पेयजल एवं स्वच्छता विभाग
जल शक्ति मंत्रालय
भारत सरकार
DEPARTMENT OF DRINKING WATER AND SANITATION
MINISTRY OF JAL SHAKTI
GOVERNMENT OF INDIA
सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Manual: Biodegradable Waste Management

July 2021


धन योजना
स्वच्छ भारत मिशन

Manual: Biodegradable Waste Management

Contents

Preface VII

Glossary IX

Abbreviations XI

Chapter 1: Introduction 1

1.1 Background 1

1.2 Need and importance of Biodegradable Waste Management 1

1.3 SBM (G) Phase-II 2

Chapter 2: Biodegradable Waste Management 5

2.1 Solid waste in rural areas 5

2.2 Composition of waste in rural areas 5

2.3 Components of biodegradable waste management 6

2.3.1 Segregation of waste 6

2.3.2 Collection and transportation 7

2.3.3 Treatment and disposal 7

Chapter 3: Composting - Process and Types 9

3.1 The composting process 10

3.2 Types of composting 12

Chapter 4: Technologies of Biodegradable Solid Waste Management 15

4.1 Decision matrix for management of biodegradable waste 15

4.1.1 Biodegradable waste management at Household 15

4.1.2 Biodegradable waste management at Institution/Commercial areas 16

4.2 Household Level 16

4.2.1 Details of different household-level composting methods 17

4.3 Community/ Institutional Level Composting 26

4.3.1 Technologies for the community-level waste disposal 26

Chapter 5: Funding Provisions **37**

Chapter 6: Role of Stakeholders **39**

Chapter 7: Case Studies **43**

1. Madan Heri village, SAS Nagar district, Punjab 43
2. Adimaly Gram Panchayat, Idukki district, Kerala 45
3. Gram Panchayat Kali Billod, Depalpur block, Indore district, Madhya Pradesh 47
4. Lalpur village in Lucknow district, Uttar Pradesh 49

Preface

The Government of India, in February 2020, approved Phase-II of the Swachh Bharat Mission (Grameen) (SBM [G]) with a total outlay of Rs. 1,40,881 crores to focus on the sustainability of Open Defecation Free (ODF) status and Solid and Liquid Waste Management (SLWM). SBM (G) Phase-II is planned to be a novel model of convergence between different verticals of financing and various schemes of Central and State Governments. Apart from budgetary allocations from Department of Drinking Water and Sanitation (DDWS) and the corresponding state share, remaining funds will be dovetailed from 15th Finance Commission (FC) grants to rural local bodies, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Corