit. Also, Rotifiers, crustaceans and protozoans are definitely present if reduction in BOD is 75%. The BOD and Suspended solids levels should be plotted on a graph to measure any deviations or variances. The ammonia and ortho-phosphorous levels of the treated sewage should be less than the raw sewage sample. It goes the same for suspended solids as well. Winkler's method can be used to determine dissolved oxygen quantitatively and microscopic examination of microbes should be carried out at intervals. The results obtained can be compared to a recognized laboratory, wherein a deviation of 2-5% is permissible, and also any failure in test compliance is not subjected solely to the analysts.

To Do Activity

To perform the activity, divide yourselves into groups. At each stage, make the following observations:

- Fill 3/4th of a jar with water and add some dirty organic waste like grass or orange peels, a little bit of detergent, and a few drops of any colour ink. Close the jar, shake it well and keep it in the sun for two days.
- After 2 days, shake the bottle well before opening, pour a sample in a test tube and label it as Sample 1 : Before treatment. Note the smell.
- Bubble air through the sample in the glass jar using an aquarium aerator. Allow for aeration for many hours, and then leave the aerator in place overnight. Use a mechanical stirrer or a mixer if you don't have an aerator. Next day, pour another sample in a test tube and label as Sample 2: After aeration
- Form a cone with a filter paper. Put it in a funnel after wetting paper. Place the funnel on a stand. In the funnel, layer sand, fine gravel, and then medium gravel. Pour the remaining aerated liquid into the beakers via the filter. Allow no liquid to pass through the filter. If the filtered liquid isn't clear, filter it several times until it is.
- Pour a sample of filtered water in two test tubes. Add a chlorine tablet in one of these tubes and mix well. Label as Sample 3: Filtered and Sample 4: Chlorinated respectively.
- Observe all the samples carefully and just smell them.
- Answer the following questions as per your observations:
    - (i) Changes in appearance of liquid after aeration.
    - (ii) Change in odour due to aeration?
    - (iii) What was removed by the sand filter?
    - (iv) Did chlorine remove the colour?
    - (v) Does chlorine have an odour? How was the smell in comparison to wastewater?

3.4 Faecal Sludge Management

One of the most critical areas in the O&M of sanitary systems is the Faecal sludge management. The requisites of Faecal sludge management (FSM) are as follows:

Single Pit Latrines: It comprises of a pit-based system, wherein the toilet is connected to a pit. The faecal matter undergoes decomposition by bacteria present in the surrounding soil. If the pit gets filled, it cannot be used until it is emptied. Therefore, using a twin based latrine is much more ideal and efficient.

Twin Pit Latrines: Similar to the single pit latrine, these comprise of a pit-based systems connected to a surrounding absorbent soil. The soil absorbs the gases and leached water and the faecal matter is decomposed by the bacteria aerobically from the soil into manure. The decomposition takes a full year, wherein the filled pit is remained closed. Two pit systems are used such that if one pit is filled completely, the toilet can be connected to the second pit. No external management is required apart from pit cleaning and maintenance.

Septic Tank Type Toilets: In a septic tank, the faecal matter is decomposed by the bacteria through an anerobic process. The bacteria convert faecal matter into sludge, which keeps getting accumulated as the process continues. The sludge has to be removed periodically to ensure efficiency of the septic tank. However, these are much useful in urban areas in contrast to rural settings where management system and manpower will not be enough to carry out periodic removal of the septic tank, which ultimately results in the discharge of the septate on open ground or water bodies. Therefore, to avoid such malpractices, septic tank construction in non-urban settings will not be ideal, and requires much more integrated efficient management systems.

Faecal Sludge Management: Three plans are available for a typical faecal sludge management which

are trenching, building an FSM plant or co-treatment. The first two plans are part of the Faecal Sludge Management System (FSMS). Densely populated villages can have septic tanks or co-treatment plans with a pre-existing sewage treatment system. This pre-existing sewage system comprising of Sewage Treatment plants (STPs) are generally present in urban settings, which can be used as a co-treatment system with a village septic tank.

Faecal Sludge Management System: For areas where a co-treatment option is not feasible, or where collected sludge needs to be transported to long distances, a Faecal sludge management system (FSMS) can be employed. FSMS is put into practice by the use of the following methods:

1) Trenching: In these deep rows of trenches are used. It can be employed for those villages, whose faecal sludge generation is low. It is not appropriate for those villages neighboring water bodies like lakes, rivers etc.
2) Faecal Sludge Treatment Plant (FTP): It employs use of planted or unplanted drying beds, for villages generating a high amount of faecal sludge.

The District Water and sanitation mission (DWSM) or District water and sanitation committee (DWSC) develops a faecal sludge management plan based on the availability, capacity, location and number of pre-existing STPs and FTPs in the district. This proximity-based assessment can be interpreted in order to ascertain the number of villages for which co-treatment can be employed. Co-treatment saves the cost and time for building a new faecal sludge management plan. A thorough process of assessment and faecal sludge management comprises of several protocols. Firstly, a number has to be established for the houses containing single pits or septic tank toilets. Once ascertained, it must be ensured that emptying or desludging is carried out at regular intervals. Cleaning and emptying of these pits should take place in accordance to a financial model previously drawn by government or other schemes, which includes mechanical cleaning and transportation. The technology for sludge management should be employed based on the local conditions of the area. The DWSM/DWSC selects areas based on a number of factors, such as shed availability, ease of approach, parking areas, and any construction not posing a threat of contamination or disrupting the balance of the environment. The DWSM/DWSC should appoint agencies for the construction, maintenance, emptying etc. The agency should comply to standards in lieu with technical handling and experience. The agency should also produce a financial model for running the sludge management. Districts have the responsibility to make the operation and management feasible and sustainable.

Table 3.3 FSM Implementation Approach Matrix

Type of Containment	Context or Issue	Remedy	Alternative Option
Twin-Pit System	Leaks in the Y junction	Retrolift	Co-composting or solar drying with long storage is recommended
	Less than 1m between pits	Retrolift	
	Rim of pits are allowing rain water to enter pits	Retrolift	
	In high water table area or too close to the ground water source	Upgrade to insite treatment	Implement FSM
Single-Pit System	All single pits will have to be upgraded, pits close to ground water will be given priority	Upgrade to insite treatment	Implement FSM
Septic Tank	Applicable to census towns or peri-urban areas	De-sludge every 3-6 years	Implement FSM

Construction of toilets is gaining good speed, especially in completely rural areas. Usually, the toilets created in individual households are based on the 'twin-pit' system, and therefore, cause negligible amounts of faecal sludge. However, more traditional forms such as septic tanks and single pit systems are still being used, due to reasons like low upfront costs, less maintenance etc. Since these are increasingly getting constructed in areas with dense population, the drainage leads off to storm-drains or pathways, which carry the untreated sewage or 'black water' into water bodies. Along with this, dirty water from laundry and bathing, also called as 'grey water' is run off in the same manner, causing untold levels of pollution.

Reasons to Treat Faecal Sludge

1. Sludge does not get treated in septic tanks, and single-pit systems require months to treat the sludge to a minimum degree.
2. The toilet can get blocked and even overflow, if the single-pit or septic tank system is at full capacity.
3. Overflows from the toilets can contaminate a large area, and cause wide-spread diseases.
4. Most of the residents do not know how to de-sludge or maintain the systems, and this can lead to bigger problems in the long run.
5. Vacuum trucks that empty the systems work irregularly, and generally dump the sewage into water bodies without treating them at all.

Faecal sludge toxicity is easily 10 times higher than that of raw sewage. Hence, proper treatment of faecal sludge is absolutely critical. Figure 3.21 illustrates the various ways sludge can be managed at site, it can be primarily disposed off in water or land and left undisturbed it will deteriorate or degrade slowly. Sludge can be mixed with vegetable waste 2-3 times its volume, tossed at regular intervals and left like that it will turn into fertilizer that can be used as manure. It can be left to settle down and layered with sand to form a dry bed. It can be treated at Waste water treatment plants in the Municipal Corporation for an efficient treatment.

Planning and Implementation of faecal sludge management

Step 1- Retrofitting of Existing Toilet Systems

1. Know your data- District officials are suggested to make a record of households with septic tanks or single-pit systems.
2. An effort should be made to convert single-pit systems to twin-pit systems. If funds and land availability permit, vermi-filter and/or bio-gas plants can be connected to the toilets. Additionally, soak pits are also an option for treatment of effluent from drainage pipes.
3. A schedule should be created for regular de-sludging of single-pit/septic tank systems. Strict adherence to the plans should be maintained, otherwise waterlogging and overflowing might occur.

Step 2- Locating Existing STP and FSMPs

1. The district government must create detailed records of Sewage Treatment Plants (STPs) and Faecal Sludge Management Plants (FSMPs) that are available in their territory. These records should also have data on the capacity and working mechanisms of these plants, apart from just their numbers and locations.
2. Analysis of existing STP/FSMP plants should be done to confirm the size of area that they can service. In essence, this activity not only ensures efficient working of all the available of all the plants and territories, but also makes sure that new plants are not constructed in lands that already have existing treatment plans.

Step 3- Using Existing Infrastructure for Co-treatment

1. The working procedures of all existing operators should be licensed. Strict rules and regulations should be imposed on all contractors, government and private.
2. De-sludging activities should be converted to entirely mechanical mechanisms. Efforts should be made to enforce adherence to 'The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act' of 2013. Plans should be put into place for penalization of recurring violators.
3. Co-treatment of sludge from related territories should be made mandatory.

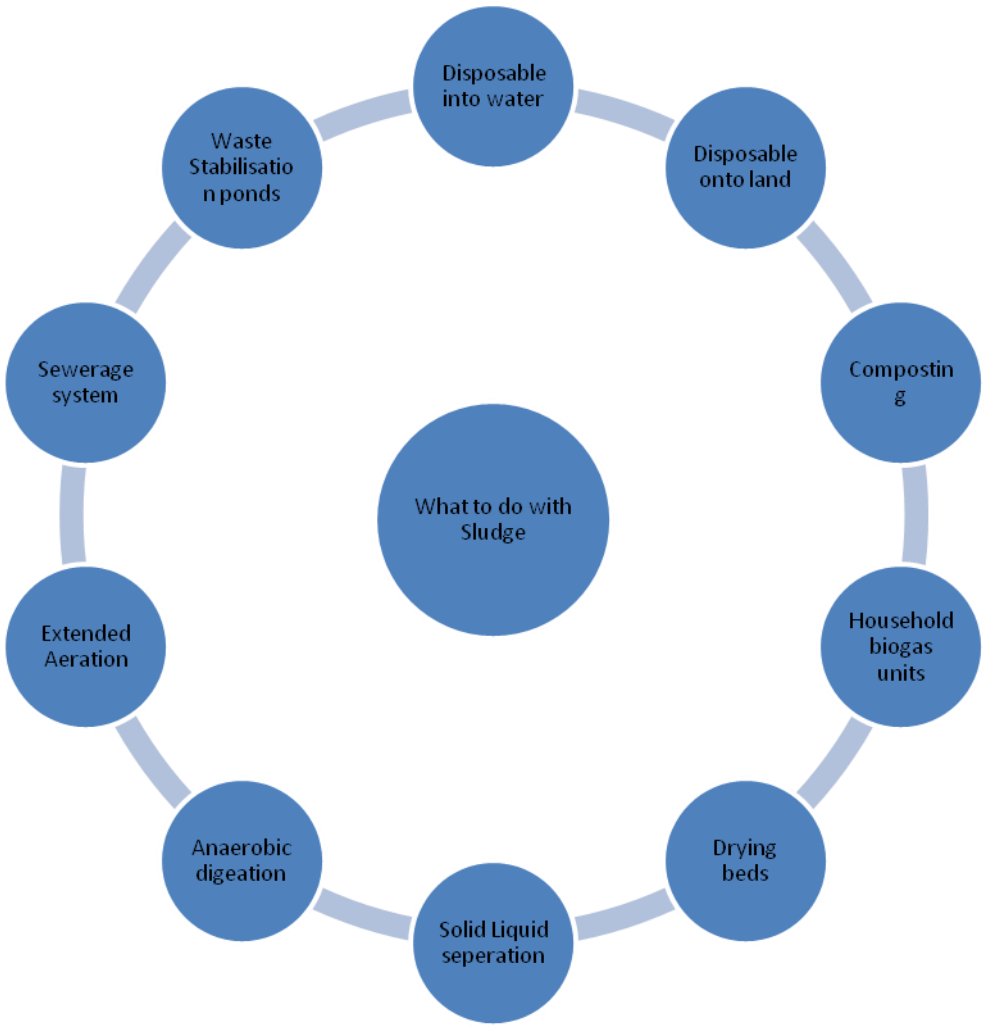


Figure 3.21 Sludge Treatment

Safe Transportation and Clearing

1. The machinery involved in emptying out the pits and septic tanks should be fitted with adequate safety gear to guarantee protection.
2. All the trucks working for sanitation purposes should be registered, and their service radius should be extended to cover rural areas. Regular maintenance should be made mandatory, confirming leakage-free status of vehicles and machinery.

Equipment that is commonly used for de-sludging:

1. Vacuum Truck
2. Tractor-mounted vacuum
3. Tanker
4. Vacuum pump

Step 4- Planning a New FSTP

In-case there are no plants to service a reasonable size of area, and co-treatment is not a practical option, a new FSTP plant will have to be constructed. The responsibility falls upon the DWSC to plan, set-up and maintain smooth operations concerning a new plant. Like always, plans, equipment, and mechanisms should be created in such a manner, that the running of the plant is 100% safe. While a higher priority must be given to safety, different options should be explored to drive the efficiency as high as possible. Altogether, the collection, transportation, treatment and further disposal of the waste material should be up and running all-round the year.

Faecal Sludge Treatment Unit/ Faecal Sludge Management Plant (FSTP) is a place that has been fitted out and designated for the task of treating septage that is collected from septic tanks/ single-pit systems. Using vacuum trucks, septage is collected from household, and is taken to FSTPs for processing. There, various technologies and mechanisms are employed to treat the septage, and the resulting materials are disposed of by environmentally-safe methods. Septage is the upper layer of excreta and water that is formed in septic tanks/single-pit units, after they have been left untouched for a long time. Usually, the sewage is only emptied after the containment units are at full capacity, and that takes a long time. This partially degraded form of waste is even more harmful than the raw form of sewage.

Following steps should be carried out

1. Identify and register an appropriate piece of land.
2. Find out which villages need servicing and are in the Area of Influence (AOI) of the new plant.
3. Based on the data collected, plans should be made for the set-up of a new plant of appropriate handling capacity.
4. Work in co-operation with an approved technical agency/ expert, with at least 3-5 years of detailed experience in the direct construction of FSM projects.
5. Enlist entrepreneurs and various businesses to put forth operation models. This would help to take a look at various perspectives and pick the option that is best overall.
6. Search and confirm contracts with different parties, to set up multiple avenues for sale of by-products, like compost. For example, local farmers, municipality, forest department etc.

Site Identification for FSTP

The DWSC should take care of the following points before confirming the location of a new FSTP:

1. The site should have appropriate roads for approach, and there should be adequate space for sheds, for parking of various vehicles and storing equipment.
2. It should be not be close to a water body, as this can result in unwanted contamination.
3. Preparation of the site should not involve significant damage to the environment.
4. It should not be near a densely-populated area. Otherwise, it can cause harm to the local residents and their lives.

Role of District Administration

1. Design, plan and set-up a district level strategy for efficient working of FSMs.
2. Effort needs to be put in to ensure safe and sanitary processing of all the waste material that is collected.
3. A thorough list of STPs/FSTPs should be created, along with information about their vehicles, equipment, and work mechanisms.
4. Development of business models, in co-operation with in-house as well as other private agencies.
5. Engage shareholders and people from various walks of life, through seminars, workshops, even social media. Through these methods, spread of awareness can increase by exponential levels.

6. Ensure strict adherence to Manual Scavengers and their Rehabilitation Act of 2013, and shoot for maximum use of machinery. Violators should be penalized heavily.
7. Training programmes should be held regularly. This would help new masons learn how to properly construct sanitation systems, and will also serve as a revision course for already-employed masons.
8. Contracts should be conducted with varied markets and dealers. Based on the dealings, sourcing of equipment and reagents; affordable maintenance of systems; good selling price for by-products can be obtained. These efforts can make the plants economically viable.
9. Achieve key goals of FSM programmes in a tightly-scheduled manner. Arrangement for sourcing of subsidies and government funds are initial steps that are quite critical.
10. Keep a track of the plants' workings; take pro-active steps to keep errors and shutdowns to as low a count as possible.

These are the kinds of trucks that are used for de-sludging of septic tanks/single-pit systems. Households can contact these agencies as per schedule, and regularly empty their waste collection pits.

A Large-Dense Village (LDV) or even a cluster of villages, can employ these methods for their Faecal Sludge Management

1. **Deep Row Entrenchment (Trenches)**

   This is an option for areas which have a lower population count, as the quantity of faecal sludge produced is quite low. The sites chosen for such a purpose should neither be close to a village nor to a water body. It should also be ensured that the site does not have a high ground water level, as the leakage could percolate through the layers and contaminate the water.

2. **Unplanted Drying Bed**

   This method is fairly simple, even with the plumbing technology that is applied. Used for faecal sludge management of villages, it is a very effective way of dealing with sewage. The sludge is poured over the 'beds', and the water is allowed to makes its way underground through various layers. It gets collected at the bottom of the bed via perforated pipes, and is lead off to a different section for treatment. The sludge that remains on the top dries up over time.

   The raw sludge should be poured over the bed, in a specific thickness level. This would help speed up the drying process. The layers of sand and gravel above the pipes allow the water to leach through, while holding the solid sludge up. After about 15-20 days, the moisture content can decrease by as much as 60%. After the sludge has dried up to a definite stage, it can be removed from the bed, and sold to agricultural farms as manure or compost.

3. **Planted Drying Beds**

   Third option of treating the management of faecal sludge is called Planted Drying Bed. This treatment offers two benefits - it requires less time and is more enhanced than the unplanted bed, because of the plants' transpiration process. One of the major benefits of the planted drying bed treatment is that there's no need for the filter to be de-sludged after individual cycles of drying or feeding. With this time-consuming process out of the picture, fresh sludge is applied directly on the layer. This direct application causes no harm as the porosity levels of the filter are maintained by the plants. Another benefit of this treatment offers is that it helps stabilise the sludge, while also allowing water to pass easily through the gaps created by the roots of the plants. This also helps in dewatering the sludge. In order to support the vegetation and give them no harm, sand and gravel are used to make these beds. With this technology, the filtrate is collected in the drains as it flows through the sub-layers of the applied sludge, instead of the discharge**.**

Challenges in FSM

There are many challenges faced in the faecal sludge management especially in the rural areas. One of the most important challenges is emptying the pit. On many occasions, the pit is not emptied appropriately which hinders use of the toilets. There are also other challenges associated with this. Two pit systems are much more efficient in comparison to one pit latrines. However, construction of second pit and the connection to the toilets is often tedious, because of which the toilet cannot be used efficiently. This results in issues such as open defecation. Also, the filling up of a pit is a scare among the locals who lack awareness, which limits the access of toiletries. Other challenges include the inaccessibility to septic tanks in the rural settings. Septic tanks are generally placed under toilets and are sealed off which makes it difficult to access. Access of desludging mechanisms to rural areas is also a tedious process. The construction of septic tanks is also hampered with, such that standard size requirements are not met despite government guidelines. As a result, faecal matter decomposition does not take place successfully due to which the tank gets filled faster. Septic tanks are emptied into gutters and nallas, which is extremely hazardous to the environment. Due to lack of appropriate infrastructure and capital, maintenance and operation becomes a tedious task, since there are budget cuts because of which inefficient machinery, labor are put into practice. This is also one of the major reasons, wherein the sludge is not treated properly and dumped into water bodies, thereby contaminating it. Sometimes, rural sludge is introduced into urban sludge treatment system, which adds additional pressure. A much-needed awareness is due among the locals, such that waste treatment and construction of a FSM plan should be of utmost priority.

Case Study 11: Wai Municipal Council

At the foothills of Western Ghats in Maharasthra, there is a small town called Wai, right along the banks of the Krishna River. With an area of about 3.6 sq.km., it has an approximate population of 42,000 (36,025 was the number as per Census 2011). On an average, it receives about 1000mm of rainfall in a year, spanning over a period of 4-6 months.

The city created history when: on May 30, 2018, Wai Municipal Council started the very first Scheduled De-sludging Service in all of India. The Faecal Septage Treatment Facility was constructed adjacent to the Municipal Solid Waste Management Facility, and has been operational since then. At the time, the facility consisted of 70KLD holding-cum-equalization tanks (4 cylindrical containers). Haulage vehicles transported septage to the containers from all over the city.

In the plant, the influent septage would pass through a filter the entry port of the tanks. This initial screen served the purpose of separating debris and other unwanted materials of a larger size. Further, the septage would be pumped upwards into a de-watering unit, that had been constructed at a height. Basically, a mechanical filter press, it was mounted on the top of a container that was already double-stacked. At the juncture, a polymerised filter was added to increase the separation between the solid and liquid waste matter. Towards the end of the mechanism, it was reported that resultant effluent contained 25% solid matter. Accordingly, it was a clear implication that the particular process removed liquid waste to the tune of 10 times, when compared against the received septage.

As stated earlier, the capacity of the plant was at 70 KLD. The liquid run off that got separated from the semi-solid effluent, would then pass through an anaerobic chamber. Subsequently, it would be led off to a modified version of Moving Bed Biological Reactor (MBBR) fashioned facility. Post that, the stream would be passed at force through a pressure sand filter, along with an activated carbon filter, serving as tertiary treatment step. In the final step for liquid matter, an ultra-violet chamber would be employed to provide maximum sterilization of any remaining organic matter. The water threated in such a manner, would be used for running various services in the plant itself. Additionally, it would also be sent off into the city to be used for gardening, construction and various other purposes.

Meanwhile, the part of effluent containing more solid matter would be passed along to a conveyor belt. The conveyor was part of a pyrolysis plant, and had thus been placed into the lower-most part of the shipping container. There, the waste was heated quickly to a temperature of about 700-800 centigrade, which would then lead to the formation of a bio char with approximately 20% of moisture levels. The thermal energy produced in such a manner was quite high, and was used to run the mechanisms of the pyrolysis plant. This was done with the use of agricultural briquettes, produced by heating the waste to such high levels. While they were also used for pasteurization and drying functions, bio-char would just get dumped in the lower levels of the plant facility.

Wetland Treatment

The primary purpose of the filter media is to serve as a filter for separation of solids, so as to prevent the growth of bacteria and vegetation. Although facultative and anaerobic bacteria can break down most organic media, the vegetation releases oxygen to the root zone for aerobic bacteria to grow and break down the organic media. The plant roots have an essential role in supporting the permeability of the filter.

Design Considerations

The structure of a horizontal subsurface flow constructed wetland is dependent on the treatment target as well as the qualities of the influent. It includes the amount of parallel flow paths and compartmentation. The removal efficiency can be calculated from the surface area, while the cross-sectional area indicates the maximum flow possible. As a rule of thumb, an equivalent surface area of 5-10 m^2 is required per person.

Pre-treatment and primary treatment is required to ensure efficient treatment and avoid clogging. The influent can be aerated by an inlet cascade to support process that depends on oxygen such as BOD reduction and nitrification. The bed must have a lining of an impermeable liner to avoid leaching. It must be wide and shallow to maximise the flow stream of water in contact with the vegetation roots. For even distribution of flow, a wide inlet zone must be implemented. This also helps in preventing short circuiting. The outlet must be made variable for adjusting the water surface so as to ensure optimal treatment performance.

The most common gravel used to fill the bed are small, round and evenly sized gravel 3-33 mm in diameter. The bed is filled to a depth of 0.5-1m. To prevent clogging, the gravel must be clean and free of fines. Sand may be used in place of gravel, but it is more susceptible to clogging. Recently, alternative filter materials such as PET have been used successfully. To ensure subsurface flow, the water level is maintained at 5 to 15cm below the surface of the wetland. Native plants with deep and wide roots capable of growing in a wet and nutrient-rich environment can be used. The most common plant used is the *Phragmites australis* as it forms horizontal rhizomes that penetrate the entire filter depth.

Health Aspects/Acceptance

Successful pathogen removal is achieved by natural decay, predation by higher organisms and filtration. Since the water level is maintained below the surface, contact between pathogenic organisms with humans or wildlife is minimal. The risk of mosquito breeding is reduced as there is no standing water. The wetland is easy on the eyes and can be constructed in wild areas or parklands.

Operation & Maintenance

In the first season, it is essential to eliminate weeds that may hinder the growth of wetland vegetation. Over time, the gravel will become accumulated with solids and bacteria. The filter material at the inlet will need to be replaced by 10 years or more. Maintenance activities should be focussed on ensuring that primary treatment retains its efficiency in reducing the amount of solids in the wastewater before it enters the wetland. It must also take care to remove the growth of trees in the area as the roots may harm the liner.

Applicability

A common issue with the wetland is clogging. Hence the influent must be well settled during primary treatment before it flows into the wetland. This technology cannot be used for untreated domestic water i.e blackwater. It is a good choice for communities that already have their form of primary treatment eg Septic tanks.

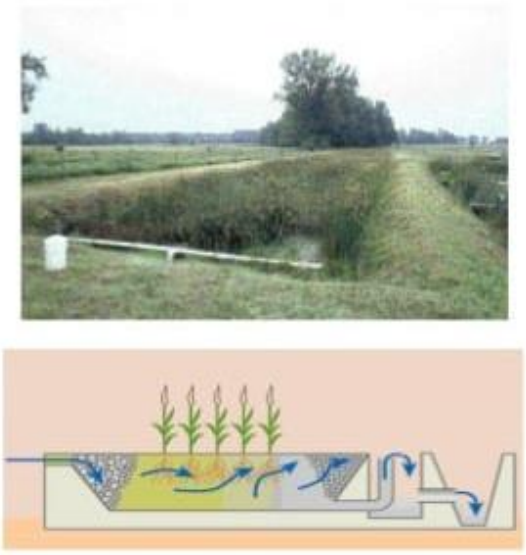


Figure 3.22 A Constructed Wasteland

The horizontal subsurface flow constructed wetland is a good choice where land is cheap and readily available. Considering the volume of water and area requirement of the wetland, it can be constructed in small sections of urban areas, as well as for semi-urban and rural communities. It can even be designed for single households. The technology is best suited for warm climates, but it can also be designed to be used in cold climates and periods of low biological activity. Depending on the climate, reusing the effluent could lead to losses due to high evapotranspiration, which can be seen as a drawback of this technology.

Although CWs (Constructed Wetlands) have immense potential for use in developing countries owing to their low cost and easy maintenance, these systems have not yet been used widely in India due to lack of awareness and local expertise in developing the technology in the country. India's first CW (with an HF of 2700m^2) was constructed at Sainik School, Bhubaneshwar in Orissa. It was planted with two species of macrophytes viz. *Typha latifolia* and *Phragmites karka*. Currently, the wetland treats about 180-200m^2 of wastewater. The BOD and nitrogen removal is estimated to be 67-90% and 58-63& respectively (Juwarker et. al, 1995)

An HF demonstration unit was built by EPCO at Ekant Park in Bhopal for an intended treatment of 70m^3 per day. A septic tank of 35m^3 was installed and planted with *Phragmites karka*. The monitoring results (April 2002 – September 2003) showed excellent removal rates for COD (77%), TSS (79%), Coliform bacteria (99%) (Vipat et. al, 2008). Another field HF case study was observed at Ujjain Charitable Trust Hospital and Research Center, Madhya Pradesh. The system was filled with gravel to a depth of 10-25mm and planted with *Typha latifolia*. It treated 8m^3 per day with a surface area of 80m^2 and showed good removal for BOD (75%), TSS (78%), NH_4(68%) (Diwan et. al, 2008). Another HF system at Ravindra Nagar Township, Ujjain, Madhya Pradesh, filled with zeolite to a depth of 3-9mm, was monitored from 2006 to 2008 and showed NH_4 removal of 70%.

Several pilot studies were carried out in the last 10-15 years. Some examples are in Mahendragiri, Tamil Nadu, for domestic wastewater, and at Mother Dairy, Delhi, for dairy wastewater by the CPCB and GTZ. Another pilot study was conducted for a small residential area in Ujjain, Madhya Pradesh, where a horizontal flow system of 42m^2 planted with *Phragmites karka* showed, after five months, removal efficiencies of 78% for NH_4-N and TSS, and 58-65% for P, BOD and TKN (Billore et. al, 1999).
In 2000, an HF system that receives the outfall of sewage from Ravindra Nagar residential colony, Ujjain, was constructed. The wastewater undergoes primary treatment in sedimentation tanks and is then sent to the HF system with an effective surface area of 300m^2 and hydraulic loading of 40m^3 per day. The gravel bed was planted with *Phragmites karka*. The removal efficiencies of organic nitrogen and ammonium nitrogen were 86% and 40% respectively (Billore et. al, 2006).

The CDD society is a non-profit NGO in India that promotes the use of DEWATS and has implanted more than 350 projects in South Asia. (CDD, 2013). The preferred treatment is a modular system with a design non-dependant on energy, consisting of 4 treatment phases; a septic tank or UASB, an anaerobic filter or baffled reactor, a planted gravel filter (HF) and in some cases, a polishing pond. About 30 DEWATS systems have been constructed in India, most of them near Bangalore and in regions of Karnataka, but also in Maharashtra, Kerala and Tamil Nadu. The volume of wastewater treated in these plants range from 1.5 to 615m^3 per day, and the size of the HF CWs range from 1.4 to 14.6m^2 per m^3 of wastewater, with an average of 5.7m^2/m^3. In most cases, the system shows a reduction in BOD and COD of 97-99%.

3.5 Sludge Management: Reuse and Disposal

Dewatering sludge eliminates the water content, making it easier to handle and transport to a treatment facility or disposal. Dewatering can be accomplished mechanically or with the use of drying beds. Chemicals (coagulants and flocculants like lime, for example) are frequently used in mechanical dewatering to improve the process. Mechanical dewatering is more expensive than drying beds, however it is employed when there is a lot of waste and area is limited. The filtrate from the dewatering unit must be processed further in a waste stabilisation pond, anaerobic baffled reactor, built wetlands, or aerobic treatment systems, among other places.

Unplanted Sludge Drying Bed: It's a basic, permeable bed that separates the sludge's leachate/liquid from the solids. It also allows the leachate to be collected separately at the bottom and the solid sludge to be dried by evaporation, minimising microorganisms. The bed structure is coated with concrete or plastic sheeting and sloped properly for leachate collection. Perforated pipes go down the bottom of the drying bed, draining the leachate. For improved liquid penetration, sand and gravel layers are put on pipes. During the monsoon, the bed can be covered with a roof to keep rain water out of the beds. Because the sludge will not dry efficiently, it is deposited in layers of no more than 20-30 cm in the bed. The sludge will dry out within 10-20 days, depending on the weather, and can be removed for further treatment. Approximately 50-80% of the sludge/septage volume drains as liquid. Only when the dried sludge from the previous batch has been removed can new sludge be put to the beds. Where there is a lot of sludge production, multiple drying beds can be built and used at the same time. After that, the leachate is treated in a stabilisation pond or another treatment system while the solid sludge is composted or processed in conventional sewage treatment plants.

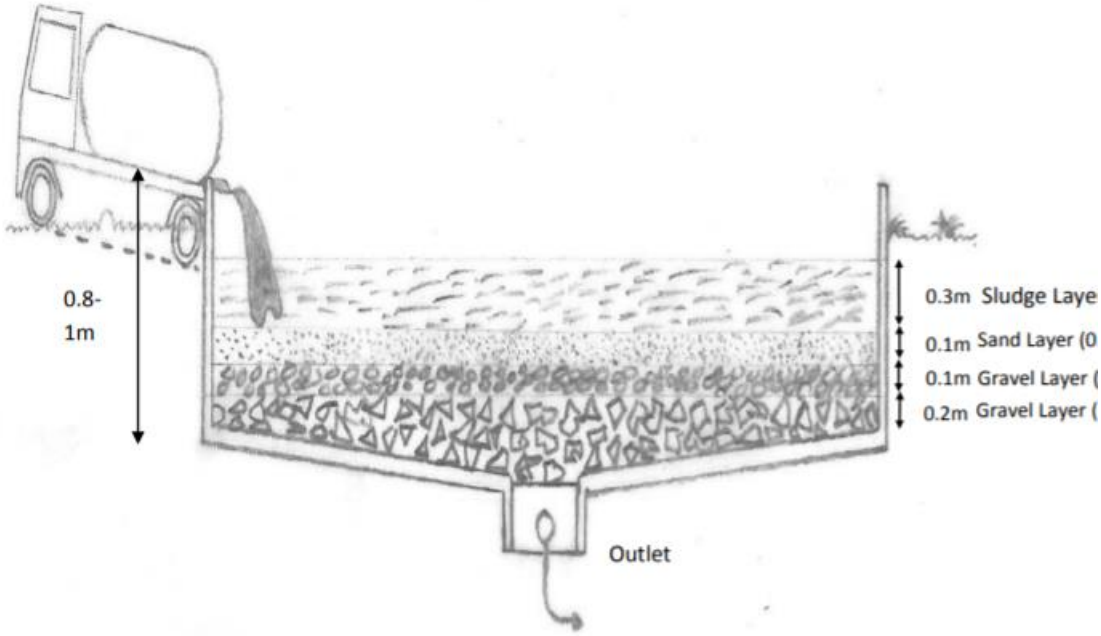


Figure 3.23 Unplanted Sludge Drying Bed

Planted Sludge Drying Bed: A planted drying bed is comparable to an unplanted drying bed except that it allows for more transpiration and also it does not require de-sludging between feed/drying cycles. Fresh sludge can be placed immediately on top of the previous layer; the filter's porosity is maintained by the plants and their root systems. This technique has the advantages of dewatering and sludge stabilization. Depending on the environment and drying, the sludge can be removed after three to four years. However, it is recommended that fresh sludge not be applied for one to two years prior to cleanup. As a result, the treated sludge solid is almost pathogen-free and may be utilised as bio-solid/manure in agriculture or as a land fill material. The leachate has travelled through the plants and is comparatively treated, but it still has to be treated further in a polish plant or elsewhere before being disposed of or reused. As the sludge drying beds may have some odour, it is advisable that such beds are constructed as far away from the habitations for hygiene purpose. However, odour is reduced in planted drying beds.

Co-Composting: Treatment of sludge/septage with biodegradable municipal solid waste is referred to as co-composting. Sludge/septage has a lot of moisture and nitrogen, whereas biodegradable trash contains a lot of organic carbon and has strong bulking characteristics. Combining the two can improve the composting process and provide a better end result in the form of manure. This system is capable of treating both liquid and dewatered sludge/septage. Composting can be done on the ground or in a vessel. Composting in a vessel, on the other hand, needs a constant supply of moisture and air, as well as mechanical mixing, making it inappropriate and inefficient for decentralised and tiny wastes. As a result, open treatment is most commonly used in rural and semi-urban regions. For better-quality manure, earth worms can be added to the composting process. Typically, the weight of the output (compost/treated waste) is 50-60% of the total input (sludge + solid waste) in aerobic compost treatment. On the ground, the mixture (sludge and solid trash) is heaped into long heaps/rows called windrows, or it can be handled partially underground in long pits/trenches. To prevent rainwater percolation in the heaps and excessive drying of the mix, the system may need to be covered or covered with a roof. For cost-effectiveness, the cover might be

built of net attached to metal/bamboo poles. Waste is only deposited in trenches/pits for treatment in vermi-compost technology. Furthermore, the bottom is coated with plastic sheets to keep moisture out. On the top layer of piles, earthworms from the local market are introduced. To guarantee worm life in such a system, temperature and moisture must be regulated. As a result, water is sprinkled on the piles as needed. Gunny bags/jute bags can be used to keep the temperature and moisture in the piles. The compost generated can be utilised as manure in agriculture.

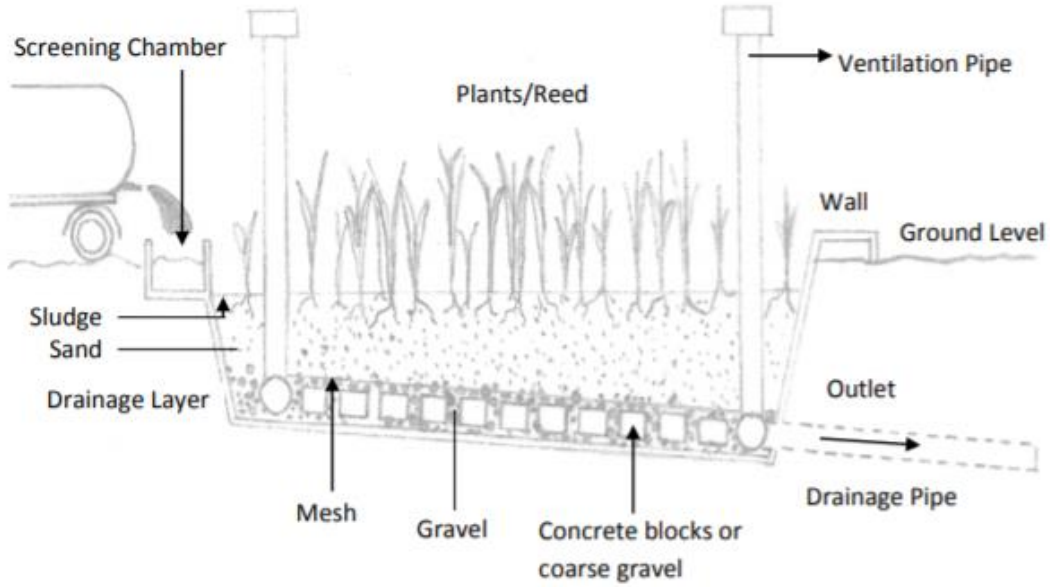


Figure 3.24 Planted Sludge Drying Bed

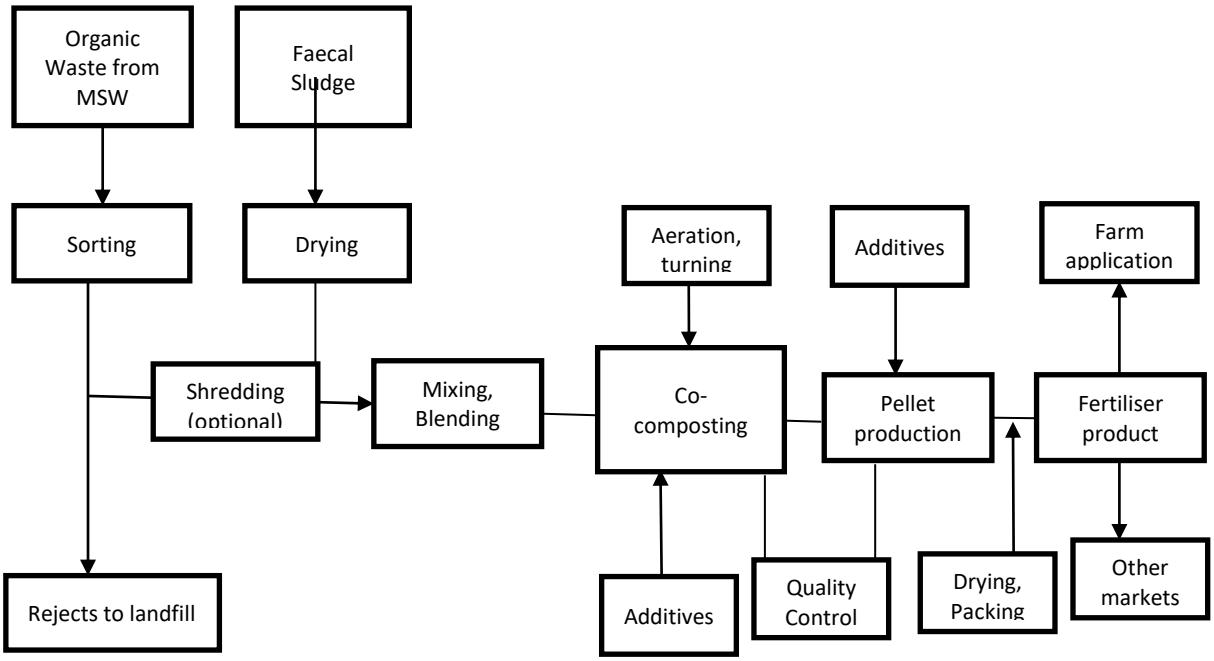


Figure 3.25 General process flow on co-composting and pellet production

Co-treatment of Septage in Sewage Treatment Plants: Co-treatment of septage/sludge along with domestic sewage at a sewage treatment plant (STP), if available, is also one of the options for its

treatment. However, STPs are not very economical and has very high O&M costs. Moreover, the sewage treatment plants should have adequate capacity to accept the septage without hampering the functioning of the sewage treatment plant.

Land Application of Biosolids: Sludge/septage that has been digested and stabilised, also known as bio-solids, can be applied to land for cultivation. The stabilised sludge from the drying beds may usually be applied to land. However, if the ground water table is too high, such a system should be avoided since it may contaminate the ground water. Manure spreaders, tank trucks, and specifically specialised vehicles are used to disperse bio-solids over the ground surface. The rate of application should be determined by the soil and biosolid properties. Biosolids can help enhance land's water retention capacity while also reducing soil erosion.

Table 3.4 Project Outlay of Village-level Zero-based Solid Waste Management Project for the Population of 2000

Particulars Quantity Cost	**Quantity**	**Cost (Rupees)**
Non-recurring expenses		
Cost of shed construction of 36' x 24' (Non one-time investment)	1	1.30
Cost of tools and accessories (cleanliness aids such as hand gloves, masks, soaps, tasla, kassi, panajli, etc.)	2	0.05
Tricycles	2	0.20
Toilet	1	0.022
Subtotal		1.572
Recurring expenses		
Payment to workers for handholding support and handling of solid waste, like collection, transportation, segregation @ `4,500 for (9 x 9,000) months	2	0.81
Supervisor on sharing basis @ `10,000 pm for 5 GPs (9 x 2,000) months	1	0.18
Misc. expenditure @1,000 per month		0.09
Subtotal		1.08
Monthly expenditure		0.12

The waste was collected and taken to the shed for segregation. The biodegradable waste was divided into two categories: the first was used in the production of vermicompost, while the other was used for making household items. Non-biodegradable waste was further segregated into different categories—plastic and plastic goods, polythene, glass and glass bottles, tetraProject Outlay of Village-level Zero-based Solid Waste.

Surface Disposal of Bio-solids: Stockpiling of biosolids or its application underground in landfills are both examples of surface disposal. When biosolids cannot be utilised, this is done. Bio-solids should not be combined with municipal solid trash in landfills while filling under the earth. It might be given its own location. The dumping site should be far away from waterways and human settlements. Where the ground water table is particularly high, such a system should be avoided, or a plastic liner on the ground should be installed. To preserve cleanliness and avoid flies and stray animals, the

trash should be covered with dirt. This method should be used only when bio-solids cannot be further treated or reused as this system occupies space and there are not benefits out of it.

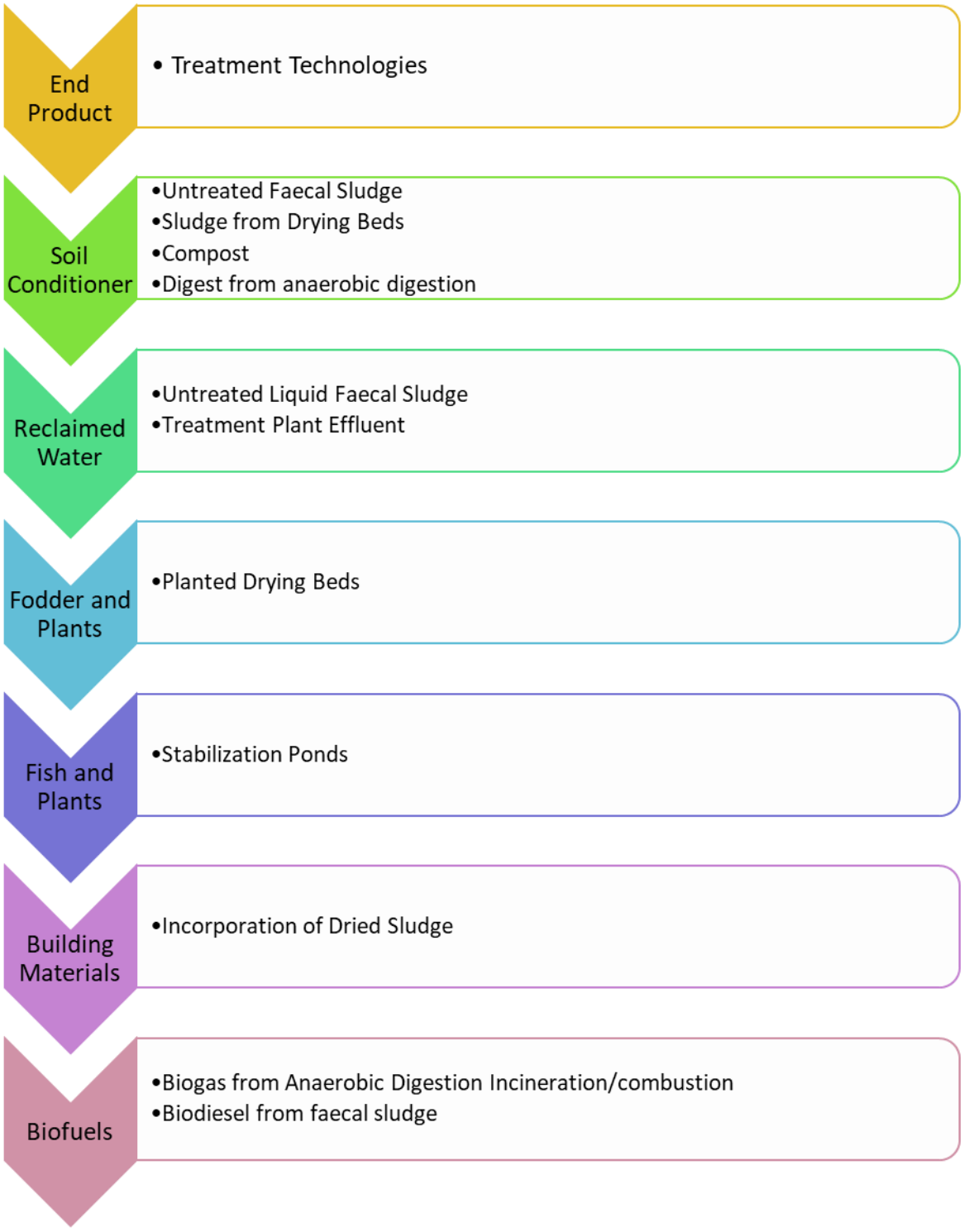


Figure 3.26 Selection of Treatment Technologies Depending on Desired End Product

Chapter Summary

The goal of sewage system maintenance is to keep it running smoothly. The process should be followed by Inspections and studies of facilities by O&M professionals reveal sewage system issues. To tackle the issues, they must prioritise rehabilitation efforts for each institution. In order to

safeguard natural water bodies, sewage treatment is a multi-stage procedure. Various wastes are found in sewage. Incorrect collection and treatment of sewage and sediments may harm human and environmental health. A treatment plant's main goals are to clean sewage and fulfil discharge criteria. Soil solids, organic matter, nutrients, pathogens, and other contaminants are reduced by treatment plant workers. The facility must also preserve the receiving water body, which can only take so much pollution before degrading, as well as its workers' and neighbours' health. The volume, physical, chemical, and biological aspects of sewage are constantly changing. Seasonal, monthly, weekly, and daily variations in sewage volume and composition cause certain modifications. Another kind of change is long-term, as a consequence of changes in local demographics or economics or technology. How effectively a treatment plant operator can see possible issues may affect the quality of the received water and public health. A complete understanding of current sewage treatment facilities and technologies is required. Lesser known but more expensive sludge treatment methods exist. Untreated sludge stinks and is pathogenic. Toxin-binding sludge stabilisation reduces odours, pathogens, and biodegradable toxins, while reducing heavy metal leaching into groundwater. They may be safely utilised or disposed of. STPs treat sludge, which is made from organic debris removed from sewage, as well as the quality and amount of sewage entering the plant.

Model Questions

1. Draw up a work plan to establish collection, transport, treatment and disposal systems that align with local systems, by working with local authorities responsible for excreta management.
   Hint: Apply existing national standards and ensure that any extra load placed on existing systems does not adversely affect the environment or communities.
2. Define systems for short- and long-term management of toilets, especially sub-structures (pits, vaults, septic tanks, soakage pits).
   Hint: Design and size sub-structures to ensure that all excreta can be safely contained and the pits desludged. Establish clear and accountable roles and responsibilities and define sources of finance for future operation and maintenance.
3. Outline an SOP (standard operating procedure) to desludge a containment facility safely, considering both those doing the collection and those around them.
4. How will you ensure that people have the information, means, tools and materials to construct, clean, repair and maintain their toilets?
   Hint: Conduct hygiene promotion campaigns on the use, cleaning and maintenance of toilets.
5. Confirm that any water needed for excreta transport can be met from available water sources, without placing undue stress on those sources.
6. Recommend an excreta management programme in difficult times like that of a flood, cyclone or excess rains.
7. Which constituents cannot be removed from waste products by most treatment technologies?
8. How can that problem be solved?
9. Why is the volume an important parameter for describing waste products?
10. Which listed parameters can be monitored in the field or in rural areas?
11. Which listed parameters need to be measured in a laboratory? What other parameters could be important? Where are they relevant?
12. Are the nutrients in faeces readily available?
13. How can eutrophication of a lake be reversed?

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Chapter 4 Sanitation Infrastructure

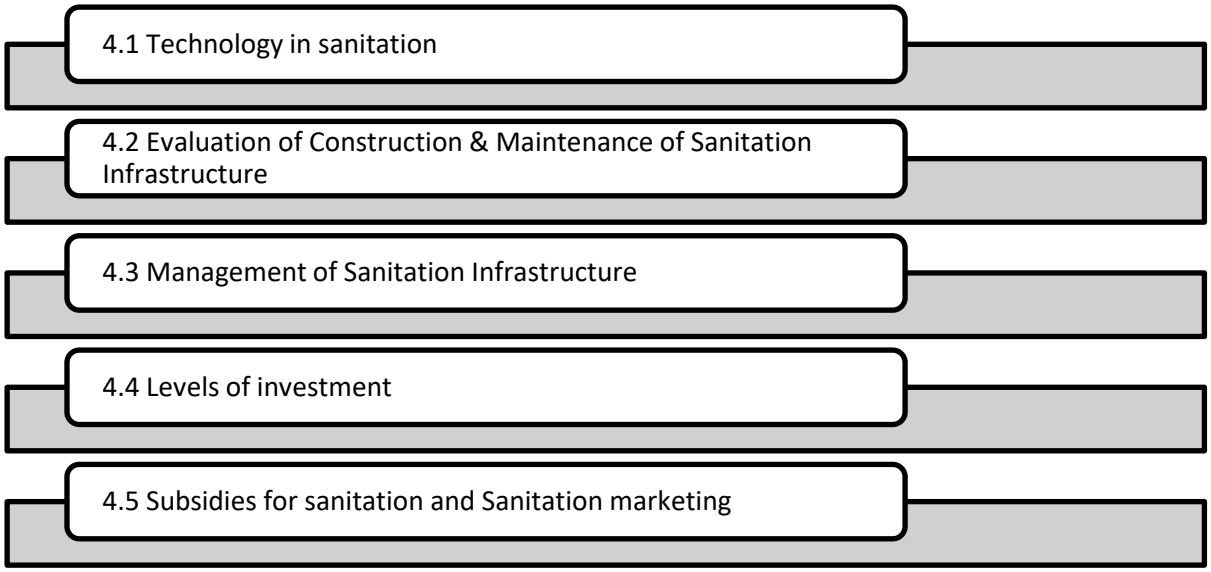
Introduction

Drinking water provided by the local authority is considered a free service. This is slowly changing, at least in the urban sector, as individuals become conscious of their need to pay for services. Still, nothing has changed in the rural sector. Similarly, urban residents are aware of the dangers of open defecation, but not rural residents. Even in cities, about 12.6 percent of the population defecates in the open. Recognizing the significance of MDG for water and sanitation, it is necessary to end open defecation, however finances for sewerage and sanitation are lacking. Except in certain metropolitan regions, the public is hesitant to pay their dues. Even in the urban sector, many local governments' revenues do not cover present sewage costs, much alone future expansion. In order to achieve comprehensive cleanliness, a careful mix of location-specific technology and prudent financial management is required, as well as novel project delivery methods. Operations and maintenance costs includes recurring costs for electric supply, supplies like soap, hand wash, toilet paper, sewage disposal (depending on the method adopted), staff costs and miscellaneous supplies. These costs are generally met by a combination of user fees and advertisement revenue by the private operator. In addition to the above, a small scale commercial complex can also be constructed, the revenues of which may be used to offset a part of the maintenance costs.

Objectives

- To provide description of the various technology interventions in leading to development
- To define specific parameters needed for maintenance of sanitation infrastructure
- To understand temporary sanitation arrangements and their management
- To identify the resource allocation for the construction and maintenance of the sanitation infrastructure
- An overview of subsidies available to the stakeholders by the state (Government & Private)

Chapter Structure



4.1 Technology in Sanitation

Maintaining ODF is crucial to India's sanitation plan. Sanitation is a behavioural and physical intervention aimed at breaking the illness cycle. This chapter focuses only on actually selecting the most suitable system and technologies based on local needs, requirements and habits. In addition,

the sanitary system should be designed using the existing infrastructure. A system is a series of technologies that each process the products until they are finally disposed of. In other words, cradle-to-grave processing of all waste products should be considered. Sanitation should provide a healthy and safe environment. A sanitation system must include the following:

- Protect and promote health — it should keep disease-carrying trash and insects away from humans, both at the toilet site and in surrounding residences and the surrounding environment.
- Protect the environment - prevent pollution of the air, soil, and water, replenish soil nutrients/resources, and save water and energy.
- Keep it basic — the system must be self-sufficient in terms of locally accessible resources (human and material). Where technological expertise is scarce, simple technologies should be prioritised.
- Be affordable - overall expenses (capital, operating, and maintenance) must be within users' means.
- It must be culturally appropriate — it must take into account local norms, beliefs, and wishes.
- Work should be inclusive - it should take into account the health requirements of children, adults, men, and women.

"Access to improved sanitation" Table 4.1 is a measurable monitoring parameter based on the hygienic quality of sanitation technologies.

Table 4.1 "Access to basic" vs "access to improved" sanitation

Improved Technologies	Unimproved Technologies
Connection to a public sewer	Bucket latrines
Connection to a septic system	Public latrines
Pour-flush latrine	Open latrines
Simple pit latrine	
Ventilated improved pit latrine (VIP)	

Ensuring Access to Sanitation for New Households and Anyone Left Behind

Covering any households that may have been left behind with IHHL Construction of Community Sanitary Complexes in Gram Panchayats (as required per State's assessment) to cover the needs of fl oating population and large congregation in GPs such as melas/tourist places/religious places

Developing/ Retrofitting Needed Infrastructure

Toilets were constructed under previous programmes as well. To ensure sustainability in the future, they may be retrofi tted as appropriate: Toilets which are not constructed as per standard and/or are single pit toilets may be retrofi tted to twin-pit, so that they can be used on a continued basis Plans to be made to repair toilets which may become defunct over a period of time Construction of soak pits for septic tanks, wherever not already present

Toilets whether CT/PT should have all facilities such as bathing cubicle, laundry, children's toilet and disposal of used sanitary towels. When planning the number of seats, the ULB should take into account not only the average daily frequency but also the peak load. The peak load factor, i.e. H. the number of users who use a toilet at peak times in a day has a significant impact on the service and therefore toilets must be designed for peak demand (to handle the maximum load at the same time). For example, local public transport near train stations have continuous all-day demand, while those who use CT are on the move at certain times of the day, for example between 6:00 and 10:00

a.m. and 6:00 p.m. to 10:00 p.m. The underlying planning sense is a maximum waiting time of 5-10 minutes in order to avoid queues in front of the system. (The time of 5-10 minutes is indicative and based on the user's perception as there are no norms or guidelines for it) CPHEEO / SBM recommend that PTs and CTs be in reasonable proximity (1km for PT and 0, 5 km for CT) dependent user.

Box 4.1-Usage of appropriate technologies for different topographies In high water table areas and areas prone to seasonal flooding, given the risk of contaminating ground water, the toilet design can be modified by raising the pit above the ground and covering the exposed part with earth by making a mound for absorbing the leachate In cold mountainous regions the pits can be constructed below the frost line. In rocky soils where fissures in rock spread pollution, toilet linked biogas plants, ecosan toilets and septic tanks with secondary treatment systems can be used.

Prior to being properly disposed of, a sanitation system should evaluate all products created and all Functional Groups to which these items are exposed. Domestic goods are primarily distributed via five distinct Functional Groups that work in concert to establish a system. The term "user interface" refers to the sort of toilet, pedestal, pan, or urinal with which the user comes into touch. The user interface also has an effect on the final composition of the product, since it is the point of entry for water into the system. As a result, the user interface is often determined by the availability of water. The terms "collection and storage/treatment" refer to the processes used to gather and store goods created at the user interface; storage often includes some degree of treatment. Conveyance is a term that refers to the process of moving items from one process to another. While items may need to be transported in a variety of methods in order to reach the needed procedure, the longest and most significant gap is between on-site storage and (semi-) centralised treatment. Conveyance is therefore confined to the movement of items at this stage for simplicity's sake. (Semi-) centralised treatment refers to treatment systems that, in comparison to on-site systems, are bigger, demand a higher intake (which is often not fulfilled by a single household), and frequently require more expert operation. The terms "use and/or disposal" relate to the processes by which goods are eventually returned to the soil as harmless compounds or beneficial resources. Additionally, items may be reintroduced into the system as new ones. The use of partly treated greywater for toilet flushing is a common example. Technologies are infrastructure configurations, procedures, and services that are purpose-built to hold, convert, or convey goods to another process, site of use, or disposal (Tilley 2008).

The steps involved in choosing a site-specific system include, the identification of the types of products produced or those that the stakeholders want to produce (e.g. segregated urine). Choose the most appropriate systems; the corresponding products and the number of processing steps that the stakeholders would be willing to operate and maintain. Although newer sanitation technologies are being demonstrated with time, there are seven basic sanitation technologies accepted worldwide (1 unimproved strategy-dig and cover and 6 technologies). They are 1. bucket latrines, 2. ventilated improved pit (VIP) latrine, 3. double-vault composting latrine, 4. urine-diverting compositing latrine, 5. pour-flush toilet with septic tank, and 6. sewered toilet. Select the specific technologies for each product for each process in each of the identified systems. Select one of the systems based on the social, economic and resource aspects of the associated technologies.

Table 4.2 Main processing steps of a sanitation system and its technology options

User Interface	Collection and Storage/Treatment	Conveyance	Semi-Centralised System	Use and/or Disposal
• Dry Toilet • Urine Diverting Dry Toilet • Urinal • Pour-Flush Toilet • Flush Toilet • Urine Diverting Flush Toilet	• Single Pit • Single VIP • Dehydration Vaults • Septic Tanks • Composting Chamber • Anaerobic Baffled Reactor • Anaerobic Filter etc.	• Human Powered Emptying and Transport • Monitored Emptying and Transport • Simplified Sewers • Small Bore Sewers • Conventional Gravity Sewer • Jerry Can/Tank etc.	• Anaerobic Baffled Reactor • Anaerobic Filter • Trickling Filter • Waste Stabilisation Ponds • Activated Sludge • Constructed Wetland • Co-composting etc.	• Application of Urine • Application of Dehydrated faeces • Compost • Irrigation • Aquaculture • Soak Pit • Leach Field • Land Application • Surface Disposal etc.

The dig and cover strategy is a slight improvement over open defecation; the user interface and collection is the ground and feces are covered with a small amount of earth or rolled onto earth or sand. A bucket latrine, a non-improved technology, collects feces (urine is not usually collected) and can be moved to a separate location such as a compost heap on a daily basis. A Ventilated, Improved Pit Latrine (VIP), an improved technology, is similar to the traditional pit latrine in that it has a pit and plate but also promotes airflow into the pit and a mesh-covered ventilation pipe to relieve discomfort Reduce odors and insects. The latrines include the user interface of a toilet, collection in a pit, and possible extraction and treatment by faecal sludge management. A compost latrine with two vaults requires the addition of sufficiently dry organic material after each use and the resulting piles must be mixed to ensure adequate ventilation to encourage composting. The other three are discussed in detail with the process flow described for each.

1. Waterless System with Urine Diversion

The user interface (s) in this system generates two different products: faeces and urine. Hence, each product must be treated separately using its own appropriate technologies and processes. Faeces are stored in a double dehydration vault where they dehydrate. Without moisture, organisms cannot grow, odors are minimized and pathogens are killed. The use of two vaults allows the faeces to dry out and be disinfected while the system remains in use.

Table 4.3 Flow scheme illustrating waste processing in a dry sanitation system with urine separation and final application of all products. (Modified from Tilley 2008)

User Interface		Collection and Storage/Treatment	Conveyance	Semi-Centralised System	Use and/or Disposal
Urine Diverting Dry Toilet & Urinal	Faeces	Double Dehydration Vaults	Human Powered Emptying and Transport	→	Application of Faeces
	Urine	Storage Tanks	Jerry Can/Tank etc	→	Application of Urine
	Greywater	Greywater treatment			

For both urine and feces, no technology option is required in the treatment process step: the arrows indicate that the next required process step is required after transport, reuse and disposal. In this system, the various processing steps do not offer a choice of technology.

2. Water-based, alternating double pit

If the pour-flush toilet (or pan) is connected to double pits, the black water produced is stored and treated on site - there is no need to transport the black water to a semi-central treatment facility. While one pit is being filled, the other full pit rests. The water penetrates into the surrounding soil and is absorbed by it. Within 12 years, the black water is converted into a harmless, safe, ground-like material that can be dug manually. Since this material can be dumped locally on compost heaps, conveying and central processing processes are not necessary and are therefore not shown in the graphic. Three to four months of composting are usually enough to produce compostable compost. However, 12 months is recommended for a completely safe product to be manufactured.

Table 4.4 Flow scheme illustrating waste processing in a water-based sanitation system with alternating double pits and final application of all products. (Modified from Tilley 2008)

User Interface		Collection and Storage/Treatment	Conveyance	Semi-Centralised System	Use and/or Disposal
Pour Flush	Blackwater	Twin Pits for Pour-Flush	Human Powered Emptying and Transport	→	Compost/Eco Humus
	Greywater →	Greywater treatment			

3. (Semi-) Centralised Blackwater Treatment System

This system is characterized by the use of water-based user interfaces: the pour-flush or the cistern flush toilet. In both cases, black water is produced, a collection and storage / treatment technology is used to remove solids and partially treat the wastewater. The draining wastewater is then fed to a (partially) centralized treatment technology either via a solid-free or a simplified sewer system. The

resulting faecal sludge should be treated using a suitable technique such as a planted drying bed. Treated faecal sludge can be reused as a soil improver in agriculture, applied to fields or, if necessary, disposed of. Grey water should be added to the sewer system to improve flow, although if needed it can be made up of recycled water and reused on site.

Table 4.5 Flow scheme illustrating waste processing in a water-based (wet) sanitation system with off-site treatment and final application of all products. (Modified from Tilley 2008)

User Interface		**Collection and Storage/Treatment**	**Conveyance**	**Semi-Centralised System**	**Use and/or Disposal**
Pour Flush Toilet Cistern Flush	Greywater →	Greywater treatment		Trickling Filter UASB WSP Aerated Pond Constructed Wetlands Floating Plant Wetlands	
	Greywater →		Simplified Sewers →		Irrigation
	Blackwater →	Septic Tank ABR Anaerobic Filter	Solids Free Sewers →		Aquaculture
					Disposal/ Recharge
		Faecal Sludge ↑	Human Powered/ Monitored Emptying and Transport →	Co-Composting Thickening Ponds Un-Planted Drying Beds Biogas Reactor	Surface Disposal Land Application

When selecting the most adequate system, technical, physical, economical, institutional, and socio-cultural criteria should also be considered.

4.2 Evaluation of Construction & Maintenance (Sanitation Infrastructure)

Due to fast population expansion, the global need for basic sanitation services (i.e., drinking water supply, excrement removal, and wastewater disposal) has expanded enormously. This resulted in the United Nations establishing the International Decade for Safe Drinking Water and Sanitation (1981-1990). While the issues associated with excreta and wastewater disposal are well understood, they have received less attention. To draw attention to these issues, the term "sanitation" was coined and was widely considered to relate only to excreta and wastewater disposal. All sanitation initiatives should strive to provide hygienic disposal that does not jeopardise public health. The high expense of a sewerage system (which is often more than four times the cost of on-site alternatives) and the necessity for piped water supply limit its implementation in many towns in poor nations that lack appropriate sanitation. It is strongly advised that while designing a latrine, you monitor local sludge build-up rates. Without local data, the values in Table 4.6 are indicated as the maximum. There is some evidence to suggest that these figures are on the high side. However, when waste is added to excretion, the accumulation rate might be significantly increased. If faeces is only retained for a brief period of time, as in twin pit latrines or composting toilets, the reduction process may not be complete until the sludge is removed. In these instances, sludge buildup rates greater than those specified above must be employed. For the time being, a 50 percent increase is suggested.

Table 4.6 Suggested maximum sludge accumulation rates (litres per person per year)

	Sludge accumulation rate
Wastes retained in water where degradable anal cleaning materials are used	40
Wastes retained in water where non-degradable anal cleaning materials are used	60
Waste retained in dry conditions where degradable anal cleaning materials are used	60
Wastes retained in dry conditions where non degradable anal cleaning materials are used	90

It is recognized that to improve the general health of the rural population a "package" of water, sanitation, and health education and disaster preparedness programs are required. As a result it is essential to evaluate the construction of sanitation infrastructure, the purpose of the same has been outlined below as an exemplar.

Purpose of the evaluation:

- To assess the methodology, approach and implementation and suitability of the SBA (G) program (to end open defecation practice)
- To study the impact of the sanitation program on the community
- To assess the impact on villages and how this has followed through to community involvement, feeling of ownership and on hygiene behavior

The evaluation will seek to answer the following questions:

- How appropriate was the planned responses to the sanitation program? (Timeliness, coverage, local relevant)
- The suitability of toilet site, materials used and finished construction works.
- The suitability of the toilet models and health education programs, have they met the needs of the most vulnerable target group? (if not why)
- Is there any observable hygiene behavior change due to the sanitation/health education activities?
- Has the sanitation activities contributed to a reduction of hygiene related diseases in the community?
- Has the program had an impact on behavior change enabling the stakeholders to be more aware of the new understanding about transmission routes of communicable diseases?

Case Study 12: Cultural considerations when locating toilets and selecting plots in India.
A slum area in Vijayawada, Andhra Pradesh, India, had been upgraded; however, the community was not using the new toilets provided on the house plot. This was not immediately apparent to outsiders, however, when a local woman resident was asked by a native Telegu speaker, the local language, if there were any problems with the recent developments, she explained that most of the residents had not been using the toilets provided. The reason she gave was that the toilets had been placed on the northeastern corner of the house plots, which, according to Hindu astrology, is a bad place to locate toilets. The northeast corner is reserved for the water source, the prayer room or the main door. Toilets should be located in the south corner of the plot. This is why many residents were not using the toilets provided and went to the edge of the upgraded area to defecate in the open. (House and Reed 1997)

The factors that have the greatest impact on the rate of sludge build-up are whether decomposition occurs above or below the water table and the type of anal cleanser used. The decomposition under water leads to a much larger reduction in volume than the decomposition in the air. This is due to better solidification, faster decomposition and removal of the finer material in the water stream. Anal cleansing materials vary widely around the world, from those that require little or no storage space, such as water. While designing a latrine it is strongly recommended that local sludge accumulation rates should be measured and this depends on several factors that include:

Ground conditions affect the selection and design of sanitation systems, and the following five factors should be taken into consideration:

1. bearing capacity of the soil
2. self-supporting properties of the pits against collapse
3. depth of excavation possible
4. infiltration rate
5. groundwater pollution risk

Based on the type of demand, typical toilet unit size, and required facilities toilet projects can be conceived on the following lines:

- Construction of permanent new toilets / urinals
- Rehabilitation of an existing toilets (working / defunct)
- Conversion of a urinal to a toilet
- Deployment of temporary toilet / urinal

The above choices are governed by land availability, site layout and alignment and available finances, etc. Upgradation of existing infrastructure is preferred prior to creation of new infrastructure. Indicative land requirements for toilets is indicated in Table 2.3 & 2.4, for reference.

Some of the typical field cases regarding for PT/CT are:

• There could be site conditions wherein sufficient space is not available. In such cases smaller facilities with fewer units (1 men and women toilet), either urinals / toilet units can be installed.

• In cases where land alignment is not suitable, modular / prefabricated structures, etc. can be used.

• In cases where, full-time deployment of manpower is not possible, self-cleaning toilets could be an option.

To Do Activity

Imagine that in the area where you are working a flood emergency happened and nearly 5,000 people, the majority of them children, women and old people, were displaced from their area. Your office assigned you to be a member of the emergency response team. The team conducted a quick assessment on the existing situation and identified that there is an urgent need for more latrines. What latrine options would you suggest in the immediate and longer term to cope with this particular population? Prepare a report as a team and discuss with other members to draw a real time plan making risk assessment of the local area you live in and previous incidents of a disaster or natural calamity.

Temporary Sanitation Arrangements and their management in emergency situations

An emergency is a sudden and unforeseen event that calls for immediate measures to minimise its adverse consequences. Emergencies may force the population to move away from their homes to avoid the impacts. Emergency situations are often caused by disasters such as droughts, floods,

earthquakes, disease outbreaks, wars and other conflicts. In emergency situations, immediate measures and technologies that are available for Sanitation and Hygiene that would otherwise not be recommended in normal situations are tapped. The technologies and service coverage will then be gradually improved upon. The aim of every sanitary system in an emergency is to minimize the spread of faecal-oral diseases and to restore a healthy environment. The safe disposal of the faeces is therefore very important. In addition, sanitary interventions after a disaster also deal with the promotion of hygiene, surface runoff (rainwater) and waste disposal as well as the handling of corpses. There is no such thing as the best emergency remediation system, and options need to be considered as individual as the events that cause the emergency. The choice of the optimal system depends on the cause of the emergency event, the degree of displacement of the affected population, the emergency phase (immediate, stabilization, recovery), the available capacities and the political and social context of the affected region. The advantages of ecological dry toilet systems were shown for some emergency contexts. Natural disasters (floods, earthquakes, storms, droughts) and conflicts in combination with adverse physical (environmental) and social factors (e.g. poverty, vulnerability) can trigger a multitude of emergencies that require sanitary interventions, the transmission of faecal-oral diseases, the contamination of water sources and the (further) development of breeding grounds for vectors, dignity and general well-being of the people affected (see also water hygiene and health). In a second stage, emergency situations can also be an opportunity for long-term development (see also water disposal and development) as well as for emergency preparedness and resilience. The best emergency toilet and sewage disposal system does not exist. The choice for a particular system will depend on the specific conditions, and each system has advantages and disadvantages. The choice can be influenced by:

- The event: e.g. people affected by an emergency situation can live locally (people stay at or near their homes) or can be displaced into a dense or dispersed context (cities, schools, mosques, camps, etc.) (ex situ). Context: Simple pit latrines are often the minimum and most commonly used toilets advertised in an emergency.
- However, challenging conditions such as difficult soil conditions (rocky, sandy, etc.), high water table or flooding, lack of water or lack of space can make other options such as urine drainage toilets, elevated latrines, (shallow) trench latrines or peepbag more suitable.
- The capacities available in the field: e.g. locally available capabilities for the construction, operation and maintenance of the facilities.
- The choice can also be influenced by some conflicts of interest (e.g. long-term versus short-term thinking).
- Gender aspects and vulnerable groups such as children or the disabled always need special attention, especially when designing toilet systems

A disaster is a serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of the affected population to cope using only its own resources. A rapid-onset disaster could be defined as resulting from a unique, distinct and unforeseeable event such as a flood. A slow-onset disaster unfolds gradually over time and is often the result of a combination of events such as drought which leads to population movements and to widespread famine. Disasters can be classified according to their source:
(I) Meteorological disasters: storms (hurricanes, tornadoes, cyclones, snowstorms), cold spells, heat waves, droughts (possibly resulting In famine), etc.
(2) Topological disasters: floods, avalanches, landslides, etc.
(3) Telluric and tectonic disasters: earthquakes, volcanic eruptions, etc.

(4) Accidents: failure of structures (dams, tunnels, buildings, mines, etc.), explosions, fires, collisions, shipwrecks, train crashes, poisons entering water supply systems, etc.

The magnitude of a disaster may be appraised by its effects:
(I) Loss of or damage to human and animal lives
(2) Disruption of community services: electricity, gas and other fuels, communications, water supply, sewerage system, food supply, and public health
(3) Destruction of or damage to private and public property.
(4) Spread of communicable diseases.
(5) Disruption of normal activities.

The international community of emergency response organisations has defined **minimum standards** that people who are affected by an emergency can expect from organisations providing humanitarian assistance (Table 4.7). The most commonly mentioned minimum standards are the Sphere Standards. For excreta disposal in emergencies, they include:

- A living environment **free from human faecal contamination**
- **Access** to adequate, appropriate and acceptable **toilet facilities**

Table 4.7 Factors that determine the individual/Community response in case of an emergency

Factors	**Example**
The **cause** of the emergency event	Flooding, storm, pandemic, draught
The **type of the area**	Rural, urban
The **level of displacement** of the affected population	In-situ: people staying close to their homes Ex-situ: highly dispersed settlements, mass shelters, self-settlements, planned camps
The **emergency phase**	Immediate-, stabilisation-, recovery-, settlement phase
The available **capacity** and **resources**	Financial, human, knowledge, material, skills, etc.
The **political and social context** of the affected region	Stability, corruption, traditions, habitudes, etc.

It then goes on to list more specific requirements which include:

a) a maximum of 20 people use each toilet
b) toilets are no more than 50 m from dwellings
c) they can be used safely by all sections of the population including children, older people, pregnant women and persons with disabilities
d) they are sited in such a way as to minimise security threats to users, especially women and girls, throughout the day and the night
e) they are sufficiently easy to use and keep clean and do not present a health hazard to the environment
f) they allow for the disposal of women's menstrual hygiene materials and provide women with the necessary privacy for washing and drying menstrual hygiene materials
g) separate, internally lockable latrines/toilets for women and men.

The Sphere standards also lists the possible options for safe excreta disposal and when they would be used in an emergency situation.

Table 4.8 Sphere guidance on possible alternatives for safe excreta disposal (Sphere Project, 2011)

Excreta disposal type	Phase of use/comments
Demarcated open defecation area (e.g. with sheeted-off segments)	First phase (2–3 days) when there may be a huge number of people needing immediate facilities
Trench latrines	First phase for up to two months
Simple pit latrines	From the start through to long-term use
Ventilated improved pit (VIP) latrines	For medium- to long-term use
Ecological sanitation (ecosan) with urine diversion	In situations where there is a high water table or flooding. May be required from the start and suitable for medium to long term use
Septic tanks	Mid- to long-term phases

Table 4.9 Factors to be considered for arrangement of sanitation measures in an emergency

Factor	Communal Latrines	Family Latrines
Speed of construction	Can be constructed fast by well-trained and well-equipped team, rate of construction is limited by number of staff and equipment	May take considerable time to train families, but large numbers of latrines may be built quickly
Technical quality of latrines	Higher quality of design and construction easier to control but innovative ideas from users may be missed out	Potential for innovative ideas of users, but more difficult to ensure good quality
Construction costs	Use of materials can be easily controlled but labour must be paid for	Construction labour and some materials may be free of charge, but families may not have the time or the right skills
Maintenance costs	Maintenance, repair and replacement costs are easier to predict, but staff might be required to clean and maintain facilities in the long-term	Users take responsibility for cleaning and maintenance but recurrent costs are less predictable
Technical possibilities	Heavy equipment and specialised techniques may have to be used (e.g. rocky ground)	Families may not be able to dig in hard rock or build raised pit latrines
Cleaning and hygiene	Users do not have to clean latrines, but these are often dirty, and a greater mix of users increases the risk of disease transmission	Latrines are often cleaner but many users may prefer not to be responsible for construction, cleaning and maintenance
Access and security	Latrines may be less accessible and more insecure, particularly for women	Latrines are often more accessible (closer to dwellings) and thus safer
Development issues	People may lose or not acquire the habit of looking after their own latrine	People keep or develop the habit of managing their own latrine

Immediate response in an urban area may include installing or reinforcing sewage tankers to bypass clogged sewers, or performing an intensive septic tank or latrine drainage in urban areas. Every effort should be made so that people can use their existing toilets. Public facilities may need to be provided by providing access to schools or community centers, or by temporarily installing public toilets. In rural areas, protection of water sources is usually a priority due to the lower population density and lower risk of faecal contamination. Immediate sanitation and technology are available

when dealing with displaced persons that would not be recommended in non-emergencies. Emergency toilet structures are selected according to the urgency of the need and should be gradually provided and improved from clearly marked open defecation fields to trench defecation fields, communal trench latrines, community pits or borehole latrines to household or family pit latrines (see immediate and short-term sanitation in emergencies Table 4.9).

The options for handling and disposing of solid waste in emergency situations are similar to the standard methods that have been discussed in the last chapter. Dumping in open spaces should be avoided due to the health risks for humans and animals. Solid waste incineration is possible, although it creates the problem of smoke and does not reach a sufficiently high temperature unless a specially built incinerator is used. If possible, existing landfills should continue to be used. In the case of temporary settlements, areas for burying waste should be designated, far away from households and fenced off. If on-site garbage is to be buried in household or community pits, it should be covered with a thin layer of soil daily to prevent it from attracting vectors such as flies and rodents. Figure 4.4 shows the main features of a solid waste pit.

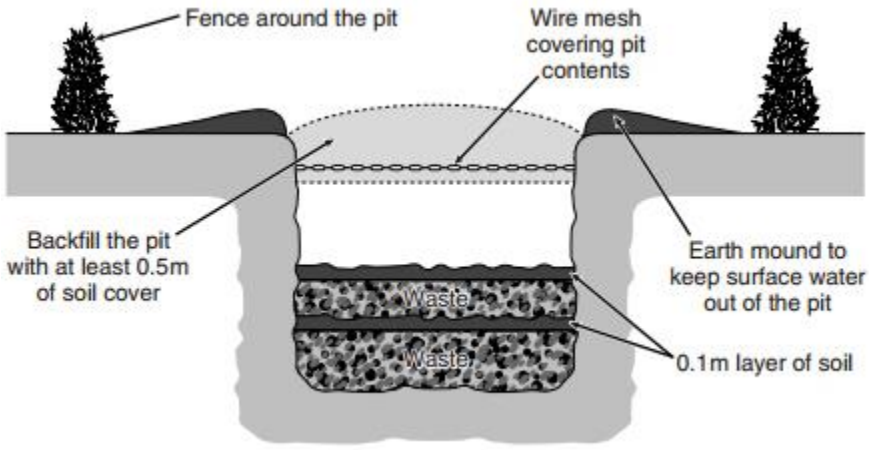


Figure 4.1 Solid Waste Burial Pit (Davis & Lambert, 2002)

4.3 Management of Sanitation Infrastructure

The availability of finances for community toilet operation and maintenance is one of the most critical variables affecting their proper operation and maintenance. Another technique that has proven to be successful in the southern half of the country is involving user groups in maintenance. When women are actively participating, these groups have a better chance of succeeding. This was discovered via the experiences of a Municipal Corporation in the southern region of India. Community toilets were built with the help of the ladies in the region. The women's group "SHE - Team (Sanitation and Hygiene Education - Team)" was founded to take on the job of maintaining the pay-and-use communal toilet. The women's group quickly made money from toilet upkeep and invested it in the refurbishment of an abandoned communal toilet nearby that was previously used by males. They repaired and renovated the men's common toilet, replacing the broken water closets and doing other repairs and renovations. The local guys began to use the newly rebuilt community toilet, avoiding open defecation in the slum. The community has chosen to build a separate toilet for youngsters next to the pay-and-use latrines for men and women. They may design and build a toilet that is suitable for children. Girls and boys in the slum who are under the age of six utilise the child-friendly toilet. As a result, community engagement, particularly among women, has a high possibility

of ensuring the successful operation and maintenance of communal toilets. As a result, a system based on user empowerment, ownership, operation & maintenance, and service charge collection by user groups appears to be a long-term option for the repair of defunct communal toilets as well as the building of new ones.

If you want your communications to be effective, you must know who your target audience is and what they anticipate from you in order to personalise your message accordingly. People and families face a variety of problems when it comes to adopting healthy habits. These include obstacles at both a personal and communal level. There are a number of stakeholders that need to be informed and educated about ODF Plus' numerous components in order for it to be successful. Despite the fact that each stakeholder will be approached individually in terms of behavioural uptake, they will all need to be involved from the start and throughout the communication process.

In this context, "primary stakeholders" refers to people who are directly targeted for change. Persons who are able to maintain regular toilet usage, maintain and clean it, wash their hands with soap at essential times, as well as utilise water sparingly. To better understand the role of secondary stakeholders, we must first understand the role of prime stakeholders. The key audiences/stakeholders' cultural and social contexts are the primary sources of inspiration. Swachhagrahis, Frontline Workers (FLWs), and Panchayat officials are examples of those who assist the programme and contribute to an enabling environment that facilitates the adoption and sustainability of the new behaviours. Tertiary stakeholders are those who influence the behaviour of other stakeholders, either directly or via influencing the behaviours of others. As a result of their acts, the prevailing social and cultural norms are being reflected. Members of the political and religious establishments as well as educators and other public servants are examples.

The Integrated Solid Waste Management System (ISWM): The quantity and characteristics of total waste generated in a local authority, the financial resources available, and the in-house capability of local authorities to oversee project implementation all influence the Integrated Solid Waste Management System (ISWM) and the adoption of processing technologies.

- At-source waste reduction and reuse: In the ISWM hierarchy, the most recommended choice for waste management is to avoid the development of trash at multiple phases, such as during product design, manufacture, packaging, usage, and reuse. Waste prevention reduces the expenses of waste processing, treatment, and disposal, as well as the environmental implications of leachate, air pollutants, and greenhouse gas production (GHG). The most popular waste prevention measures include reducing trash creation at the source and reusing things.

- Waste recycling: Recycling waste to recover material resources through segregation, collecting, and reprocessing to generate new goods is the next preferable waste management option in the ISWM hierarchy. Composting is classified as an organic material recovery method in the waste management hierarchy, and it is frequently grouped with inorganic waste recycling.
- Waste to energy: Energy recovery from waste through the generation of heat, electricity, or fuel is preferable when material recovery from waste is not possible. Some waste-to-energy processes include biomethanation, waste incineration, refuse derived fuel (RDF), co-processing of combustible nonbiodegradable dry fraction from MSW in cement kilns, and pyrolysis or

gasification.

- Waste disposal: At the bottom of the hierarchy, residual inert wastes are to be disposed of in sanitary lined landfills that are built in conformity with the SWM Rules, 2016. Landfills that incorporate the capture and utilisation of methane are favoured all over the world over landfills that do not capture the landfill gas. The least desired alternative, according to the hierarchy, is to deposit garbage in open dumpsites. However, Indian laws and regulations prohibit the disposal of biological stuff in sanitary landfills, allowing only inert rejects (residual garbage) from processing industries, inert street sweepings, and other inert materials to be disposed of. There is a potential of trapping methane gas for future use in circumstances when historic landfills are to be closed. Repeated garbage burning, on the other hand, dramatically reduces the ability to capture methane. Before selecting and implementing appropriate treatment technologies, the hierarchy emphasises that all possibilities for source waste minimization should be explored.

ISWM is inextricably tied to the 3R strategy (reduce, reuse, and recycle), which likewise emphasises trash reduction, reuse, and recycling above other kinds of waste processing or management. Adherence to these principles helps to reduce the quantity of garbage that has to be disposed of, as well as the public health and environmental concerns that come with it. Both techniques encourage maximising resource recovery at all phases of solid waste management.

Producer responsibilities increased Extended producer responsibility (EPR) is a policy approach in which a producer is held accountable for a product's post-consumer stage, typically for defined tasks such as separate collection (for e-waste or hazardous waste components), reuse (for example, disposal-refund systems for bottles), recycling (for used cars), and storage and treatment (e.g., for batteries). EPR programmes are frequently mandated by legislation, although they can also be established on a voluntary basis (i.e., retail take-back programs). To guarantee that EPR efforts are executed successfully, national and state engagement is required. ULBs, on the other hand, should support local initiatives based on EPR principles.

Waste Management Systems with a Decentralized Approach: In some cases, decentralised waste management methods at the community level are preferable to centralised waste management solutions. Decentralised waste management systems, also known as community waste management systems, alleviate the strain of managing huge amounts of MSW at a central location, lowering transportation and intermediate storage expenses.

The following are some of the benefits of decentralised waste management:

- Decentralised systems allow for a lower level of mechanisation than centralised solutions, while still providing employment prospects for informal labourers and small businesses.
- Decentralized alternatives may be tailored to the waste stream, climatic, social, and economic constraints in a given area.
- Waste collection, transportation, and disposal costs for ULBs are reduced with decentralised systems.

However, ULBs should be mindful of some of decentralised waste management's limitations, such as the following:

- difficulty obtaining land in many urban areas;
- difficulty maintaining scientific and hygienic conditions due to a lack of sufficient space and worker training and capacity;

- uncertain quality of end products;
- difficulty ensuring the system's economic viability, especially when qualified staff is required.
- It is preferable to collect recyclables at the community level, especially with the participation of the informal sector, and to manage organic waste through household composting systems and community composting systems.

Integration of the Informal Sector In India the informal sector: An important part of recycling in India is done by the informal sector, which includes the kabadi system and rubbish pickers. The recognition, identification, and integration of informal sector employees into official waste management systems and initiatives is a major focus of national and state level programmes. The integration of the informal sector has several benefits, including the creation of jobs, social acceptability, and security for employees in the informal sector. Organizing them into self-help groups (SHGs) or cooperatives can be an effective way to empower them to work as entrepreneurs in a business.

Operation and Maintenance (Faecal Sludge Management)

- Sludge should be placed out on the drying bed under monitoring while this sludge is drying. Personnel should use appropriate safety equipment, and raw sludge should never come into touch with humans.
- In general, the sludge layer should not be more than 10–15 cm in thickness (as per design). If necessary and if sufficient bed space is available, two or more sludge drying beds can be utilised at the same time to allow laying sludge in thinner layers.
- A date-by-date journal of the number of vehicles arriving and the amount of sludge placed should be kept. The schedule for evacuation or raking of the dried sludge will be useful for scheduling purposes as well.
- Regular checks should be performed for obstructions in the inlet and outlet pipes of each of the treatment modules.
- Periodic removal of collected waste from the screening chamber and excess sludge from the settler should be carried out.
- The dried sludge must be emptied when the bed is full or according to the design desludging period. To allow for complete drying and pathogen decrease, a bed should be allowed to rest for 6 months before being emptied. If resting within the bed is not possible, the sludge can be drained and heaped outside the bed for six months away from human interaction.
- Removed dried sludge should be transferred for further treatment.
- Filter materials of the drying beds and planted gravel filters must be cleaned of clogs or replaced if the percolation rate declines or drying time exceeds what was expected.
- Plant harvesting in PDB and planted gravel filter should be done.
- Emptying of a full bed should preferably be done during dry seasons
- It is recommended that you clean the perforated discharge pipe and inlet pipes on a regular basis, using the proper equipment.

A critical aspect of management is the ability to determine the level of private sector involvement and provide them with a supportive business environment. Private sector engagement could be for: Providing manpower for O&M construction / rehabilitation / retrofitting activities Financial investment in construction. Frequent problems in PT / CT projects relate to poor construction quality (poor material selection, poor processing and poor monitoring) and a lack of personal responsibility

on the part of the operator. Often the construction is outsourced to a local contractor and the operating and maintenance work is handed over to another operator. In such cases, the operator pays minimal attention to routine maintenance and repairs while waiting for ULB to intervene. The resulting poor maintenance leads to user dissatisfaction and non-use of the facilities. ULBs should consider alternative arrangements and select the most appropriate option that will ensure good build quality and proper use of the constructed facilities. The possible agreements that are emerging are: A single agency handling the construction and O&M quality issues, construction under ULB guidance, Operator finds his own contractor for different activities, procurement of pre-fabricated construction material or provision of Mobile units to avoid construction issues.

Case Study 13: Municipal Corporation of Greater Mumbai (MCGM) – Slum Sanitation Project

Supply-driven sanitation development projects were offered by the Municipal Corporation of Greater Mumbai (MCGM) prior to the Slum Sanitation Project (SSP), which was launched in 2010. In light of the widespread failures of toilet facilities, a demand-driven strategy was implemented where slum inhabitants choose where infrastructure was erected.

• Designed to accommodate 16-20 people, the restrooms include separate entrances for men, women, and children. Two-story facilities were developed in areas where space was restricted, with one men's and one women/child sections on each floor. The caretaker's quarters were located on the second storey, which also held a water tank.

• These toilets required 24-hour water and energy supplies, as well as connections to municipal sewers or septage cleansing.

MOUs between MCGM and non-profit organisations or small businesses were signed (SLBEs). Toilet facilities were maintained by non-profit organisations and small businesses (CBOs/SLBEs), while MCGM was responsible for funding, monitoring, and evaluating the facilities over time.

• MCGM bore up to 60% of the overall capital investment expenses for toilet supply, with user capital contributions ranging from Rs 100 to 500 helping to offset the remainder.

Visitors were required to pay Rs. 1 for each use of the facility, while families were required to pay Rs.30 a month.

4.4 Levels of Investment

The financial requirements are mostly capital, which is used for the construction and maintenance of infrastructure as well as day-to-day operations and maintenance. Both components are equally crucial in this symbiotic exercise. The money for building operation is usually provided by the government, but the funds for operations and maintenance must be provided by the public, who must pay taxes and fees for services. Herein is the crux of the issue. The finances for capital are also derived indirectly through the taxes that the populace pays for other services. As a result, as long as

the government's revenues are insufficient to cover the overall cost of providing and maintaining various services, the practise of prioritising allocations to various services from limited finances continues inside the government. It's easy to see how the above-mentioned goals can never be met as long as this cycle continues. As a result, it is critical to plan changes to the physical and financial elements of sewage services in such a way that the gap can still be bridged Table 4.10.

Table 4.10 Institutional Framework for Rural Sanitation

National Level • Develop Guidelines • Funding • M& E • Intersectoral coordination	Ministry of Rural Development DDWS
State Level • Funding • Planning and regulation • Technical support • M& E • Training • Intersectoral coordination	SWSM Nodal Department CCDU
District Level • Faclitate overall implementation • Develop action plan	Zilla Parishad/DWSM District Sanitation Cell
Block Level • Institution building eg. GP'S WATSAN Committee • Facilitate supply chains • Hygiene education	Panchayat Samiti Govt/NGO Extention Workers
Village Level • Mobilisation • Facilitate construction of hardware • Hygiene education	Gram Panchayat

There are various revenue sources involved in funding of sanitation infrastructure and implementation. Some of these include

1. **Swachh Bharat Cess (SBC):** Initiated in 2015, SBC is levied as 0.5% on service tax. The service tax is applied to all services. The amount collected under SBC is to be used to fund for Swachh Bharat Programmes.
2. **Swachh Bharat Kosh (Clean India Fund):** is the contribution coming from Corporate Sector under the Corporate Social Responsibility (CSR). Companies are motivated to donate 2% of their annual profit to CSR programmes.
3. **Municipal Bonds:** Municipal bonds are capital for sanitation infrastructure projects including improved sewerage systems, faecal sludge management infrastructure and wastewater and sludge treatment. They are financial services and not revenue and must be paid off from tariffs and taxes.
4. **P-budget:** An Indian public finance team referring to allocation of a defined proportion of an urban municipality's total budget to pro-poor investment and services. The Ministry of Housing and Urban Poverty Alleviation (MHUPA) recommends that around 25% of municipal budget should be P-Budget. The sources of these funds are transfers from central government and municipal own-revenues: so, P-Budget is not a source of new revenue to the government. We can expect variation in the extent to which this budget is actually spent effectively on the poor.

The Department of Drinking Water and Sanitation, Ministry of Jal Shakti, is the nodal Department for implementation of this strategy. Government funding is the primary source of financing in the sanitation sector. However, encouraging alternate means of fi nancing is an important focus area to ensure sustainable fi nancing of sanitation in rural India. The following types of funding will be used for future sanitation efforts: Central Government: a. Community level elements of ODF Plus will be provided funding support through the Swachh Bharat Mission – Grameen. Convergence of resources between schemes cut across rural development, employment and skilling, and livelihoods at local government level.

State Government

a. State's contribution to the Swachh Bharat Mission - Grameen
b. State specific schemes on sanitation
c. Specific aspects of appropriate technology, environment protection, sanitation for those with special needs or for women through convergence with the relevant State Government schemes and departments

Panchayati Raj Institutions: a. Fourteenth Finance Commission (FFC) through grant allocation for GPs and Fifteenth Finance Commission funds post 2020 b. Funds devolved to PRIs under various schemes by the state government and State Finance Commissions c. GPs may raise their own revenues for sanitation financing and maintenance of sanitation facilities, as per appropriate Acts 5.4.2 Alternative financing for sanitation Credit financing may be promoted by States including models like a) Credit Linkage to SHGs; b) Direct Lending to SHGs; c) Individual Lending; d) Bulk lending to business correspondents Increase microfinance facilities through knowledge exchange to develop capacity of MFIs in providing water and sanitation loans, policy-reform for enhancing non-income generation loans focused on livelihood improvement such as toilet construction and water connections, awareness regarding water and sanitation loans to create a demand Self-Financing towards gradual leveraging of community resources in the form of tariffs for SLWM, water supply, O&M.

Table 4.11 Sources of Funding for ODF Plus Projects

Swachh Bharat Mission (SBM) funds	Corporate Social Responsibility funds
State scheme funds	Ganga Gram Yojna
World Bank Performance Incentives	District Mineral Fund
Member of Parliament Local Area Development Scheme (MPLADS)	RuRBAN Scheme
Member of Legislative Assembly Local Area Development	ABHY Scheme
14th Finance Commission Funds	Priority Sector lending from Banks
State Finance Commission	NABARD
Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)	Funds under Gram Panchayat Development Plan (GPDP)

There are three types of costs included in public and community toilets management, the land cost, construction cost and operations and maintenance cost. For the benefit of administrators, typical

cost heads for capital works as well as the O&M works have been provided in Table 4.8. However, the business model may not be profitable if the land costs are included. Hence, the general trend is that the land is provided by the public agency for constructing a public toilet, thus negating the cost attached to it in the business model. A financial operating plan (FOP) needs to be prepared for assessing the life cycle costs. The principle while preparing the FOP should be that the user charges should aim to recover at least the operations and maintenance cost of both the community and public toilets.

Capital Costs

Local bodies will have to use a mix of centrally sponsored schemes, state government support, internal revenues and funds mobilized through CSR activities. Swachha Bharat Abhiyaan can partly fund the creation of public toilet facilities in urban areas. The funding for water supply distribution and sewerage infrastructure for servicing the public toilets can be availed under AMRUT. For financing the capital costs, various innovative mechanisms should also be explored. These may include the following:

- Grant subsidies from Government, donor agencies
- Grant/ loans from micro-financing institutions,
- A fund by the local body by levying a 'Cess' towards financing capital costs of public toilets for general users only (specific to public toilets only)
- Creating a commercial area attached to the toilet block and the revenues generated to be used for financing the capital costs (specific to public toilets only)
- Subsidies provided from time to time or increases in incentives offered under SBM

Table 4.12 Typical Cost Heads FOR Construction

Construction
Item
1. Structural Cost, including associated components
Civil – sub-structure elements, super- structure (walls, roof, flooring, plastering & other necessary civil structures) Procurement charges for fibre-reinforced plastic structure / modular / pre-fabricated structures / e-toilet, etc.)
Plumbing
Labour – civil, plumbing, electrical
Bore well, pumping equipment, sump & overhead tank
Ramps, hand rails, safety gate, etc.
Painting and related aspects
Structures above single storey, caretaker/store room if any
Sewer connection / Septic tank where sewerage systems do not exist
Rain-water harvesting, storm water drainage arrangements
Landscaping / horticulture / gardening
Monitoring panels

2. Fittings / fixtures
Doors – wooden, metal, PVC, incl. associated privacy & safety accessories
Sanitary Fittings (water closet / urinals / taps / floor trap / grating / wash basins)
Ventilation fittings, including exhaust fans
Other accessories (soap tray / liquid soap dispenser / buckets / mugs / waste bins / mirrors / towel rail etc.)
Electrical and Lighting fittings
Display boards, storage cabinets, racks
Solar Panels
Inverters / generators (if faced with frequent power outages)
Advertisement boards & related accessories incl. electrical connection where required
3. Service Connections
Water supply
Sewerage
Electricity
4. Other items
Signage, incl. direction signs, distance markers, sign boards
IEC items – wall painting, posters, public messaging, etc.
5. Overheads (upto 10% of above)

Funding O&M Costs

Expenses such as costs for electricity, staff costs, water supply, sewage disposal, cleaning equipment, repairs and consumer supplies are all part of the O&M costs Table 4.9. As mentioned previously, under the FOP, these costs are supposed to be covered by the amount charged to the individuals using the toilet. The shortcomings from the same can be recovered by adopting the following strategies:

1. Permitting the use of advertisements and collecting revenue for the same.
2. Subsidies for certain O&M cost overheads.
3. Repairs can be reimbursed.
4. If there are any special equipment installed, their operation cost should be treated differently.
5. Vending of toiletries on a small scale.
6. Earning capital from other areas of commercial businesses or infrastructure.

Table 4.13 Typical Cost Heads for O&M

OPERATION & MAINTENANCE
Item
1. Manpower (monthly)
Supervisor
Caretaker
Cleaner
2. Water charges (monthly)
3. Electricity charges (monthly)
4. Waste disposal / treatment charges (monthly)
Sewerage / Septic tank
Solid waste
Any other (sanitary waste)
5. Consumables / cleaning supplies (monthly)
Liquid soaps, phenyl / disinfectant, bleaching powder, dilute acid, cleaning material, floor cleaners, air fresheners, napkins
6. Cleaning equipment (quarterly)
Sponges, scraping sheets, brooms, brushes, floor wipers, gum boots, gloves, tools for removing choke, dusters
7. Replacement of accessories (quarterly / half yearly)
Buckets / mugs / soap trays / waste bins / uniform / identity card
8. Minor repairs and maintenance
9. Monitoring, telephone/mobile, registers, complaint books
10. Incidentals and other Overheads (~10% of above)
11. Taxes and other statutory compliances

Note: *The above lists of components are recommended for all PT / CT irrespective of the funding support.*

Grouping/Clustering- Areas and facilities having frequent public movement can potentially generate revenue via advertisements and other resources. Such domains having luxuriant toilets can be grouped with certain toilets which are unable to suffice their finances, thereby making the business model of that toilet much more reasonable. However, there is great amount of risk involved concerning the operator, since there might be bias with a result of which less profit-making ones may get neglected. Therefore, maintenance and monitoring are of utmost importance.

Grouping or clustering can be done depending upon the location, financial generation, project type etc. It has several advantages such as reduced amount of package outsourcing, reduced manpower requirement for maintenance and service, convenience in administration etc.

Service Contracts (SC)

Service contracts are basically outsourcing labour contracts for a definitive month with a pre-determined fee. The contracts work with an operator and can be renewed. This is relevant only if and FOP has been formed and a toilet has been constructed. The routine operating of service contracts is based upon the number of staff working and manpower required. Certain bonuses are also affixed which can be given based on performance criteria. Lack of performance and presence can also lead to deduction of the fee. Any kind of financial risk imposed by such a model is handled by the urban local bodies (ULB), and they will be responsible for its evaluation.

Operate, Maintain and Transfer Contracts (OMT)

These differ from service contracts since they have shorter terms and are dependent on the working and operating conditions of the asset. These contracts are under the possession of the ULB; however, the benefits and losses are the responsibility of the operator. The duration of the contract can be a one-time step which ranges from 3 to 5 years or can be extended to 3 years or more every time. This is subject to the performance by the labourer. The repairs and maintenance works are borne by the operator in lieu with the ability to manage finances by enhancing the charges to the users or undertake other means of earning revenue. Due to this, the evaluation will be based on the highest amount of premium paid to the ULB or least amount of subsidy taken. In clustered project packages, the toilets generating profitable finances are evaluated based on the highest premium paid to the ULB, whereas toilets with lower footfall are judged based on the least amount of subsidy sought. In such packages, the ULB can take a call, such that profits made from one package can be used to subsidize the other. This is called cross-subsidy.

Rehabilitate, Operate, Maintain and Transfer Contracts (ROMT)

Rehabilitation is the renovation of a toilet without disrupting the structural base and making changes in the interior portions. It is also known as retrofitting. Investments regarding the same are handled by the operator. A proper rehabilitation is one wherein the process can be carried out without shutting down the operations of the toilet. Selection of contractor for the same is done by the ULB or operator which is agreed mutually. The operator is in charge of the repairs, maintenance, re-investments and daily operations. Contractors are hired on a contract basis for 5-10 year and can be extended annually based on performance. For each project site, a contract period is signed and mutually agreed upon. If there are clustered projects, a feasibility analysis subject to revenue generation should be carried out and a contract period must be established. The evaluation is done subject to premium paid or the least subsidy opted for to the ULB.

Build, Operate & Transfer Contracts (BOT)

These types of contracts are agreed upon once the FOP has been determined and the toilet has to be built. The landed is handed over to the operator by the ULB before any construction and O&M services. Any form of required investment on construction is taken up by the operator. An alternative approach is to give the operator instructions to develop a toilet based on structural designs approved and monitored by ULB. It is known as DBFOT contract.

Contracts are mostly long term based, so that the operator can recover the expenses incurred during the construction and maintenance. A single time-based contract may last up to 10 years or more including any rehabilitation work. The period is based upon locality, construction cost etc. Once the term ends, the contract is reviewed or the assets are handed over to the government authority.

Case Study 14– Slum sanitation program

1. New Delhi Municipal Council (NDMC) and the Municipal Corporation of Delhi (MCD) – BOT model. This case study focuses on city wide planning, including institutional structures that may be followed. This case study gives an insight into construction, maintenance and operation of public toilets under Build-Operate and Transfer (BOT) agreements.
2. Municipal Corporation of Tiruchirapalli and Gramalaya- Community Toilet This case study attempts to delineate the role of self- help groups in the operations and maintenance of community toilets. Emphasis on multi-stakeholder involvement and community ownership of the assets contribute to the success of this model.

User Fee Collection

Collection of user fee occurs at three stages; estimation of amount to be paid, use of the facility and payment for services. User fee collection is generally is a disagreement among users. The user fee for men and women should be appropriately displayed at the entrance. Many ill practices however occur much frequently and are difficult to control. These include exemptions for regular users, give and take arrangements, excessive charging, etc. Such practices should be monitored and regulated since malpractices like these give rise to cash trapping and under reporting. Also, it disrupts the transparency of transactions as well. These give rise to vulnerability in operations since the repair costs have to be met depending on the fluctuating revenues. This results in substandard services. With emerging payment methods, such as digital payments, it can bring about much more transparency in transactions and operations.

Contracts for Installation of Pre-fabricated Toilets (MC-Maintenance contracts)

For installation of new toilet structure contract type is applied (operated by coins, normal toilets or mobile toilets) prior to the operations and maintenance services. To overcome the time-consuming process of constructing a toilet, ULBs acquire pre-fabricated systems and with minimal construction install it. For clearly defined specifications, the engagement is a goods procurement contract / goods plus services contract.

ULB or operator defines the maintenance contract separately to the product vendor based on the pre-fabricated type (material/technology/style) and who acquires the product based on the pre-defined specifications. The maintenance can be divided into various parts of the toilets such as civil, mechanical or electrical parts, for mobile toilets, maintenance is outsourced for the complete structure.

Contracting for community toilet-This contract is similar to the above-mentioned contracts except for the fact that the users are a small defined community who are willing to accept some responsibilities. The O&M activities can be taken up by the members of the community or SHO/NGO/CBO on their behalf, instead of handing them out to a private agency. Cleaning services can be allotted to individuals within the community like service contracts and in case of multiple toilets a proper framework can be created to ensure the cleanliness. The expenses required for the O&M can be collected from the community members (monthly household passes / pay by use) and additional funds can be subsidized by ULB.

Costs for operation and maintenance-In most cases, the operators pay the cost of O&M unless subsidized by the ULBs otherwise. These charges can be grouped into four categories:

1. **Daily and Occasional Maintenance Costs:** Costs include cleaning equipment, consumables, etc.
2. **Minor Repairs:** These comprise of repair/replacement of fixtures (taps, buckets, mugs, etc.) motor pumps, light, etc. Although they are not very serious at face value, if left unattended it may lead to greater damage and may close down the daily operations partially/completely. The costs of such repairs are not very high and can be adjusted from the user fee collection, they are not reimbursed by ULBs.
3. **Major Repairs:** These comprise of much bigger work such as painting, structural repairs, sewer clog removal, cleaning of septic tank/storm water drain, electrical wiring, specialized equipment in pre-fabricated toilets, etc. These damages have to be taken care of as soon as possible or else they may slow down the daily operations or completely halt the process. The cost of such repairs is greater and beforehand approval is required from the ULBs, irrespective of who may pay for it.
4. **Monthly Payments:** These are collected from the users in the community and based on various criteria such as size and layout of the facility, its age, number of WC's, operation hours, quantity and availability of water, number of staff working etc. The amount to be collected is based on all the above-mentioned criteria.

Revenue Generation Options

Various methods can be utilized to not only acquire revenue for O&M costs but also acquire refinancing costs and capital costs. One of the most common way to achieve this is by posting advertisement on the external walls of the toilet. This option is feasible depending upon the design of the toilet and care must be taken that it does not compromise the safety of the structure. One of the preferred ways is using panels or illuminated boards.

The amount of money to be collected via advertisement depends upon the advertisement rates of the area which can be formalized by the ULB Revenue Department either between

1. ULB and advertisers
2. Operator and advertisers

Other sources of revenue can be

1. Sale of toiletry related items in close vicinity.
2. Based on the location and willingness of the users they can be charged differently for the toilet usage and certain operations can be crossed subsidized too
3. Other facilities such as ATMs, candy shops, drinking water can be installed in the nearby vicinity of the toilet thereby increasing its revenue.

A proper thinking and strategy should go into generating the revenue by the ULB not just for the newly designed toilets but also for the old ones creating a uniformity in service provision and revenue generation throughout the city.

Opening and Closing times-The operation includes the general activities related to the daily operation of opening and closing the toilet facility, cleaning, ensuring safety and staffing, etc. User satisfaction depends heavily on proper and timely service, which increases with the level of service. The opening and closing times of public toilets should be based on local demand and activity pattern. Table 2.1 provides an overview of the type of PT / CT users and their duration in a day. A clear understanding of the usage pattern / movement of people in potential locations will help significantly in determining opening and closing times.

The operating hours should clearly take into account the number of female users in order to ensure easy and timely access to public transport. In the case of CT, the opening times must be adapted to the needs of the users as well as local demand and the activity pattern. The times should be

determined in consultation with the relevant stakeholders / user groups. Toilets near the fruit and vegetable market / Mandi can remain open 24 hours, as there is a constant influx of people (from morning to evening) and the associated shopping opportunities, Loading and unloading (midnight to morning). Alternatively, toilets near government offices may be open from 9-10 a.m. to 5-6 p.m., according to office hours. With an operating time of more than 8 hours, several shifts can be planned in order to keep the toilet system open without interruptions. At the entrance of the facility, a board should be placed on which the opening and closing times as well as the contact details for complaints / feedback are clearly displayed.

Equipments and Consumables

Cleaning the toilet requires different devices and materials. This usually includes safety equipment for the cleaner, consumables (such as detergents and disinfectants), and other practical items. Operating personnel should have access to a sufficient number of cleaning tools to support their cleaning activities and therefore require an inventory and storage system by the operator. A detailed list of the required equipment and consumables is provided in Table 4.14.

Table 4.14 List of Equipments and Consumables

Cleaning equipments	Consumables	Other equipments	Cleaner safety gear
• Brush for cleaning toilet seats/ bowls • Plastic scrubber/brush for cleaning wash basins • Brush/scouring paper for cleaning tiles • Brooms for wet areas • Brooms for dry areas • Cloths/mops for cleaning floor • Floor wipers • Plastic scrubber/ sponge/ cloths for scrubbing plumbing fixtures and other general purposes • Bucket for mixing floor cleaning agent with water • Mug for pouring floor cleaning agent mix • Sponges / soft cloth for cleaning mirrors • Dust collecting pan • Dust bins	• Sanitary ware cleaning agent • Tiles cleaning agent • Floor cleaning agent • Plumbing fixtures cleaning agent • Glass and mirror cleaning liquid • Soap / non-abrasive cleaning liquid • Disposable garbage bags • Hand washing soap • Naphthalene balls	• Sign boards/ Warning Signs • Trolley/tray for carrying cleaning equipment • Room freshener (optional) • Plumber's snake • Plunger • Ladder	• Rubber Gloves • Face mask • Boots • Uniform/ Apron

Cleaning Schedules

The term cleaning refers to all activities related to the provision and use of all cleaning equipment and consumables for predefined activities and schedules by cleaning staff. This schedule ensures that the toilet facility is clean and hygienic at all times. The operator has to ensure that the toilet is

cleaned regularly by performing cleaning cycles as much as the visitor frequency requires or at least three times a day. Regular, scheduled cleanings can be carried out outside of peak hours so as not to annoy users. Some cleaning activities are regularly required once a week or every 14 days, especially for fittings, goods and surfaces. The frequency of cleaning depends on the number of users (toilet in a busy shopping area requires more frequent ones cleaning cycles than a toilet in residential location). Operation standards are outlined by the ULB and also dependent on the fund availability. In any case, the interval between cleaning cycles should not exceed 8 hours. Different number of cleaning cycle can be worked out based on toilet facility layout (men and women units) and footfall. During the cleaning cycle, the entire toilet/urinal should be properly cleaned with disinfectants and water, litter should be collected and stains must be removed to make it ready for the next usage.

4.5 Subsidies For Sanitation and Sanitation Marketing

The subsidies for sanitation and construction of toilets are approved by the Urban Local body (ULB) and state government. The allocation of funds is provided in the form of a central government incentive, which differ from states/union territories and north-east/hilly states. The ULB allocates ₹4000 per toilet for a household in states and union territories and ₹10,800 per toilet for a household in states of north east and hilly regions. The funding for the construction is provided on a dual instalment basis subject to approval and verification by the ULB. The first instalment comprises of half the approved amount (i.e., 50%), in combination which is given to the grantee. A further verification of the physical parameters of the building of the toilet is carried out after which the second instalment is released along with the incentives provided by the state government.

Box 4.2- Government Subsidy

Governments at both the state and federal levels have long declared latrine subsidies. However, delivering the message to the intended recipients and putting the notion into effect has not gone as planned. The news item (The HINDU, March 20, 2011) indicates that the Karnataka districts of Dakshina Kannada and Shimoga have gained the distinction of being the "cleanest" districts, having received the state's annual sanitation award as part of a drive to foster sustainable sanitation. A Rs. 3,000 subsidy is offered to people living below the poverty line who wish to install toilets in their homes, yet some areas are still stuck in the notion that toilets are superfluous. The subsidy has been raised to Rs. 4700 in Tamil Nadu (Source The HINDU, March 20, 2011 and June 14, 2012).

The final verification associated with the building of the toilets should be carried out appositely using locality-based technology. Such technology can provide photographic images of the toilet assembly which are self-attested and geographically tagged, thereby providing a much more accurate analysis. The subsidies are transferred directly into the bank accounts of the household grantee using electronic media. These are also applicable to accounts opened under the Pradhan Mantri Jan Dhan Yojna. It is imperative that the state government adopts policies such that the subsidies are transferred to the households in a timely manner without encountering hurdles. It is also vital that norms are framed to ascertain the accomplishment of these policies. The contribution from the states will be minimum of ₹2,667 per IHHL (Individual Household Latrine Application) towards individual toilets in contrast to ₹4000 allocated by the central government. Union territories without a legislature receive the entire incentive from the central government, i.e., ₹4000 per IHHL along with ₹1333 which is signified as a union territory share. Union territories with legislation receive the similar amount, however ₹1333 is borne by the union territory and not the central government. For

North Eastern and Himalayan states, the Central share will be Rs 10,800 per IHHL, and state share will be Rs 1,200 per IHHL.

Box 4.3-Nirmal Bharat Abhiyan

The Scheme has now been renamed as 'Nirmal Bharat Abiyan' (NBA) and revised guidelines have been issued by Government of India. The salient features of the revised guidelines are:

- Accelerating the sanitation coverage in the rural areas is advocated so as to comprehensively cover the rural community through saturation approach to create Nirmal Gram Panchayats.
- Implementation of NBA is proposed with 'Village Panchayat' as the base unit. Village Panchayats where all habitations have access to water are to be taken up on priority.
- Accelerate sanitation coverage in rural areas to achieve the vision of Nirmal Bharat by 2022 with all Village Panchayats in the Country attaining Nirmal status.
- Incentive as provided under the scheme for construction of Individual Household Latrines (IHHL) has been extended to all Below Poverty Line (BPL) Households and Above Poverty Line Households (APL) restricted to SCs/STs, Small and Marginal farmers, Landless Labourers with homestead, Differently Abled and Women Headed households.
- The incentive amount for construction of one unit of IHHL has been increased from Rs.3,200 to Rs.4600 (Rs.5100 for difficult and hilly areas). The Central share out of this is Rs.3200 (Rs.3700 in case of hilly and difficult areas) and State Government share is Rs.1400. Minimum beneficiary share shall be Rs.900.
- The schools which are not yet covered under SSA and Anganwadi Centres in the rural areas will be provided with proper sanitation facilities and proactive promotion of hygiene education and sanitary habits among students will be undertaken.
- Appropriate convergence with MGNREGS has been provided.
- All houses constructed by the beneficiaries under Indira Awas Yojana (IAY) or any other State rural housing Scheme which did not have toilets shall also be eligible for the incentive for creation of sanitation facilities.
- Solid and Liquid Waste Management (SLWM) may be taken in the proposed and existing Nirmal Gram Panchayats. The total assistance under NBA for SLWM projects shall be worked out on the basis of total number of households in each Village Panchayat, subject to a maximum of:
  a) Rs.7 lakh upto 150 households.
  b) Rs.12 lakh upto 300 households.
  c) Rs.15 lakh upto 500 households and
  d) Rs.20 lakh for a Village Panchayat having more than 500 Households

The sharing of cost among the Centre, State and Beneficiary contribution is as follows:

Category	Govt. of India Share	Govt. of TamilNadu Share	Beneficiary
IHHL	3,200	2,500*	900
School Toilet	24,500 (70%)	10,500 (30%)	0
Anganwadi Toilet	5,600 (70%)	2,400 (30%)	0
Sanitary Complex	1,20,000 (60%)	60,000 (30%)	20,000 (10%)
Solid Liquid Waste Management	70%	30%	0%

Sanitation Marketing

Sanitation is defined as ''safe management of human excreta and includes both the hardware (for example, latrines) and the software (for example, hygiene promotion) needed to reduce faecal-oral disease'' (DFID, 2019). Personal hygiene is of great significance when it comes to sanitation. It includes inculcating practices such as washing hands with soap after using the toilets, safety in handling water storage and collection etc. Environmental sanitation is a broader term encompassing disposal of faecal matter, solid waste management, disposal of waste water, disease control and drainage etc.

The idea of marketing in sanitation and sanitation products calls for a number of entities such as distributors, local producers, wholesale and retail sellers of cement and sanitary wares, service providers, masons and laborers, CSO in private and government sector etc. The salient functions include supply-side activities, demand-side activities, and regulatory and legal activities often referred to enabling environment. These are important to invigorate and audit the necessary demands which denote the required supply of materials, products, services, and to focus on regulation and enabling environment. The functioning can be carried out via various strategies depending on physical, cultural and regulatory conditions.

Phases of Developing a Sanitation Marketing Program

It can be divided into five phases viz., phase 1 to phase 5.

Phase 1: Getting Started

The preliminary step is to gather a group of individuals that will aid in conducting marketing strategies, prepare kick off workshop, and carry out the site, policy and population analysis. It is imperative to maintain regulation among the team thereby developing synergised vision, achieve consensus within important stakeholders and convey the true context in which the project has to be developed.

Phase 2: Researching the Sanitation Market

Any initiative involved in marketing strategy like sanitation market requires formative research as a fundamental foundation. This is based on collecting evidence and data, factors influencing them, and the types of products/services required. Formative research is also involved in informing an intervention in a continuous format which follows from designing to implementation and monitoring. Formative research helps give a clear understanding of the following;

- The situation that prevails presently
- The type of duties allocated and information in that regard
- Consequences of the prevailing situation and the steps taken thereafter
- Objective for bringing changes and how to attain them
- Degree of intervention being delivered and monitoring its success
- Alternate strategies that can be implemented

Phase 3: Developing a Strategy

This phase is involved in recognizing the goals and developing an annual/biannual plan. This planning should inculcate details pertaining to the marketing strategy. A document can be created which describes the course of action in detail including responsibilities, objectives and milestones, estimated timeline, budget, and research and monitoring plan. The data collected will be analysed, interpreted and coalesced to respond to important queries and develop the insight that the team will require in developing the sanitation marketing program. Sanitation marketing employs the "marketing mix" or six Ps (product, place, price, and promotion, policy and partnerships) to achieve the goals targeted in the marketing strategy and plan.

Phase 4: Developing Sanitation Marketing Materials

The objective of this phase is to utilize the data obtained from the formative research pertaining to the targeted population in developing a variety of designs for latrine as prototypes. Certain important steps and criteria are as follows:

- Propose alternatives for designs to adapt to soil types such as rocky and sandy types and also to water logging.
- Designing prototypes in real life field conditions using targets providers such as pit diggers, traditional informal sector providers, latrine brick/concrete masons; locate prototypes as close to target consumer market as possible.
- Testing of construction processes with these providers using tools and equipment.
- Testing these protocols with the help of the family of the household and understanding their take on the features of the prototype and any required modifications to suit them.
- Refining and shaping the design of the prototype and finalizing the design based on technical standards, material bills and initial costing and standardized construction process.

Communication materials are also to be developed to ensure effective advertisements and banners justifying the reason for any behavioural change, selecting the most efficient means of communication channels to deliver motivational messages promoting behavioural change and to increase awareness and understanding of the new product aiding in the decision making of the consumer.

The goal of your advertising effort is to enhance the demand for home sanitation while also raising awareness of any new latrine technology or services that you are giving to the general public. The following are the five essential activity stages and the accompanying tools:

Segmentation and Determination of Behaviour Change Objectives: One of the most important aspects of successful marketing is the identification of a clear and defined behaviour change goal against which to judge your campaign's effectiveness. There are two approaches to segment selection that may be used, and your team will have to make a strategic choice on which one to use:

- Households without latrines may be targeted regardless of the percentage of households lacking sanitation. b) Needs-based: selection on the basis of public health need/risk, whereby the health risk of open defecation may be defined as greater than the health risk of relying on a basic but functional latrine.
- In reach-based selection, the biggest population segment is chosen in order to target as large a number of households/people as feasible; this method is used to pick the most appropriate population segment for a campaign.

Case Study 15: Swachh Chattisgarh- Focus on Community Toilets

- 17,796 CTs and PTs have been constructed in the state up till now
- To resolve the problem of 24/7 toilets, rooms have been made for caretakers and their families, adjacent to the toilets
- Innovative toilets- Several innovative toilets have been constructed in the state, such as
  - 24 Hour toilets
  - Pink Toilets
  - Toilets for senior citizens
  - Toilets with feedback mechanism
- The O&M expenses of the CT/PT were covered by setting up advertisement boards on the walls of the toilet
- Each public toilet has been given a unique identification number, which helps the municipality in maintenance of adequate records

Motivation selection and promotional message development: Identify the most prominent motivation(s) driving your chosen target behaviour among the members of your selected demographic and include them into your promotional message.

Develop a communications channel mix for your target audience
(iii) This step is concerned with determining which means will be used to successfully deliver your promotional messages to your target audience. Fit between each communication channel and the targeted behaviour change and/or the promotional message that has been defined is important (s). In other circumstances, you may discover that, despite the fact that a communication channel reaches a large number of individuals, it is ineffective for encouraging latrine adoption or improvement.

iv) Determining the content of essential consumer education materials and establishing its structure: Create materials that explain to buyers the advantages (as well as the possible drawbacks) of the different toilet technology options you are providing.

To Do Activity

Make a team of 2-4 people and conduct a survey preferably within 1-2 km area near your residence or the Institution. Report your findings about the natural resources in the vicinity, sanitation systems and technologies used. Write a report on the status of the population on the barriers to use the facilities, feedback for improvement, optimization of the facility and any other parameter you can define for the local area.

The most important information to provide may be a fundamental picture of the technology, which may comprise subsurface, slab, and superstructure components.

- Fundamental technological and functional information, such as: Affordability in various geographic locations (e.g., high water table, rocky land, collapsing soils, termite prone areas) - The materials and related prices that will be required. - The maximum number of users that should be allowed - Instructions on how to use the product The following are the operating and maintenance instructions:
- A list of the most important advantages as seen by the target audience (e.g., easy to clean, durable, minimises smell, child friendly etc)
- A list of the most significant consumer-perceived negatives (e.g., high cost, temporary)
- Continue the previous exercise for the many superstructure alternatives that will be available, considering the function of superstructure in providing several consumer-perceived sanitary advantages such as seclusion, shelter, and/or ventilation to those who will be using them.

v) Materials development and testing: At this stage, you will need to collaborate with a local animator or artist to develop the necessary communication materials to aid in promotion as well as consumer education materials to facilitate technology selection and access to the service/technology.

Phase 5: Implementation
When it comes to implementing a sanitation marketing program, a single model cannot be used. Rather a combination of models is ideal. A majority of these kind of initiatives are taken up by government agencies or non-profit organizations. Private organization has a significant role to play in many ways, however it is more feasible to drive them into these social causes by developing a much more viable business model.

Case Study 16: GIS Linked Tirupati City Maps-Sanitation

Tirupati developed an online public toilets inventory (www.tgiz.akara.co.in) that can is used for monitoring of toilet maintenance and for future planning. It provides for a snapshot of existing services rendered by the city and is a one-stop shop for information regarding the toilets' condition. While planning for future demand, the online inventory was used to locate toilets and prioritize their implementation and also in bundling/clustering. Moreover, using the online inventory or mobile application, users can locate nearby public toilets and file complaints or report operator defaults, thereby contribute to the monitoring of the PT infrastructure, service provision and operator compliance.

Case Study 17: Creating Demand by Highlighting the Benefits of Sanitation

Female health workers were appointed by REEDS to work in six villages in the district. The problems related to hygiene were identified and the target groups were made aware of their poor practices and were encouraged to follow good hygienic behaviour. Women in these villages were also guided to create and organize themselves into self-help groups, which would help them in spreading awareness and gather information from their respective villages, which could then be clubbed and further analysed. Two women from each self-help groups were appointed, representatives of their groups, at the village-level network. Furthermore, two representatives from the village-level network would disseminate information regarding the developmental activities undergoing in the villages along with the issues and their solutions to the cluster of villages, collectively known as Mandal. The Mandals became a key network from where they could spread messages and awareness provided by the professionals such as doctors, community health supervisors, etc. The messages are then filtered down from the village-level network to the self-help groups.

The diarrhoeal disease outbreak in a small village called Hamsanpalli, reduced massively after construction of latrines. This information when presented at the Mandal garnered a lot of positive reviews and people came from different villages to see the latrines. They were impressed by the privacy, convenience and the status provided by these latrines in a house and wished to have one for themselves, which in turn created a demand for the construction of these latrines in many villages. REEDS along with WaterAid-India's assistance, helped villagers to construct a latrine by linking their villages with the Government low-cost latrine program. Almost 50 percent houses in Chowderpalli, one of the neighbouring villages now have latrines within them, Limganpallithanda, another village has approximately 14 percent coverage with their work only in the initial stages. These villages previously had no latrines, but due to the dissemination of information from the Mandal, they are now making latrines for themselves, exhibiting, and practicing good hygiene behaviour.

Chapter Summary

Sewerage and sanitation infrastructure need to be developed sustainably, with workers trained in better O&M practises, new technology and sector management. Thus, frequent planning of training programmes and budgeting for training, field excursions, and international visits is essential from the project planning stage. It is advised to evaluate the training's influence on participants and the system's management efficiency, and to modify training processes as needed. The method should be such that trained workers stay in the company following training and do not depart for a better opportunity. This is difficult unless time-bound promotions are assured and similar services to these individuals are developed. The current incapacity of ULBs to improve service levels is always tied to revenue shortfalls. The public expects improvements before paying the increasing taxes. The extra levies must be paid by the public for the ULBs to begin and exhibit the upgraded services. A

conceivable option is for each ULB to seek a government "proving grant in aid" and then ask the public whether they are ready to pay extra levies to expand the pilot facility. However, the Government may have to spend the capital cost upfront as a soft loan to the ULBs, with the ULBs repaying the soft loan from higher levy income. This is the only way to improve services. A utility's technical, environmental, and economic factors must be considered while deciding whether or not a private partnership is feasible. Despite stronger resources, a private corporation can only run successfully on a rational economy of scale. A regular customer satisfaction survey may be required to determine if the majority of consumers are willing to pay for greater services and value. Sewage works O&M in India is a mess. One factor is a lack of O&M funding. This is due to the lack of a systematic method to forecasting O&M fund and human resource demands. This chapter examines these and proposes ways for calculating required expenses. A CD containing Excel spreadsheets is also supplied. Data collection and frequent evaluation are required to personalise the Excel sheet to each ULB. The advice demonstrates considerable prudence while applying to certain ULB. This is a genesis that will require refinement.

Model Questions

1. What is the difference between sanitation and environmental sanitation?
2. Against what environmental health threats can sanitation protect us?
3. What other indicators could measure progress in global sanitation?
4. What are the most important questions you would need to address in a rapid assessment of an emergency?
5. What are the possible interventions to manage the solid waste in an emergency situation? List at least three actions that could be taken.
6. Briefly outline why standards are important in the management of emergencies.
7. From case studies in the text and from other resources, discuss how some regions overcome obstacles to increasing their sanitation coverage have.
8. What are the effective ways of monitoring the maintenance of toilet facilities?

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Chapter 5 Community and Sanitation

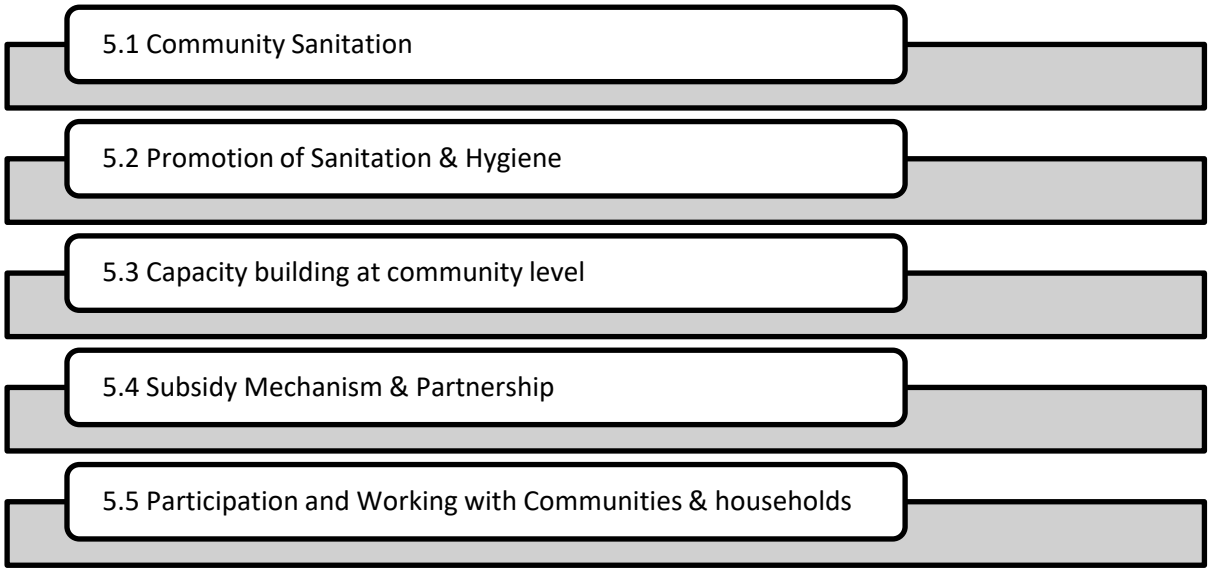
Introduction

Focus on rural sanitation began in the 1980's by the International Decade for Drinking water and Sanitation. The Central Rural Sanitation Programme (CRSP) of 1986, aimed at bettering the quality of life of rural India and also to offer privacy and increase self-respect of women. From 1999, under the "Total Sanitation Campaign" (TSC) focus on Information, Education and Communication (IEC), Human Resource Development (HRD), Capacity Development activities were undertaken to increase awareness among rural people and to generate the demand for sanitary facilities. This allowed the rural population to make informed decisions based on their financial situations through the alternate delivery systems. Financial incentives were provided to those belonging to the Below Poverty Line (BPL) households for construction and use of individual household latrines (IHHL) in recognition of their participation and achievements. Despite the large amounts of progress and awareness, an alarming number of countries are still unable to provide the entirety of their populations with appropriate sanitation and hygiene that is necessary for their health and dignity. As the necessity and need for sanitation for improvement of child development and various health issues continues to spread, achieving this goal is going to need context specific and adaptive programming, focusing primarily on the poor and the weak where this reach has been slow.

Objectives

- To provide description of the different programs on Sanitation in India
- To know about the phases for promotion of sanitation and hygiene and its impact on health
- To understand the relevance of capacity building in the community so that the benefits reach all stakeholders
- To identify subsidy mechanisms and partnerships available on site
- To provide an overview of participation by the end user in the process of working towards ODF +

Chapter Structure



5.1 Community Sanitation

Creation of community and public washrooms for sanitation purposes has been the most suitable solution to combat public excretion issues for those who cannot afford to have their own personal toilets. The Swachh Bharat Mission recognized this and introduced a provision of a maximum unit cost of 65000 per seat for construction of community toilets with a 40% VGF from central government and remaining from the state/ULB share.

Across the world, 4.2 billion people lack safely managed sanitation services. 'Sustainable Sanitation and Climate Change' - this year's theme of World Toilet Day, observed on November 19, has focused on the danger that climate change proves to be for sanitation systems and the ability of stable sanitation systems to fight back against climate change. Toilets may be the first step towards sustainable sanitation under safe and dignified settings.

Design and management of toilets plays a major role in sanitation and hygiene. A carefully thought of design can ease the management process of it and reduce the operation and maintenance cost. The design should be such that it not only focuses on the toilet facility aspect but also allows easy cleaning and maintenance and be as resistant as possible to damage. The design and materials should be such that it can be used stably for a long period of time. While the design overall should be accessible for universal use, it should also be able to cater to the sanitation and hygiene needs of the differently abled, old, young, men and women as well.

Program on Sanitation in India:

Total Sanitation Campaign (TSC), 1999: TSC was started with a simple aim to bring attention to issue of sanitation itself. It wanted to create a demand for proper sanitation facilities especially in rural areas; and create awareness for the need of it.

Nirmal Bharat Abhiyan (NBA), 2012: The main aim of NBA was to create a sustainable behaviour change with its main outcome being cleaner villages. Sanitation campaigns have advanced over the years with greater focus on public health scenarios.

Swachh Bharat Mission (SBM), 2014: SBM was launched on a national scale by PM Modi with the programs' main aim being to make India open defecation free (ODF) by 2019. The focus of SBM has been to provide complete sanitation by removing manual scavenging and open defecation as well as improving toilet structures. In the rural context, it aims to launch solid and liquid waste management techniques. Hence, Community Sanitation may be defined as a group effort to teach and implement sustainable hygiene and health measures to a group of people living close to one another. E.g.: Construction of toilets.

In order to ensure all households, especially the marginalised communities, have access to toilets, the Government of India is focusing on construction of Community Sanitary Complexes (CSCs) in rural areas as part of the second phase of its Swachh Bharat Mission. In this, it delegates the Gram Panchayats or the village councils to decide the appropriateness of location and to ensure water accessibility and long-term operation and maintenance (O&M). Previous experience shows that CSCs are plagued with low usage and poor O&M.

Box 5.1- India-Total Sanitation Campaign (TSC)

Key characteristics of India's Total Sanitation Campaign (for the rural population only) are:

- Offering a broader range of technologies and technology improvisations with reference to customer preferences, construction materials and capacities „
- Developing back-up services such as sanitation production centres (PC) and rural sanitary marts (RSM) with trained masons „
- Stressing software, including intensive Information, Education and Communication (IEC) campaigns „
- Dovetailing funds from GOI and state programmes aimed for rural development „
- Fostering broader participation including NGOs, civil society organisations and CBOs „
- Target group: especially Below Poverty Line (BPL) households „
- Districts can submit plans with 5% preparation, (100% central finance), 15% IEC, 5% alternative delivery mechanisms, and 5% overhead costs (all with 80% central, 20% state finance), 60% hardware costs household toilets (60% central/20% state/20% user), 10% school systems (60%/30%/10%) „
- Subsidy and subsidy sharing is GoI/State/Household 60/20/20% for underground parts @ Rs 625 (US $13 in 2001, users to pay all upper parts) and 30/30/40% for underground parts @ Rs 1,000 (US $21). Subsidy is to be gradually and progressively phased out „
- Open Defecation Free communities, blocks and districts can go for prize money „
- Pilots in 115+ districts had increased to 200 districts by the end 2002 (one district = circa two million people). India has 593 districts, of which 578 are rural
- Sources: GoI, 2001, Shordt, 2006

As most toilet blocks are poorly maintained it is common to find broken doors and missing locks. For women and young girls this violates their right to dignity and a threat to their safety. Presently, most public and community toilets lack any provisions for menstrual hygiene management. Only five per cent rural households lacking an individual household latrine (IHHL) used a shared latrine. Studies have been conducted to find reasons for opposition to use of a community toilet; such as caste barriers; upper castes prefer to defecate in public rather than using a shared toilet that is being used by STs/SCs or has even been made by them. There is also an opposition in doing a private act (defecation) in a public facility.

Community toilets are shared between a fixed group of households. In urban areas it is possible to create a user management committee who will look after subscriptions and fees. Urban areas are highly populated and tightly packed, makes this kind of an arrangement possible. However, in rural areas where houses may be more spread out and IHHLs more common, this arrangement may not work.

Maintenance of Community Toilets

Community Toilet: A communal toilet is a facility that is constructed when there is insufficient space or funding to construct IHHLs. Community members or local governments utilise, own, and manage it. It is usually located in or near the community area and used by practically all members of the community, whereas public toilets (PT) are provided for the floating population / general public in places like marketplaces, train stations, and other public spaces and are largely used by undefined people.

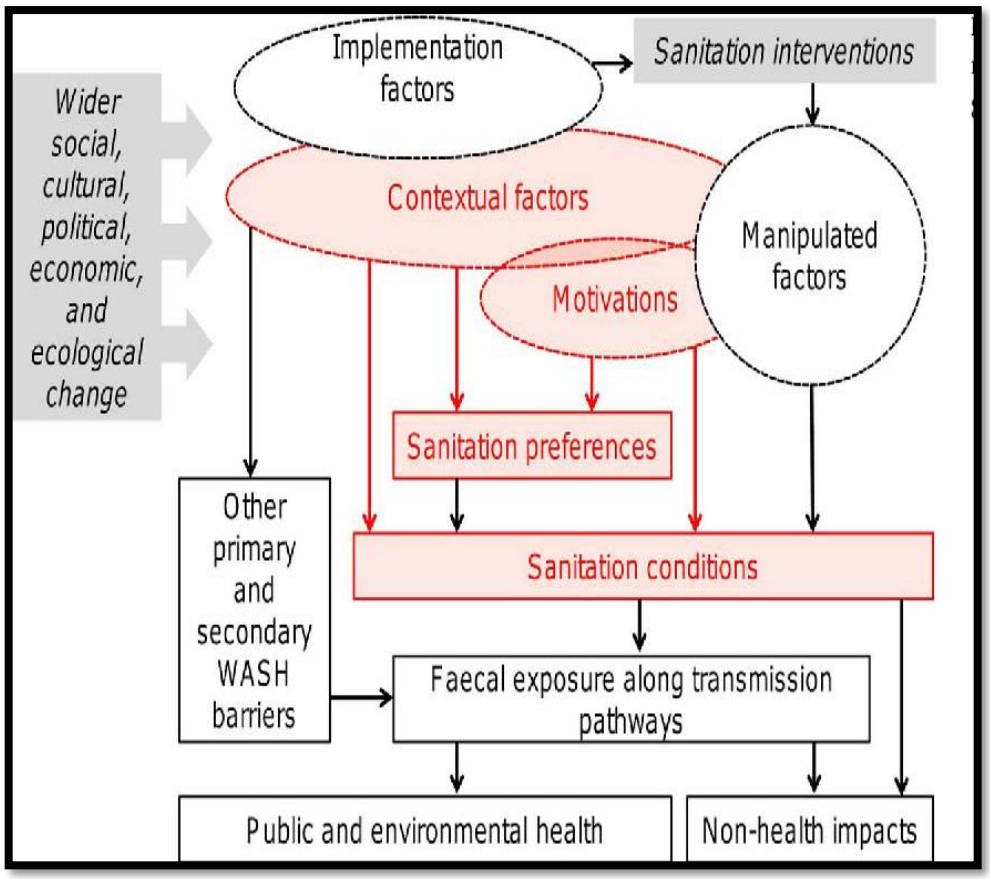


Figure 5.1 Flow Chart Depicting Factors Affecting Sanitation

In 2014-15, the SBM completed approximately 58 lakh household toilets, exceeding the objective of 50 lakh individual latrines. When it came to school and anganwadi toilets, however, the numbers had dropped significantly. While one of the main goals of the Swachh Bharat Abhiyan is to build individual household toilets, community sanitary complexes and liquid waste management are also important parts of the broader Swachh framework.

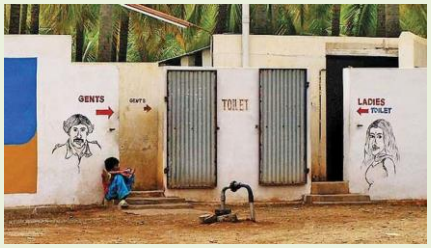
Managing Community Toilets

In India, 85 million urban citizens and slum dwellers lack access to decent sanitation. Despite the fact that community toilets have the potential to overcome the sanitation gap where individual family latrines are lacking, they are unpopular not only in urban areas but also in rural India. It is not as simple as it may appear to persuade people to use public restrooms. While complicated conceptions of contamination and purity deter individuals from building toilets in their houses, public restrooms present some very real hygienic challenges that must be addressed. The upkeep of public restrooms has long been neglected, and little has improved over time. While the majority of villages and wards used these toilets when they were available, two things influenced their effectiveness: cleanliness and water supply.

The term "public toilets" implies that they are to be given for the floating population/general public in places like markets, train stations, tourist attractions, near office buildings, or other public areas where a large number of people pass through.

A communal facility supplied by and for a group of inhabitants or an entire settlement is conveyed by the term "community toilets." Community toilet blocks are generally utilized in low-income and/or informal settlements / slums where providing a household toilet is difficult due to space and/or land constraints. These are intended for a specific user group.

Case Study 18: Status of Community toilets in MP (5 CITIES)



Out of 476 CTs only 82 CTs are such where user charges are being collected, in Gwalior only 2 and in Jabalpur only 12 CTs exists where users are paying which is very low in numbers.

CTs having water availability	**City**				
	Bhopal	Gwalior	Indore	Jabalpur	**Total**
Number of CTs having water availability	42	12	39	28	121
Not maintained and not used Properly	2	1	5	2	10
Poorly maintained but used	8	2	7	9	26
Properly maintained but not crowded	20	6	14	13	53
Properly maintained and over crowded	12	3	13	4	28

Out of 121 CTs in project cities having availability of water, 111 CT (92%) are in use and 85 CTs (70%) are maintained. From the above analysis it can be inferred that the most critical factor for the sustainable use of CTs is the availability of water.

Several studies have found that people in rural areas have a strong reluctance to using public restrooms. Individual home latrines (IHHLs) are not used by people who do not have them, preferring instead to defecate in the open.

A communal toilet should include all of the amenities listed in the section on public toilets, such as a bathing cubicle, a washing machine, a toilet for children, and a place to dispose of used sanitary napkins. A modest child care / baby feeding area is not required in a community restroom, though. Markets, train stations, tourist attractions, near office complexes, and other public areas with a large number of people passing by are examples of places where public toilets are provided for the floating population/general public. Everyone should be able to use public restrooms, and they should be well-connected to major places and pedestrian crossings (Swachh Bharat Mission Guidelines). The communal facilities provided by and for a group of inhabitants or a whole settlement are known as community toilets. Community toilet blocks are generally utilised in low-income and/or informal settlements / slums where there is a lack of space and/or land to provide a household toilet. These are for a very consistent user group. (Swachh Bharat Mission Guidelines).

The incentive granted under the scheme for the construction of Individual Household Latrines (IHHL) has been extended to all BPL and APL households, with the exception of SCs/STs, small and marginal farmers, landless labourers with homestead, differently abled and women headed households.

Community toilets were found to be better maintained in metropolitan locations, with 73.1 percent of toilets being cleaned on a regular basis by personnel hired by local municipal organisations. Many Residents' Welfare Associations were shown to be actively involved in maintaining community assets. RWA employees were in charge of cleaning community toilets in 12.2 percent of the wards. Toilets, on the other hand, were abandoned in 8.6% of wards because no one looked after them.

If towns and city corporations were more diligent, the results may be better. When Tiruchirappalli City Corporation partnered with city-based NGO Gramalaya to encourage women from local slums to care for their community sanitation complexes, it experimented with volunteerism and local initiative. The ladies took it upon themselves to ensure that the amenities were well maintained, ensuring that the majority of their fellow residents would continue to patronise them. The city corporation was encouraged by the positive results to try it out across the city. The scenario is likely to be repeated in many of today's crowded cities, where a large portion of the urban poor's sanitary infrastructure is in disorder.

Water Supply and Toilet Presence

With escalating preference for pour-flush toilets, sustained toilet use, both at the individual or community level, cannot be ensured in the absence of water. The availability of water plays a crucial role in keeping toilets functional at the household level, as seen in the graphs below. It's no surprise that the percentage of rural households with sanitary toilets and the number of households with access to water for toilet use are roughly equal - 45.3 percent and 42.5 percent, respectively; this means that 93.9 percent of households with toilets have access to water for toilet use.

Both in urban and rural households, it is obvious that continued toilet usage is contingent on water supply. However, given the increasing unpredictability (and fragility) of piped water supply, which has been documented all over, basing Total Sanitation on water flushed toilets poses a significant risk, particularly in rural regions. While community toilets such as Sulabh Sauchalaya illustrate the way forward in quickly urbanising India, we should not dismiss the importance and utility of dry pit latrines in distributed houses in smaller villages across the country. These are simple, inexpensive, clean (when used and kept properly, they consume very little water, unlike flush toilets), and comply with the cultural need of having latrines outside the house.

5.2 Promotion of Sanitation & Hygiene

Participatory Hygiene and Sanitation Transformation (PHAST) is an acronym for "Participatory Hygiene and Sanitation Transformation." The method is a participatory learning system that aims to empower communities to improve hygiene habits, reduce diarrhoeal disease, and promote effective community water and sanitation management (WSSCC 2009). It employs a seven-step structure for community learning and planning that is participatory in nature (NETSSAF 2008).

Table 5.1 PHAST for the prevention of diarrheal disease (WHO pioneered this method)

Step	Activity	Tool
Problem Identification	1. Community stories Activity 2. Health problems in our community	Posters ASHA workers
Problem Identification	1. Mapping water and sanitation in our community 2. Good and bad hygiene behaviors 3. Investigating community practices 4. How diseases spread	Community Mapping 3 Pile sorting Pocket chart Transmission routes
Planning for solutions	1. Blocking the spread of disease 2. Selecting the barriers 3. Tasks of men and women in the community	Blocking the routes Barrier charts Gender role analysis
Selecting Options	1. Choosing sanitation improvements 2. Choosing improved hygiene behaviours 3. Taking time for questions	Sanitation option 3 pile sorting Question box
Planning for new facilities and behavior change	1. Planning for change 2. Planning who does what 3. Identifying what might go wrong	Planning posters Planning poster Problem box
Planning for monitoring and evaluation	1. Preparing to check our progress	Monitoring charts
Participatory evaluation	1. Checking our progress	Various tool options

PHAST works under the premise that communities that become aware of their water, sanitation and hygiene situation through participatory activities are enabled to develop and implement their own plans to improve this situation (WSSCC 2009). In addition, PHAST tries to help communities improve their hygienic behaviour, prevent diarrhoea and promote local management of water and sanitation facilities. PHAST thus shows the connection between hygiene and state of health. PHAST seeks to help communities to improve their hygiene behaviors, to prevent diarrheal diseases and to encourage community-management of water and sanitation facilities. PHAST hence demonstrates the relationship between sanitation and health status.

In addition, the method seeks to increase the self-esteem of the participating community members by involving them in the planning process. Community empowerment helps plan environmental improvements and own and operate water and sanitation facilities. To achieve these goals, the PHAST approach uses participatory methods to encourage the participation of individuals in a group process (WHO 1998). , Action planning and responsibility. PHAST is based on another participatory methodology called SARAR, which stands for self-esteem, associative strengths, ingenuity, action planning and responsibility.

Case Study 19: Eco-san toilets, Tiruchirapalli

This strategy aimed to include self-help groups in the operation and maintenance of CTs. The success of this strategy was due to the emphasis on multi-stakeholder collaboration and community ownership of the assets. Gramalaya, a non-governmental organisation, was a partner in this endeavour to enhance and sustain sanitation in Tiruchirappalli's slums.

Within two years of forming the partnership, 179 of the 186 slums in the Corporation area were designated open defecation-free. Gramalaya has constructed leach-pit toilets and pit latrines using locally available materials. But, in some of the operational areas of Gramalaya, like in the tsunami affected areas of coastal region, Gramalaya introduced eco-san toilets. The eco-san toilets are welcomed by the fishermen communities in Nagapattinam District of Tamil Nadu. The successfully field tested models were tried in the water-logging regions of Cauvery delta in Tiruchirappalli District.
A combination of PTs in commercial districts and CTs in slum populations was used in the model. A mix of pay-per-use and free services are available. The model includes conducting hygiene and sanitation training programmes.

Factors to be addressed by a programme of sanitation health and hygiene promotion should be formulated following a comprehensive participatory process (PHAST), and may include:

- safe disposal of urine and faeces including desiccated and composted wastes,
- good personal hygiene practices,
- importance of clean toilets,
- food hygiene,
- keeping stored water clean and hygienic,
- safe disposal of wastewater,
- implications of inappropriate hygiene practices and associated diseases.

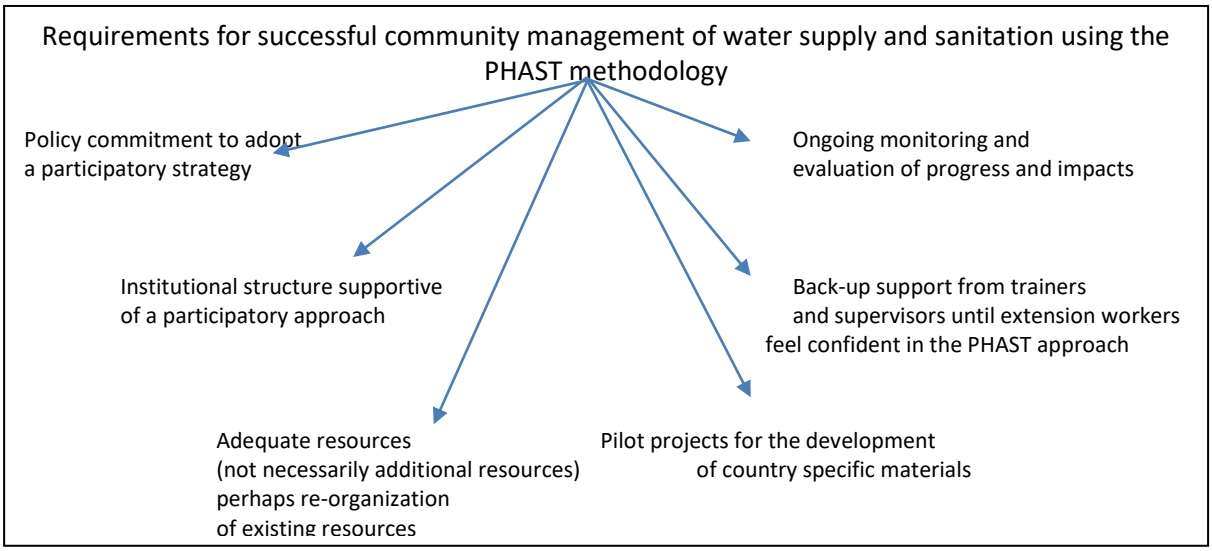


Figure 5.2 PHAST Methodology

Principles of the Partnership:

- Maximum local adaptation and innovation should be encouraged.
- The initiative should apply an adaptable learning-process approach, rather than lay down a prescriptive set of tools to be followed. This recognizes that those running the initiative do not have the answers and that the project should be experimental and creative.
- There should be common ownership of the methods and materials produced, with due recognition of the contributions of the various partners in subsequent phases and applications.
- There should be wide sharing among the partners of the lessons learned.
- There should be a core team for each country to coordinate activities, seek financial support and distil the lessons learned

It is very important to carry out the identification of all the stakeholders and their positions in each domain. The stakeholders are the people who are directly or indirectly affected by the Sanitation situation in a particular community or area, these can be further grouped into primary, secondary and tertiary. The primary stakeholders are made up of community members and farmers, who will be the end users of the implemented systems. The secondary stakeholders are the municipality and local authorities responsible for the planning and implementation of the projects. The tertiary stakeholders are made up of NGO's and CBO'S, National authorities and financial institutions, they assist in advocating, raising awareness as well as providing funds for the project.

What are Participatory Methods?

Individuals of any age, gender, socioeconomic status, or educational background are encouraged to participate in a group process using participatory methods. They're especially beneficial for enticing women to participate (who may be hesitant to express their opinions or unable to read and/or write in some cultures). Participatory approaches are intended to increase self-esteem and a sense of ownership over one's choices. They strive to make decision-making simple and enjoyable. They are intended for community-wide planning. Participants learn from one another and respect one another's expertise and abilities.

Health Awareness and Community Change

When a common water supply is replaced with domestic water supplies, the quality of life improves significantly. Domestic water sources provide more water for bathing and watering animals and gardens, as well as more privacy for faeces. Convenience, privacy, and status are all well-known benefits that might inspire a society to improve its environment. People, on the other hand, frequently misunderstand how water and sanitation affect health. As a result, fostering such understanding can aid in the development of long-term transformation.

Table 5.2 Raising Awareness and Knowledge on Sanitation And Hygiene

Audience	Specific activities	Inputs needed
Primary – general public	• Mass media – print, electronic – in Hindi and local languages • Mass media campaign	• Video appeals • Audio appeals • Print advertisements • Press releases
	• Outdoor and traditional media ✓ Outdoor media such as wall paintings and hoardings at strategic locations ✓ Folk media performances	• Hoardings and wall paintings • Sanitation and hygiene messages to be depicted through folk theatre and songs
	• Digital and social media networks ✓ Development and regular management of a campaign website cross-linked to MDWS & related websites ✓ Use social networks for viral advertisements	• Contract web agency • Develop appropriate advertisement for social networks e.g., page on Facebook
	• Mobile campaign ✓ Partnership can be forged with a service provider for initiating an SMS campaign with messages on handwashing and open defecation • Celebrity outreach campaign ✓ Broadcast PSA on primetime across the country on hygiene and sanitation for broad dissemination through radio, TV, print. ✓ Field visits by the celebrity ✓ National level mega event involving celebrities etc. to give away awards to officers, political leadership and civil society organisation who have made significant contribution in the WASH sector	• Develop SMSs with a defined call to action • Mobile voice message with a celebrity with pan-India appeal emphasising WASH issues • Identify celebrities to champion the cause/select brand ambassadors • Develop appeals with celebrities/brand ambassador Arrange field visits • Organise events on designated days/ weeks/months like Global Handwashing Day, Swachchata Utsav

How to Increase Health Awareness

People gain health awareness when they can describe how diseases spread in their surroundings and via their own actions. This tutorial is founded on the idea that people can and should learn about how diarrhoeal diseases spread, and that learning about it might motivate them to modify their hygiene habits.

People can identify alternative strategies to restrict transmission routes if they understand how transmission occurs. They can also consider the benefits and drawbacks of obstructing those paths in their own homes and towns. Is it going to be a lot of work, time, and money? What would the advantage be? Is it really worth it? This understanding premise is the foundation of three activities in the handbook. People can analyse their current hygiene behaviours by looking at good and bad hygiene behaviours, while understanding how diseases spread and stopping disease spread can help them understand how transmission occurs and how it can be stopped by looking at how diseases spread.

Advantages

- By incorporating the communities in project design and implementation through participatory methodologies, it is extremely gratifying for both community members and community workers.
- Communities develop confidence and ownership of their projects, as well as a clear understanding of what they want and don't want.
- Effective community participation in monitoring and evaluation guarantees that the services put in place react to the community's requirements and that vital direct feedback can be used to adjust operations as needed.
- With adequate leadership and management, trained community workers in participatory methodologies can become a long-term asset to the programme and the community. (WORLD BANK 2007)

Disadvantages

- Requires in-depth training in participatory tactics for community workers, as well as regular refresher sessions. This has financial ramifications.
- To participate in the training, it is usually required to pick experienced community workers. A two-week basic training does not guarantee that community workers will be able to utilise the strategy successfully in their communities.
- It necessitates a comprehensive management framework. This is doable in smaller “grass-roots” efforts, but it becomes hard when the goal is to “scale up” at a programmatic or national level.
- Their use requires a significant amount of time. The strategy necessitates the availability of the recipient communities to participate in the participatory exercises. If not effectively communicated with the community ahead of time, this may be regarded as a burden.

5.3 Capacity Building at Community Level

Community capacity building (CCB) focuses on enabling all members of the community, including the poorest and the most disadvantaged, to develop skills and competencies so as to take greater control of their own lives and also contributes to inclusive local development. In particular, it is important to mention that masons and swachhagrahis are key to ensuring the implementation of the on-site retrofitting, which is critical to the sustainability of ODF and the evolution towards ODF +. It is

therefore of the utmost importance to invest in their capacities in order to both trigger inquiries and offer and implement the technical possibilities and costs of retrofitting. Alongside the Swachhagrahis, masons too in SBM-G 2 are involved in several aspects of the interventions in building new toilets, retrofitting and providing upgrade options. Capacity of bricklayers and swachhagrahis in relation to retrofitting with a focus on: technical options for retrotting and the related construction skills (in convergence with NSDC) and communication skills for household motivators / promoters about retroting options and triggering demands for retrotting. Also skill building exercises to combat disgust.

Swacchagrahis must be well trained in communicating behavioral changes. Gender balance should be preserved. As a rule of thumb, a district must have at least one Swachhagrahi per village on average. This number can be higher if the volume of work is higher. In addition, this number can be multiplied through internal training, and more experienced / capable Swachhagrahis can be assigned higher responsibilities at the cluster / block / district level. A mechanism for paying fees to the Swachhagrahis can be established in accordance with SBMG guidelines using IEC funds. Districts can exercise the flexibility in structuring the Swachhagrahi fee based on the local context. Swachhagrahis can also be hired voluntarily and without payment if they show the State Social and Behavior Change Communication (SBCC) strategy / guidelines (2020) willingness to do so. IPC materials such as ipbooks, brochures, posters, interactive games, etc. can be made available to these Swachhagrahis by the district to enable them to better communicate.

Open Defecation is still a major problem faced by many rural districts throughout India. Due to a number of factors like lack of awareness, basic necessities and more, toilets are an issue that has not been on high priority for government officials and locals alike. However, the building of toilets in individual homes as well as public areas are going to bring a lot of major benefits. Not only does less toilets affect personal hygiene, it also leads to a lot of harmful diseases.

Benefits of Building Proper Toilets

- Reduces the physical and mental stress on people (especially women, elderly and children) to go long distances just to relieve themselves.
- Provides privacy and basic amenities, without causing a financial and ethical burden.
- The sewage run-off can be led off to proper treatment facilities, limiting the spread of harmful diseases caused by open defecation.
- By-products from the facilities, like ‘Gobar gas’ and treated water, can be put back into use for running other services. This reduces financial, material, manual, and time-related costs and problems.
- The funds, effort and materials that are saved, can be used for further progress of the local area. Especially, maintenance of amenities like steady electricity and agricultural requirements can be accomplished

Government-sponsored programs like SBM are incredibly helpful in improving the lives of local people. While the SBM program is being conducted for the past few years, more promotion is need to increase awareness and knowledge amongst districts. While it has been spreading around speedily, many people are still hesitant to avail the amenities. The most prevalent reason is the confusion around the application process, and the thought that it would be very difficult and expensive to get. The information, education and communication (IEC) component is an essential part of SBM. Inclusion of IEC is critical to achieve a measure of success for any mobilization

campaign that is targeted at an entire community.

For ensuring ODF sustainability the capacity of community, functionaries and other stakeholders needs to be enhanced greatly. This is done majorly by the Block Level Cell and Cluster Level Cell that play an important role in the capacity building of the frontline workers who will act as communicators like community leaders, Swachhagrahis, Asha, Jaldoots/Jalsurakshaks, teachers, SHG leaders etc. Change can be brought to Capacity Building Behaviour if people have enough information about the program and the benefits that it brings. For increasing awareness, multiple steps can be taken:

1. Conducting training workshops for State and District IEC Consultants every quarter.
2. Preparation of plans for IEC/BCC activities.
3. Teaching PRIs about the program, providing demonstrations of the services and benefits of the amenities.
4. Carrying out WASH seminars for teachers and students, starting at the basic schooling level for maximum impact.
5. Partnering with celebrities and using social media to spread awareness throughout India, in a short span of time.

After the SBM program has been implemented, regular maintenance is necessary to keep the community Open Defecation Free. While the residents have a duty to take regular care of the sanitation equipment, the responsibility falls upon the State and District government to enforce the rules. Detailed measures must be put into place to monitor the ongoing status of the program Table 5.3. Here, technology can help to make monitoring activities easy and efficient.

Table 5.3 Detailed measures to monitor the ongoing status of the program

One way/ Monologic	Two way/ Dialogic
To INFORM (changing awareness and/or/knowledge)	TO UNDERSTAND (building trust, listening, assessing situation)
TO PERSUADE (changing attitudes and/or behaviors)	TO ENGAGE (interacting, empowering, building consensus for behavior change)
TO ADVOCATE (promoting, influencing)	TO MOBILIZE (activating, enhancing demand and ownership)

Even during the initial stages of implementation, digital services can help keep track of progress. For example, Swacchta Raths can be fitted with GPS tracking devices to ensure it is travelling to locations according to schedule.

Initiation

There are many factors involved in constructing bulk toilets in a community driven program like cost, labour, land allotment etc. To get the process simplified and in accordance with the legal laws, local area head can work jointly with the municipal officials. Through a mix of self-revenue and State-District sponsored schemes, significant financial aid can be achieved for bulk construction. Additional funds can be obtained by indulging in CSR activities too.

Swaccha Bharat Abhiyaan provides financial help for construction of public toilets in urban areas. AMRUT, on the other hand, provides monetary benefits for sewage treatment and water supply/distribution mechanisms related to public toilets. Further funds required for regular maintenance can be acquired through:

1. Subsidies from Central/State/District sponsored programs.

2. Local body levying a small fee for usage of public facilities.
3. Creating relevant commercial options attached to the public toilets, obtaining steady revenue.
4. Partnering with local brands to sell discounted products, gaining physical and financial resources. Through this method, management can improve range and quality of offered services.

Role of the State

States are supposed to lead IEC/BCC plans and be in charge of spreading BCC interventions throughout the state. As follows:

1. Develop a BCC/IEC strategy and plans for the state.
2. Each state must ensure that all District Swachhta Plans are produced and put into the IMIS
3. Each state must evaluate and keep a record of these duly filled District Swachhta Plans for future reference.
4. States must guarantee that all districts have completed a planning and budgeting exercise for IEC/BCC programmes.
5. Put state-level activities into action
6. Use of social media: maintaining active Facebook and Twitter pages around Swachh Bharat; amplification of national IEC commercials on TV/Radio/Community Radio; and/or creative design of State-specific creative content for mass media distribution
7. Exploring greater use of new methods like Community Radio for communicating directly with local communities
8. Using local celebrities to communicate the message of SBM
9. Regular felicitation of local champions at the State level
10. Ensuring that all IEC positions in the HR structure are filled properly at the state and district levels.
11. Regular Monitoring of Progress and timely reporting in the IMIS
12. Engaging key agencies and developing partnerships to ensure that the IEC/BCC Plans are implemented effectively in the State. Partnering with Development Organizations
13. Contributing to SBM-Knowledge G's Management Portal, "Swachh Sangraha"
14. Organize workshops, conferences, and consultations as needed for advocacy, capacity building, and knowledge sharing among grassroots sanitation officials, the media, sector specialists, sanitation policy researchers, and others.
15. IEC/BCC initiatives should continue in the post-ODF period to focus on issues such as toilet cleaning and maintenance, household emptying of toilet pits, continued usage, building gram panchayat processes to maintain sustainability, ensuring water for sanitation, and SLWM activities, among others.

Role of Districts

Detailed IEC plans for the district should be created (fill relevant sections of the District Swachhta Plan - Form B09 of the IMIS)

1. Develop an annual calendar of activities
2. Ensure enrollment of one or more IEC Consultants at district level
3. Enlist the services of the Zila Swachh Bharat Prerak in scaling up IEC activities in the district
4. District level social media engagement: Active use of platforms like Facebook, Twitter and WhatsApp for spreading the message
5. Monitor Implementation in all GPs

6. Ensure that there is at least 1 Swachhagrahi in each village. Out of these, 2 motivators in each GP are to be hired by September 2017, and reflected in the IMIS.

Capacity building

Behaviour change can be affected by ensuring that all stakeholders are informed at the state, district, block, and village/GP levels. It is possible to hold training workshops in this regard.

State Level

- Quarterly training of State IEC Consultants and District IEC Consultants
- Preparation of State and District IEC/BCC Plans
- Training on communication plan procurement and execution and monitoring

District Level

- Community-led village saturation methods training
- PRI training to familiarise employees with the programme
- Communication Monitoring and Evaluation training

Block Level

- Village motivators receive training on community-led total sanitation initiatives
- PRIs receive training to become familiar with the programme
- Village teachers receive training on community-led total sanitation initiatives

CAS Training of Swachhagrahis

The training of grassroots motivators in Community Approaches to Sanitation is the most critical IEC activity that all districts must prioritise (CAS). Many organisations provide this training under many brand names, such as CLTS, CATS, and others. A number of Key Resource Centres (KRCs) for Sanitation have recently been appointed by the Ministry of Drinking Water and Sanitation. The empaneled KRCs are equipped to provide CAS trainings and may be contracted by districts at pre-approved prices, as detailed in the Ministry's Sanitation KRC Guidelines. (http://mdws.gov.in/key-resource-center-training)

Triggering and Nigrani

After the Swachhagrahis have completed their CAS training, they should be sent to villages to conduct ‘triggering' activities, followed by ‘nigrani' activities the next day. A Participatory Rural Appraisal is usually followed by a guided conversation with community members as part of a ‘triggering' exercise. ‘Nigrani' includes an early morning tour to common OD places in the village to reinforce the message after it has been triggered. Triggering and Nigrani can be carried out by CAS-trained Swachhagrahis.

Because sanitation is a joint effort, any IEC / BCC tool that divides / shames people based on toilets (e.g., putting red/green labels on houses) should be avoided. Positive reinforcement might be the best option. Those who have performed outstanding work in the field of sanitation should be publicly recognised and honoured as celebrities. They should be properly engaged in order to spread the word to neighbouring villages.

Interpersonal Communication

Manpower for IPC must be provided in the shape of an unit of Swachhagrahis. Insiders with a lot of experience may frequently make inter-personal interactions go more smoothly. They must, however, be carefully chosen and well-trained in CAS and other behaviour change communication methods. As

a matter of thumb, each village in a district should have at least one Swachhagrahi. If the amount of work is greater, this figure may be higher. Furthermore, through in-house trainings, this number might be multiplied, and more experienced / high-performing Swachhagrahis could be allocated larger duties at the cluster, block, and district levels.

According to the SBMG Guidelines, a method for paying honoraria to Swachhagrahis could be established utilising IEC funding. Swachhagrahis may be hired voluntarily and without remuneration provided they demonstrate a willingness to do so. The district may give these Swachhagrahis with IPC materials such as flipbooks, leaflets, and posters to help them communicate more effectively.

a) Each village should have one swachhagrahi.

b) Swachhagrahis should be properly rewarded as outlined in the standards, with local factors being taken into account.

c) They should be given access to timely and effective communication materials.

d) CAS-trained motivators must engage in 'triggering' activities before engaging in 'nigrani' activities.

Aside from motivators, each district need an IEC/BCC Consultant to help in coordination.

→ *Pic: Innovative game (sorting game) used during face to face interpersonal communication*

Figure 5.3. Communication tools used for improved interpersonal communication

Melas / Group Meetings

To honour local champions and create a healthy competition between villages, GPs, and blocks to achieve ODF status, the district must publicly celebrate small victories such as ODF declaration of villages, gramme panchayats, blocks, and so on through gaurav yatras (pride processes), raatri chaupals, melas, special gramme sabhas, and so on. During these events, IEC audio-visual material created by professional creative agencies at the national and state levels may be used as edutainment.

Mass Media: National and state-level mass media messages are shared (all national IEC material, including TV/Radio ads, can be downloaded for free at tinyurl.com/sbmiec and tinyurl.com/sbmiec2). The role of districts in relation to the media:

1) Television/Radio: The districts may broadcast these messages on local cable television channels and radio stations to broaden their reach.

2) Community radio: Community radio is a very effective way to reach a huge number of people with messages that are tailored to their particular culture and needs. National and state-level mass media messages must also be broadcast on community radio stations.

3) Outdoor media: Depending on the environment, stakeholders, and resources available, outdoor media such as hoardings and wall murals can be employed to complement IPC and community mobilisation efforts.

4) Digital media: Mobile phones are gaining popularity in rural India. Mobisodes (short audiovisual clips) can be created and shared using mobile devices. State-level social media campaigns can also be investigated.

5) Create new material: States and districts may also hire a creative agency or engage a Development Partner / NGO to create new creative commercials that will be shown across the above channels.

→ *Pic: Snakes and ladder game used during interpersonal communication in a small group setting*

Figure 5.4 Use of emo demos during the interpersonal communication sessions

Awareness and Training Workshops

Workshops on sensitization, awareness generation, and technical training for district officials, masons, Swachhagrahis, and others are particularly useful in developing the human resource required to lead and sustain Swachh Bharat Mission activities in the district.

Convergence: The Swachh Bharat Mission's mandate can be carried out by a variety of departments and ministries. Here are a few examples:

1) Swachhta and Schools: Teachers in local schools can function as ambassadors for the mission both within and outside the classroom. Students can be role models by convincing their parents to install and use toilets in their houses. Rallies, nukkad naataks, and letter-writing campaigns, in which schoolchildren write letters to their parents begging them to install a toilet in their home, have all proven to be quite effective.

2) Swachhagrahis: To develop the network of Swachhta motivators on the ground, local ASHA workers, ANMs, Anganwadi workers, health-center doctors and staff, postal service employees, and others may be hired as Swachhagrahis.

3) Swachhta Rath: These are mobile exhibition vans that can be constructed according to a district's needs and can be used as a travelling exposition. They would include all information on sanitation practices, toilet technology, as well as printed, digital, and audiovisual communication materials to emphasize the urgent need for sanitation and hygiene behavior change.

5.4 Subsidy Mechanism & Partnership

When it comes to financing the construction and management of toilets, three types of costs are involved; land costs, construction costs, operation and management costs. When preparing a financial model, the inclusion of land costs significantly renders it non-profitable. To overcome this, the public agency is supposed to provide the land, which in turn does not negatively affect the financial model. In order to estimate costs required for the running and maintenance of the toilet, a Financial Operating Plan (FOP) is prepared. The FOP is prepared in a manner wherein the costs of maintenance and operations of the toilets are significantly recovered by the amount charged to the individuals using them.

National WASH systems could be strengthened by increasing budgets, provided that transparency mechanisms are in place. External support organizations could: improve targeting of aid to the poor and vulnerable; Consider increasing budget support to the sector; Consider allocating more outside resources to support the operation and maintenance of existing WASH services. Allocations should be consistent with human rights guarantees and commitments. Government contracts for the provision of water and sanitation, including outsourcing WASH services, must provide the best services at the lowest cost. Governments need to ensure that spending on WASH is non-discriminatory. The priority should be areas and populations with less access to services. Government financial reports should identify measures taken to ensure water and sanitation rights for the most marginalized communities. Donors should make information about payouts publicly available and accessible. Donors should release committed funds in good time. Governments should monitor and assess the impact of their spending. There is an urgent need to establish and track specific sanitation and water budgets

Box 5.2 - Sanitation and Water for All (SWA)

Sanitation and Water for All Partnership SWA is a global partnership of over 90 developing country governments, donors, civil society organizations and other development partners working together to catalyse political leadership and action, improve accountability and use scarce resources more effectively. Partners work towards a common vision of universal access to safe water and adequate sanitation. SWA provides a transparent, accountable and results-oriented framework for action based on a common vision, values and principles. Source: http://sanitationandwaterforall.org/

Reco is a

collective responsibility that requires collective action and the possibility of local financial solutions to help households / individuals who are having real difficulties building an improved toilet; Building capacity at the local level to improve data collection and use of surveillance data, with a particular focus on equity and inclusion; Encouraging local leaders to mobilize the community to pay labor dues to households facing labor shortages and unable to pay for the work; advocate the need to ensure transparency at local level in identifying poor households or individuals; Promote partnerships with civil society organizations that target people living in poverty and support income-generating activities and / or provide microfinance facilities and water.

Financing sanitation for the urban poor is affected by a multitude of problems that go beyond the cost of plumbing. Often, the sector faces low priority setting, competing needs, poor planning, political interference, poor policy implementation, poor governance and / or accountability for the resources available. Absolute poverty in some urban slum areas and the lack of property and land tenure rights continue to hamper landlords' investments in sanitation. Funding arrangements for the benefit of the poor are often most effective when combined with advocacy and capacity building initiatives that help turn civil society organizations (CSOs) and communities into active participants in the planning, monitoring and decision-making of sanitation and hygiene services. At governance level, creating a dedicated budget line for sewage and hygiene and improving cross-sectoral coordination between the ministries for sewage and hygiene (ministries of urban planning, water and the environment, local government, health and education) create the structure necessary to support sustainable development

At governance level, creating a dedicated budget line for sewage and hygiene and improving cross-sectoral coordination between the ministries for sewage and hygiene (ministries of urban planning, water and the environment, local government, health and education) create the structure necessary to support sustainable development Access to and provision of sanitary and sanitary services.

5.5 Participation and Working with Communities & Households

Effective sanitation and hygiene (S&H) programming requires this. Working with communities and other stakeholders to modify attitudes, expectations, and behaviours around S&H, as well as anchoring new social norms, has proven to be a successful way to achieve long-term behaviour change. This is not an easy procedure to follow.

Behaviour Change Communication

Social attitudes and beliefs can limit toilet use, resulting in partial use in a family or community, and affecting several aspects of the sanitation service chain. Habits are difficult to break, therefore people need the right tools, skills, services, resources, and confidence to try new things. It is vital to comprehend and deconstruct present behaviours, attitudes, conventions, and influencers within a group or civilization.

Case Study 20: Citizen's First – SaciWATER – Hyderabad.

Saciwaters took up an initiative to educate the people of Hyderabad on water, sanitation and hygiene, to inform of them of their rights, to improve their living standards and delve information on WATSAN services.

The primary objective was to strengthen citizen's platform which was formed earlier in 2012. Second objective was be to activate government's WASH related service delivery in three existing wards and to ensure access to WASH in all the schools in these wards.

An understanding of government programmes and developments. Discussions on capacity building on WASH issues. Educating students on WATSAN rights, advocacy and policies. Guiding the community to their rights to clean water and sanitation and how they can correctly demand for said activities. BVM members were trained for capacity building of the communities to further expand the knowledge base and update the citizens of changing policies and schemes. They held inception meetings as Basthi(slum) walks. They helped the community build representation skills to present their issues to governing bodies so appropriate actions could be taken. This information is then discussed by keeping small Basthi meetings. These interventions led to some small but great outcomes. Through the BVM-GHMC networking, A basthi resided in Banjara hills was able to get approval of 8.5 Lakh Rupees for fencing an open Naala of their vicinity. They were also able to sanction a budget for solid-liquid waste management. Thousands of households of upper-class community (not part of the BVM) were also benefitted by the GHMC renovation of open drains. This issue was brought to media attention by the BVM.

On the eve of World Toilet Day, they organized an event in all three wards to facilitate awareness on generation, sensitization and behavioural change. A total of 400 children from Bholakpur, Rasoolpura and Addagutta were engaged in these events. Children were introduced to maintaining public toilets and keeping them clean. Involvement of all the stakeholders (community and their representative Civil Society Organizations (CSO)) has made the project successful.

The causes of behaviour and existing social norms will vary; thus, programmes must be devised based on a thorough context analysis and formative research to fully comprehend them in a given setting. While emotional drives can help people improve their behaviour, the principle of Do No Harm must always be followed. Individuals may be shamed or harmed as a result of behaviour

change messaging; accidentally reinforcing pre-existing social injustice or stereotypes; or stigmatising vulnerable or marginalised groups within a society. To ensure that new S&H behaviours are embedded and that everyone in a neighbourhood, area, town, region, or country can access and use enhanced S&H, the sector must continue to identify and develop innovative approaches to behaviour change.

Changing people's health and hygiene habits is generally difficult, but the present COVID-19 issue has given it a new urgency. In certain cases, community-led total sanitation has been successful, and lessons can be learned. Furthermore, participatory design and behaviour-centred design, as well as well-designed mass campaigns, show promise. Institutional triggering and advocacy are effective behaviour change tactics for persuading decision-makers to prioritise S&H and to lead area/city-wide efforts to change norms and behaviours.

Sanitation and hygiene behaviour modification campaigns and techniques directed towards men and boys In India, Unilever has developed character profiles to target men for behaviour modification. The terms "good man" and "tough man" are used to better target and promote sanitation to men. The following are quotes from the Unilever 2010 poster campaign: Trading on ‘tough man' clichés has been criticised for promoting undesirable (and male supremacist) stereotypes, yet being justified and used for their instrumental ‘appeal' to some men.

Community Led Total Sanitation aims to encourage communities to eliminate open defecation. Rather than being a centralised campaign, communities are free to assess their situations and open defecation occurrences and adopt whatever activities they think necessary to achieve the ultimate goal: to be open defecation free (ODF).

Attitudes, beliefs, and actions are the focus of CLTS. CLTS clearly realises that in order to eradicate open defecation, it is necessary to consider the attitudes and beliefs of those who engage in it. It encourages people to think about their habits in order to modify them. This is especially crucial in rural north India, where our research indicates that many people prefer open defecation. Many individuals believe that defecating in the open is more enjoyable, cleaner, and healthier than defecating in a latrine. This overwhelming tendency for open defecation is a significant barrier to efforts that promote the use of latrines and the usage of latrines. CLTS is accurate in emphasising attitudes, beliefs, and behaviours in the outset.

CLTS raises concerns about the random distribution of latrine subsidies. The provision of sanitation "hardware"—often pit latrines—is not enough to ensure that people cease defecating in the open, according to a basic concept of CLTS. CLTS advises that funding or installing toilets without ensuring that people would use them is a waste of money that will not result in healthier children. It's no surprise that the majority of individuals in rural north Indian communities who have "benefited" from latrine construction initiatives continue to defecate in the open, given their preference for open defecation and the resulting lack of demand for latrines.

What are the challenges to the CLTS approach in rural north India?

CLTS aims to harness public outrage over open defecation, but latrines are already repulsive to many in rural north India. CLTS facilitators strive to instil villagers' disdain for defecating in the open by having them calculate the amount of excrement that is released into the environment or showing

them how flies migrate between faeces and food. However, the method may not be very effective in rural north India. Many individuals believe that defecating in the open is healthier than using latrines, and many people find latrines to be disgusting. There is a popular perception that building a toilet close to one's home, or even worse, close to one's kitchen, is contaminating or filthy. Some people find it repulsive to defecate in a confined location, while others are concerned about faeces gathering near their home or that it could contaminate their drinking water.

CLTS (Box) seeks to get people to the bottom of a "sanitation ladder," but there isn't one in rural north India. CLTS emphasises that a village should first eliminate open defecation by enabling residents to design and build their own simple pit latrines. People will climb up a "sanitation ladder" by improving their pit latrines with time and follow-up, CLTS claims. In concept, this is an excellent proposal; many rural Indian families can already afford to build low-cost pit latrines.

Families, on the other hand, appear to be highly opposed to inexpensive latrines with small pits or temporary superstructures, preferring open defecation to inexpensive latrines, according to our research. Those in our sample who built their own latrines dug massive trenches with brick and cement superstructures, which cost at least as much as adding another room to the house in many cases. Those in our sample who had received government latrines mocked them, calling them "temporary" or "little pit" latrines. The size of the hole was cited by many as a reason for not utilising the latrines.

Box 5.3-CLTS and CATS

Community-led Total Sanitation (CLTS) is an innovative methodology for mobilising communities to completely eliminate open defecation (OD). Communities are facilitated to conduct their own appraisal and analysis of open defecation and take their own action to become ODF (open defecation free). It is predicated on the premise that merely providing a toilet does not guarantee its use. Thus CLTS places a strong focus on mobilising the community to bring about sustained behaviour change aimed at creating ODF communities. **Community Approaches for Total Sanitation (CATS)** is the term used by UNICEF for community based sanitation approaches. CATS encapsulate various approaches to community based sanitation such as CLTS and others. The approach allows flexibility in developing the most appropriate route for a given setting when working with government and partners. The minimum elements of this approach includes – that it is driven by collective process (as opposed to targeting individual households); that handwashing at critical times is a key component of the programme and; that community leadership includes children and caregivers

CLTS seeks to urge people to take collective action to prevent open defecation, however in rural north India, collective action is challenging. CLTS proponents claim that where the strategy has worked, it has tapped into the collaboration of individuals who consider themselves as part of a single community. In an ideal world, communities would come together to decide to stop defecating in the open, assist one another in building latrines, and apply social pressure on those who continue to do so. Villages in rural north India, on the other hand, are usually not an integrated "community" capable of working together toward common goals. In rural north India, villages are huge, and families are generally from diverse castes and religions. Because of the oppression of lower castes and women, as well as societal fragmentation along caste, gender, and class lines, it is difficult for individuals to identify with one another and collaborate.

How to Trigger CLTS: Triggering

According to the 2008 "CLTS Handbook," there is no "one way" to trigger in CLTS. This manual contains a rough step-by-step procedure that can be followed. Facilitators are encouraged to adapt and change activities based on the circumstances on the ground.

The following steps for the triggering process are suggested by the UNICEF manual approved for usage of CLTS in Sierra Leone:

1 Pay a visit to the neighbourhood, emphasising that you are there to learn about their sanitary issue.
2 Facilitate 'Kaka Mapping,' which entails drawing the key sites in the hamlet, followed by the primary defecation sites.
3 Facilitate the 'Walk of Shame,' a community-wide walk to open defecation sites.
4 Place a faeces sample in a bag.
5 In front of the community, spread poo on the floor and talk about how flies move between food and waste.
6 Expect the community to be startled to learn that they are indirectly ingesting each other's faeces.
7 Fill a water bottle with faeces and ask the community whether they want to drink it.
8 Determine how much faeces is produced each day and inquire as to where it is disposed of.
9 Ignition
10 Wait for the development of "Natural Leaders" with whom to collaborate in order to establish a strategy.

The goal of the triggering process is to make the residents disgusted by physically demonstrating the sanitary issues. The communities are supposed to recognise that there is a serious sanitation problem and that they must take action during the 'ignite' phase. Natural leaders are members of the community who are invested in the process and are viewed as change agents.

Action Planning

If some constructive action toward CLTS appears to be taking place, offer assistance and facilitate wisely. Encourage them by telling them that if they can achieve 100% total sanitation and eliminate open defecation, many people from outside and neighboring communities will come to see their village. Tell them about the possibility of becoming known as the block, sub-district, district, or province's first open defecation-free hamlet. The planning approach should focus on some quick good action plans.

Activities include:

Forming a sanitation action group (including representatives from all of the village's neighborhoods

- Making a list or map of houses and their current sanitation status
- Developing individual family plans to end open defecation are examples of activities. During the early days, it was typical for associated homes to build shared restrooms.
- Digging trenches and temporarily using them as temporary latrines.

The 'F' Diagram or Faecal Oral Route Transmission proposed by Wagnor and Lanoix

Pathogens can travel from a sick person's faeces to another person's intestines via a variety of routes, some direct and some indirect. The primary paths are depicted in this diagram (Figure 1.2). Fluids (drinking water), food, flies, fields (crops and soil), floors, fingers, and floods are all easy to remember because they all begin with the letter "F."

(a)Through fluids mainly water: Germs from faeces on the ground can contaminate water (fluids) that can be taken.

(b) Through fingers: Through dirty fingers or hands that haven't been washed since using the restroom. Germs on the items to be eaten can be transmitted by these filthy hands.
(c) Through flies: Flies can transfer germs from faeces to food. So, it's important to keep flies and insects out of the kitchen or area where food is kept.
d) Through fields or floors: If faeces are not properly disposed of, germs can leak into crops and other sources of food, as well as into houses through animals or fowl. It's critical to dispose of faeces in the bathrooms to avoid field pollution.
Prevention is always better than cure. The same principle is applied to excreta-related waterborne diseases. The primary barriers are preventive measures that can be taken to lessen the spread. The bars represent the barriers to prevent disease transmission from source (faecal contamination). Yellow bar represents sanitation. Sanitation is the first objective to prevent faecal contamination. The second objective is to keep the water sources clean and install proper filtration and disposal systems. The secondary barrier to prevent further spread of disease transmission to other victims is through hygiene. Simple acts such as washing hands and maintaining hygiene will act as the second barrier of infection. Hygiene is represented by the pink bars.

WASH Program

By expanding global access to nutritious and safe water, appropriate sanitation, and enhanced hygiene, the WASH initiative saves lives and reduces sickness. The WASH programme focuses on long-term preventative and control strategies for bettering health, poverty reduction, and socioeconomic development, as well as reacting to global emergencies and epidemics of life-threatening infections.

There are four key principles to guide our practice so we can work more effectively with women and men in water, sanitation and hygiene (WASH) initiatives. It is also founded on the principle of equal rights and opportunities for men and women. Men and women are not the same, but they are both human beings with the same human rights. Their responsibilities and opportunities to contribute, have a say in what happens in their communities, and benefit from development should not be determined by their gender. When men and women are meaningfully involved in important decisions that affect their lives, there are more benefits in the long run. This may result in changes in women's and men's relationships, but we know that such changes are possible because the way women and men relate to each other today is different than it was in the past. It is critical that changes benefit both men and women, and that men and women work together to achieve these goals. Gender and development theory and practise embodies these concepts.

To do Activity

Visit a garbage dumping site in your neighbourhood and make a list of your group's observations based on the following:

(i) Make is list of any flies, birds or any other animals thriving on the garbage.
(ii) Types of wastes thrown in the garbage dump.
(iii) Was the waste inside the dumping site or thrown all around it?
(iv) Describe your experience of visiting the site.

Principle 1: Make participation and inclusion easier. Concentrate on methods of working that allow women, men, girls, and boys to participate actively in improving their water, sanitation, and hygiene conditions.
Principle 2: Pay attention to the process of decision-making. Use decision-making methods that allow

both men and women to actively participate in the project and activities.
Principle 3: Recognize and appreciate diversity Recognize, appreciate, and value the work, talents, and concerns of women and men in the areas of water, sanitation, and hygiene.
Principle 4: Create opportunities. Allow women and men to experiment with and share new roles and responsibilities in a safe and supportive environment.

Principle 1

Women are among the first to be affected by water, sanitation, and hygiene issues. In rural areas, they are frequently in charge of collecting and storing water for cooking and hygiene for themselves and their families, as well as caring for sick family members. As a result, they must participate, and the community benefits from their participation. A focus on inclusion and participation allows women, as well as other groups who might otherwise be excluded, to participate. It is possible that women and minority groups will be left out if this guideline is not followed. This means individuals will miss out on opportunities to learn, their opinions will go unheard, and the community will be deprived of their expertise and ideas, as well as their assistance in sharing the long-term maintenance work of facilities and practises.

Principle 2

At all stages of a project, from the initial decision to improve water, sanitation, and hygiene behaviours, to planning and continuing management, at both community and family levels, the decision-making process is critical. WASH programmes rely heavily on committees, both existing community committees and those constituted particularly for WASH purposes. The effectiveness of a WASH programme will have a significant impact on its success. This includes committee member interactions, such as whether some persons have more authority and influence than others, and how well a committee represents the interests of women, men, and other groups within communities. How WASH concerns are addressed and duties are assigned and managed is influenced by decisions made within families and households. If some family members have more sway over water, sanitation, and hygiene decisions than others, the decisions may cater to the requirements of some family members more than others.

Good decisions are created with the active participation of those who will be impacted by the decision. Such decisions are more likely to have widespread support and to reflect everyone's concerns. In the case of water, sanitation, and hygiene, this entails involving many groups of women, men, youth, and others who are frequently marginalised in communities. Those who are most affected by the problem are frequently in the best position to find a solution. The water and sanitation technologies that are most likely to succeed, for example, are ones those potential users believe are the most appropriate. A solution that suits the community's requirements and context,

and that people helped choose, enhances community sustainability and ownership. When this principle is followed, both men and women can have their voices heard in decision-making, which can enhance relationships and raise respect for women and the contributions they can and do make. Women will also feel better about themselves and be more confident in speaking up as a result of this. Women's participation in WASH decision-making may be their first opportunity to take a public leadership position in their community.

Individual or societal beliefs, whether defined as customs or different sorts of norms, such as social or moral norms, can influence individual or societal sanitation behaviour, or result in groups being excluded from services or decision-making. It's crucial to comprehend these ideas and the circumstances that influence them before attempting to change them.

Principle 3

When the many needs, uses, concerns, and priorities of key users and groups are recognised, decisions about activities, places, and technologies such as taps and toilets are likely to be better. In traditional gender roles, women and girls are expected to do more work and spend more time managing the household's water, sanitation, and hygiene than men and boys. Women, for example, spend more time carrying water or cleaning toilets during the day. The time spent on this job and the value it adds to family and community well-being are frequently overlooked. This labour is sometimes not regarded as "work," but rather as a natural part of what women do. Women and excluded groups will be more respected within communities if their labour is better recognised and valued. This could lead to a more equitable distribution of tasks and responsibilities. Women feel better about themselves when their effort is recognised, and mutual trust between men and women grows as a result of this recognition.

Principle 4

Providing opportunities for men and women to collaborate can help them develop a shared understanding of their respective positions, including an appreciation for their work and the problems they face. It also helps to develop new talents, as well as self-esteem and confidence. It can give women and men a once-in-a-lifetime chance to make a difference in their communities and serve as great role models for the future generation.

Providing opportunities for women and men to try out or share new roles and responsibilities aid in the achievement of better and more long-term WASH outcomes. Water supplies and sanitation facilities will be better maintained if we work with individuals based on their willingness, interests, availability, and motivation to participate, not on their gender. It implies that a community is better prepared to deal with any problems or challenges that arise with their WASH system. Hand washing

should be done properly to preserve everyone's health, and both moms and fathers have a role to play in instilling this habit in their children.

Campaigns and approaches aimed at men and boys for sanitation and hygiene behaviour change Unilever has created character profiles to target men for behaviour change in India. The 'good man' and the 'tough man' are intended to better target/market sanitation to these men. Below are quotes from the poster campaign (Unilever 2010): Whilst justified and used for their instrumental 'appeal' to some men, trading on 'tough man' stereotypes has been critiqued for reinforcing unhelpful (and male supremacist) stereotypes.

Table 5.4 Approaches used used to encourage men to stop open defecation in India

Swachata Adalat – sanitation court	Courts held every Saturday for those caught OD by the *nigrani samiti* members.
Youth clubs in Fazilpur Badli village, Haryana	Youth clubs comprising young men and women have taken the lead to convince elderly men to use toilets.
Nigrani samite, Kalarpur village of Haryana	A group of elderly women (and a separate team of elderly men) who do the rounds in their village early in the morning and in the evenings to ensure nobody goes out in the open to defecate. If they caught other men defecating during their rounds of monitoring, they would insist that the open defecators cover the faeces with soil and take a pledge in front of the community that they would not defecate in the open.
Enforcement by the Gulabi Gang	The Gulabi Gang make regular visits to households that OD and convince men to use toilets for better health outcomes.
Gandhigiri	Nigrani committee members also visit those households that do not have toilets and offer OD vermillion and flowers to the household members.
Secret Sanitation Voting	When a person is observed resorting to OD, that person's name is written on a piece of paper and put in the ballot box. The *Panchayat* and *nigrani samiti* members follow-up.

Men's and boys' active and positive engagement in sanitation and hygiene (S&H) means improving sustainable outcomes, as well as increasing the potential for redistribution of unequal domestic and care responsibilities from women to men. Discussions around gender in S&H (and elsewhere) often focus on the roles, positions or impacts on women and girls, however this issue of Frontiers of CLTS explores examples of men's and boys' behaviours and gender roles in S&H. Of particular interest is the extent to which the engagement of men and boys in S&H processes is leading to sustainable and transformative change in households and communities and reducing gendered inequality

Case Study 21: Participation of Women in WASH

Women played an important role in a remote community WASH project in Vanuatu. The women donated funds and made significant contributions to the initiative because they wanted the WASH community action plan to be implemented. The money raised through fundraising allowed the women to carry all of the components (roof sheets, sand, and slab material) for the water system to the village, as well as pay for the transportation. The concept came to fruition as a result of the women's efforts. Another beneficial effect was that the men in the neighbourhood recognised these efforts.

Women and men were included in communal decision-making about water, sanitation, and hygiene facilities during a community planning process using PHAST. They ranked numerous sorts of water supply choices in a group activity. A rainwater collecting system was favoured by the women, while a gravity feed water system was favoured by the men. The women's decision was ultimately approved because it was based on their previous issues with a gravity feed system that had failed owing to a land dispute. Past decisions and mistakes had had a direct impact on the women. Women's and men's perspectives were heard through the participative approach. The final decision was to fundraise for rainwater tanks, which was led by the ladies. According to one female participant, "the voices of the women have been heard after PHAST seminars; now we have water tanks." The community has access to a safe drinking water supply.

Solid and Liquid Waste Management in Rural Areas

Solid and Liquid Waste Management (SLWM) is one of the primary components of the Swachh Bharat Mission (SBM) (G), which was started with the goal of improving rural sanitation, hygiene, and overall quality of life. This document provides a basic, fast overview of rural Solid Liquid Waste Management (SLWM). Information, Education, and Communication (IEC) interventions should focus on SLWM to create a demand for a sustainable system. This must lead to setting up systems for waste disposal in such a way that it has tangible impact on the Population. The community/Gram Panchayat (GP) has to be encouraged to come forward and demand such a system, which they can

subsequently operate and maintain. Sanitation programmes are only as good as the people who use them. Migrating to the ODF-S and ODF+ levels necessitate a long-term commitment to social behaviour change from communities. It is necessary to ensure that all households have access, that everyone uses toilets, maintains them, and repairs incorrectly constructed toilets, that everyone has access to safe water, that everyone practises appropriate and safe hygiene, and that their surroundings are free of wastewater and garbage.

They must also ensure that ground water is not affected by septic tank leachates or incorrect faecal sludge disposal. The longer journey of consolidating sanitation gains has begun now that the construction phase of IHHLs is nearly complete. As a result, social and individual behaviour change is a vital aspect in consolidating sanitary infrastructure and ODF benefits and implementing suitable SLWM.

Table 5.5 SLWM in Rural Areas

Level	**Organisation**
State	Public Health Engineering Department
	Water Supply and Sanitation Department
	Communication and Capacity Unit
	Panchayati Raj and Rural Development Department
	Tribal Development Department
	State Pollution Control Board
District	Zilla Parishad
	SBM (G) Cell
	NGO's
	Private Sector
Block	Block Development Officer
	Panchayati Raj Public Works
	Block Resource Centre
	NGO's
	Private Sector
GP	Gram Sevak/Sachiv
	Panchayat Development Office
	Community Based Organisations
	SHGs
	Private Sector/ Enterpreneurs
	Households

Source Ministry of Drinking Water and Sanitation and Asian Development Bank (2014) Guidelines on Solid and Liquid Waste Management (SLWM) IN Rural Areas, Government of India.

Communities can also pass local bylaws to avoid OD in their village, bringing social and legal standards closer together. Such systems may be necessary to monitor, regulate, and maintain the social norm, as they signal to all (even newcomers to the community) that using toilets is the normative expectation in that society.

A far deeper commitment to community participation and a multi-stakeholder approach is required. This will entail NGOs, CSOs, youth organizations, the government, the private sector, and others working together to maintain ODF, address design and construction difficulties, and train sanitation employees while developing toward ODF+ and ODF-S.

Drafting and Implementing a SLWM Plan

GPs should carry out the following activities in order to plan, implement and manage SLWM interventions at GP level. Though the actual interventions would be applicable at village and habitation level, a plan must be prepared for each GP separately. Institutions such as Block, District, Division and State have to clearly define their role and support GPs in preparing these plans. It may also be suitable to identify government, non-government and private agencies and individuals to support the preparation of such plans.

This involves five stages

1. Planning
2. Options Analysis, Technical feasibility
3. Identify Resources
4. Implementation
5. Management and Monitoring

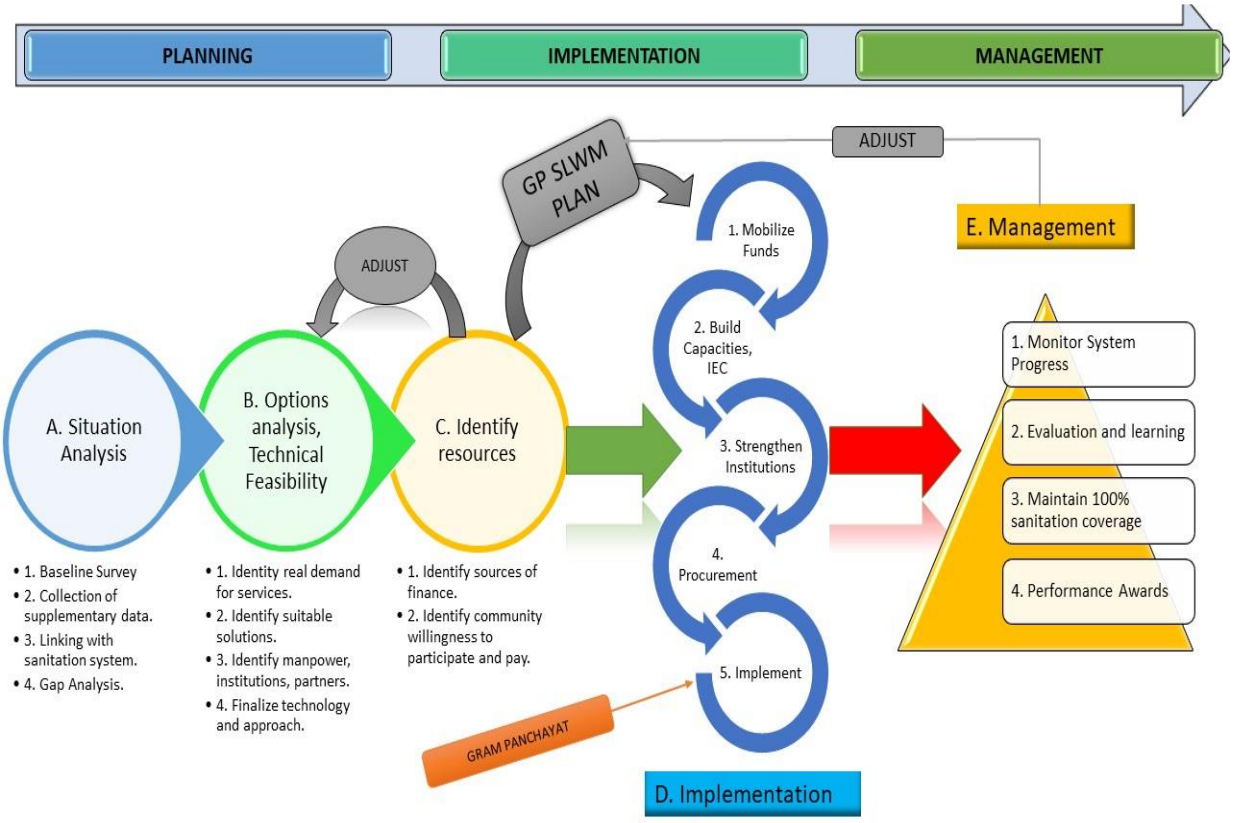
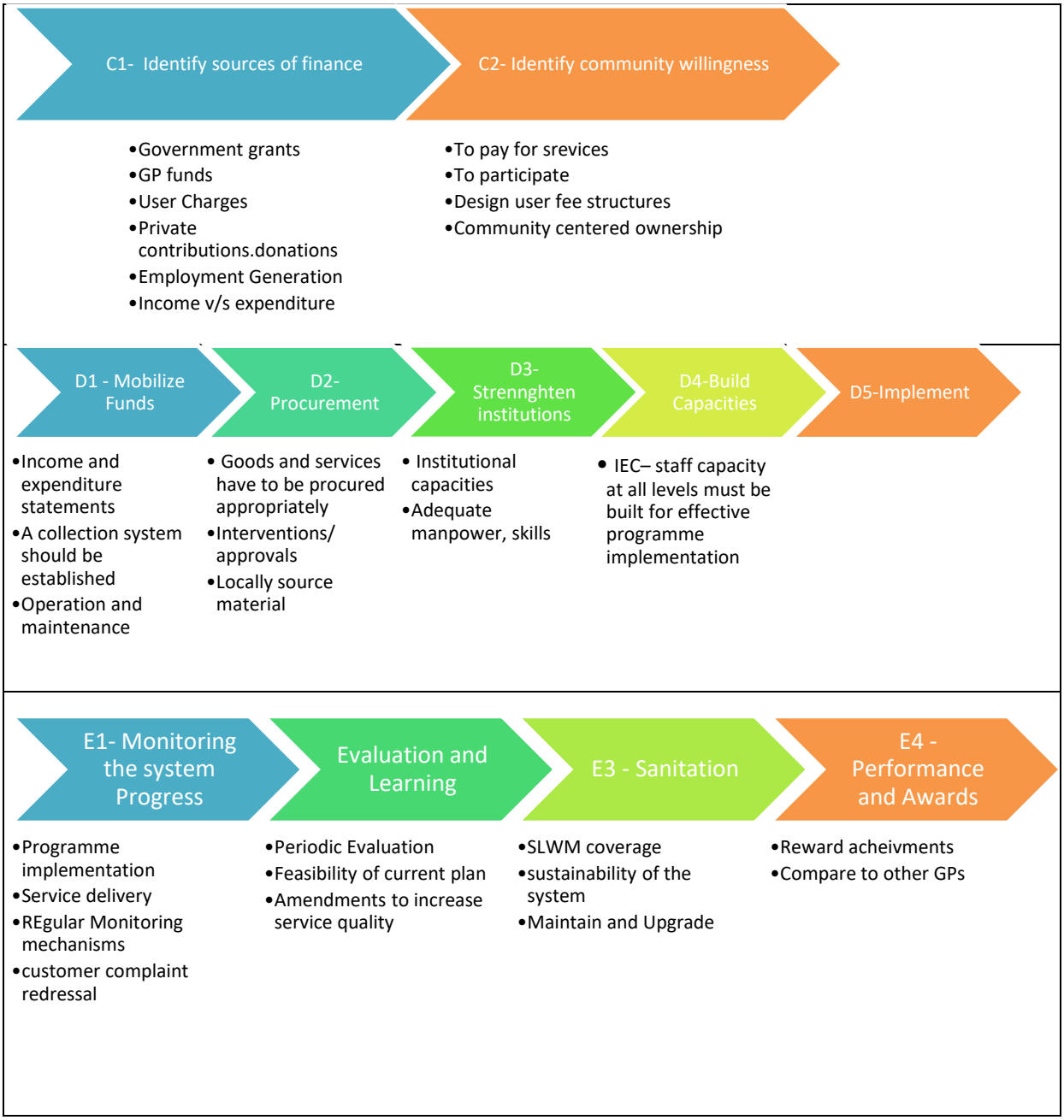


Figure 5.5 Drafting and implementing a SLWM plan

A1-Baseline Survey	A2-Supplementary Data	A3- Link with existing sanitation systems	A4-Gap Analysis
• Availability and access to physical infrastructure • Condition and adequacy of the infrastructure • Existing service levels, approaches and methods • Financial conditions (sources, availability, aspects related to user fee collection (if any), • Existing O & M system including community practices • Geography and geological features • Role and responsibilities of different stakeholders • Demographic details • Socio, cultural and gender aspects, • Awareness levels, etc.	•Data related to toilet coverage, disposal type •Availability of landfill site nearby •Existing market linkages for solid waste •Possibilities for recycling, processing of solid waste •Possibility of usage of treated waste water, etc. •Existing treatment facilities nearby which could be accessed •Role of Private player in the sector	•Treatment plants, septage managements. •Mapping Tools. GIS based Maps •GP EnvironmentalSanitation Plan	•Community consultations •A complete analysis of all data •Disadvantage and Advantages

B1 -Real Demand	B2 - Identify Suitable Solutions	B3-Identify Manpower	B4 - Finalize
•Governance •Options for methods, approaches and service provision •Technology options •Meeting Financial requirements •Recvery of O/M expenses •Monitoring •Achieving sustainability	•Technology, approaches, methods, management •Models, preferences, etc. should be selected based on local needs, conditions. •Suitability and acceptance. Best suited solution may be suggested.	• Identify manpower, institutions, and partners- in order to plan and implement SLWM interventions appropriate skilled manpower, institutions and partners along with specific and clear roles they are expected to play has to be identified •District should support GPs in identifying such institutions and partners and GPs may take a final decision that suits their needs.	•Finalize technology and approach – based on the outcomes of the situational analysis and technology and options analysis, appropriate technologies, methods and approaches should be finalized in consultation with all key stakeholders. •Communities shall be well aware of the final plan and its components and the role they are expected to play including user fees and other contributions and the type of facilities and services they are expected to get.



Composting

An alternative solid waste treatment method is composting. It is a biological phenomenon wherein organic matter present in the waste is allowed to undergo decomposition by using microbial treatment and controlled conditions. Microbial degradation of the organic matter forms a substance known as humus (also known as compost). It has a resemblance to potting soil in terms of texture and odour. Humus has many significant advantages and can be mainly used as soil conditioner or mulch. Composting is a very advantageous method which can degrade and process garbage and sewage sludge in one operation itself. The ever-increasing rules and environmental laws have put many restrictions towards landfill and waste incineration.

Composting can serve as a very rapidly developing alternative which will be propitious in the near future. The choice of composting technology depends on a number of criteria which include quantity of waste to be processed, land requirement, climatic conditions, stability, energy requirements,

financial implications, monitoring requirements, and aesthetic issues. Despite multiple measures of sanitation and treatment, landfills still remain one of the most common ways for disposal of waste. While they may not be the most efficient of options, landfills help to segregate waste away from the population's lives. Serving as last last line of defence, they are used to contain waste that is untreatable, and cannot be recycled back for further use. If there is enough land available for creation of such sites, it may be the most economical measure. Considering factors like low financial capacity, availability of barren land, and the types of waste being generated, landfills are accurately suited for developing areas of civilisation. Even after the bad reputation that this method has garnered, properly treated landfills have been converted to provide additional benefits to society. Recreational parks, golf courses and multiple other forms of positive developments have been made on post-landfill lands.

Table 5.6 Comparison of a few composting methods

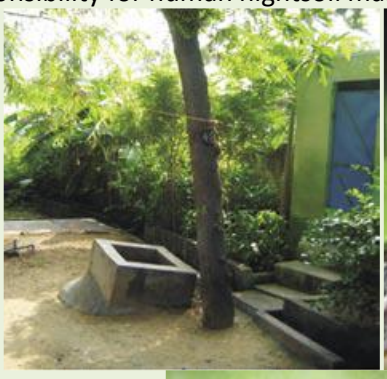
	Description	Conditions for use	Advantages	Limitations
NADEP Method	Composting takes place in a rectangular brick tank with aeration holes. Organic material is added in layers and compost is ready in almost 3 months	Tanks can be built in all conditions. The thatch roof protects the tank from moisture. Tank should be monitored to check for cracking of seal which would allow moisture to escape. Tanks require space and a lot of initial material so a community approach is better, using a communal space for the tank and agreeing the date for bringing material/ filling the tank.	Composting can be done on a larger scale than using piles. All nutrients are retained inthe tank so resulting compost is more nutrient rich.	Tanks work in 3 month rotations so at least 2 are needed which increases the cost. Large quantities of soil and water are needed which can be difficult to transport in some areas. The entire tank should be filled within a maximum 48 hour period (24hrs is better).
Bangalore Mehod	Waste is composted anaerobically in a pit. Compost is ready in 6-8 months	Useful in areas where the use of piles is limited by severe weather conditions e.g. strong winds and sun.	Can accept municipal waste and night soil. Good for dry areas and no O+M is needed	Cannot be used in wet areas as the pit may become waterlogged.

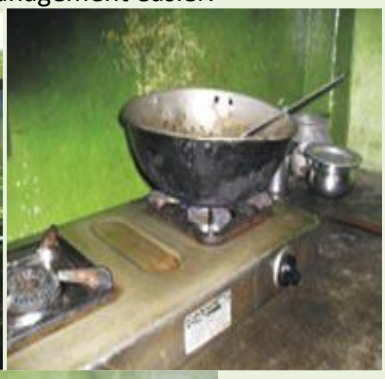
		Can be done at the household level where space permits as no O+M is required. Very cheap compared to tank methods as no infrastructure is required		Gases produced can smell and the pit requires quite a large space. Composting process is slow
Indore Method	Waste is cut into small pieces and spread 10 -15cm thick above ground or in a pit. Compost is ready in 4 months	Pit/heap is unprotected so may need some protection from animals/children etc. A windbreaker can be used to reduce effects of drying out. Very cheap compared to tank methods as no infrastructure is required.	No infrastructure is needed and process is relatively quick	Nutrients are lost to the soil. Regular turning is needed (every 5 days). Cannot be used in wet areas or areas with heavy rainfall due to waterlogging
Vermi Composting	Composting using a specific species of worms to break down waste Compost is ready in 3-4 months	Worms' optimal temperature range is 15- 35 degrees Celsius. Lower temperatures hamper reproduction and	More efficient than normal composting and produces richer compost.	Needs a vermitank or verminbed and worms need to be bought or grown which increases cost Needs more O+M than normal
Biogas	Biogas is produced when organic matter undergoes decomposition under anaerobic conditions. It can be used as a fuel to produce nutrient rich slurry.	Choice of design varies on capacity, available space, type of waste and capital available. Waste should be introduced on a daily basis for prolonged gas production.	Good alternative for electricity especially in rural areas. It Is an efficient source of feul.	Slow gas accumulation rates. Requires large area for construction.

Case Study-22: Making Nightsoil-based Biogas Plants viable in Maharashtra's Pune District

Biogas produced from nightsoil has a dual purpose: it provides energy while also assisting in the management of human waste. However, 1 cubic metre of biogas requires the nightsoil of 25- 30 people per day. Biogas created from the nightsoil of community toilets, which are used by larger groups of people, has proven to be viable, but gas produced from individual toilets, which are used by 5-10 individuals, is insufficient for any practical purpose.

With this in mind, several households in Dehu village, Maharashtra's Pune district, have devised a novel method in which they allow their neighbours to use their toilets for a modest maintenance fee, making associated biogas plants commercially viable. In Dehu, there are approximately 75 family-owned human nightsoil-based biogas facilities that provide people with kitchen fuel. The technique has also decreased pollution caused by open defecation and made the local Panchayat's responsibility for human nightsoil management easier.





Biogas systems that treat animal and human waste improve sanitary conditions for plant owners, their families, and the entire village population. The fermentation process considerably reduces the pathogenic capacity of the starting ingredients. Each new biogas system reduces the need for one or more waste/manure/latrine pits, significantly improving the village's sanitary conditions.

Cow manure from two milch animals (10kg per day) is mixed with water to make a slurry, which is then fed into the biogas chamber's inflow. The flushed-out toilet faeces are led into the biogas chamber by connecting the flush out outlet pipe to the slurry inlet. The gas generated by five people using the toilet is enough to cook food (breakfast, lunch, and dinner) for a family of five. It reduces cooking time drastically, saves fuel cost.

The plant's upkeep is quite basic and may be learned by anyone, even in the community. The only technical consideration is that the cow dung slurry should be neither too thick nor too thin. When the toilet is flushed, the night soil from the flush out toilet will flow smoothly down from the biogas plant.

Chapter Summary

Living a healthy and good life is basic human right. Sanitation and Hygiene are key for being healthy. Improper garbage disposable, lack of clean drinking water and exposure to toxic fumes is detrimental. The unprivileged sections of the societies bear the grunt of it most. Whilst the government and respective governing bodies have schemes and plans in place to alleviate the situation, they do not reach the people. Lack of knowledge of their rights is often exploited. To improve the quality of their life, their area needs to be taken care of too. It is a collective effort of the governing bodies and involvement of the community itself. Awareness is the primary objective. The community first needs to realize that their surroundings, open defecation, exposure to sewage, water contamination are very detrimental to health. Water contamination can contaminate food and fields leaving to agricultural damage, food poisoning and therefore falling sick. The stigma of toilets being "unclean" to be at home and making them realize toilets are not privilege, its an essential is important. Community needs to be educated on how to handle pseudo-legal matters, who to approach and how to approach and representation of their issues. One solution does not fit all. Each community/area/district will require a tailored plan-approach to set up sanitation or waste-segregation and disposal. Care should be taken that the system should be beneficial to all members of the community irrespective of gender, race, ethnicity or caste system. Members of the community have to be moved into upgrading their skills to contribute to the system. This will generate employment and self-sustenance. Setting up systems is easier; they will also need to be taught maintenance or knowing who to approach for maintenance. It is a time and labour-intensive process but it is their human right and it needs to be delivered to them.

Self-Assessment

1. What is the role of state and districts for community capacity building?
2. What are the steps for implementing a SLWM by GP?
3. What are the financial parameters for building a community toilet?

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Editors' Profile

Dr W G Prasanna Kumar

Dr. W. G. Prasanna Kumar, PhD in Education with basic degree in Social Work and Master's Degrees in Sociology, Public Administration and Political Science has professional education in Environmental Economics, Public Relations, Communication and Training and Development. Presently Chairman, Mahatma Gandhi National Council of Rural Education (MGNCRE) under the Ministry of Human Resource Development, in Government of India strives to promote resilient rural India through Higher Education interventions. The national initiative of reviving Mahatma Gandhi's ideas of NaiTalim, spearheaded by Dr. W G Prasanna Kumar, has met unprecedented success at both national and state levels. The primary objective of this initiative is to promote Gandhiji's ideas on Experiential Learning, NaiTalim, Work Education and Community Engagement, and mainstreaming them in School Education and Teacher Education Curriculum & Pedagogy. As Professor and Head Centre for Climate Education and Disaster Management in Dr MCR HRD Institute, conducted several capacity building and action research programmes in climate education, disaster management and crowd management. He has handled many regional, national and international environmental education programmes and events including UN CoP11 to Convention on Biological Diversity and Media Information Management on Environmental Issues.

He was Director in National Green Corps in the State Government for over 11 years and Senior Social Scientist in State Pollution Control Board for 6 years. Conducted various curriculum and non-curriculum related training programmes in environmental education. He was a Resource Person for AP Judicial Academy, AP Police Academy, AP Forest Academy, EPTRI, Commissonerate of Higher Education and Intermediate Education, State Council for Educational Research and Training and National Council for Educational Research and Training New Delhi, CCRT, Bharathiya Vidyapeet University Pune, CPR Environmental Education Centre Chennai and Centre for Environment Education Ahmedabad. Dr W G Prasanna Kumar was trained in Community Consultation for Developmental Projects in EPA Victoria Australia in 1997 trained as State Chief Information Officer by IIM Ahmedabad and MCRHRDI Government of Andhra Pradesh in 2004 and trained in Environmental Education and Waste Management Technique by JICA, Japan in 2011.

He was awarded Best State Nodal Officer of National Green Corps Award from Centre for Science and Environment, New Delhi, 2008, Jal Mithra Award from Earthwatch Institute of India and Water Aid New Delhi, 2014 and Certificate of Commendation for the services in UN Conference of Parties to Convention for Biodiversity conducted at Hyderabad from 1-20 October 2012 by the Government of Andhra Pradesh 2012.

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there is Universal Prosperity

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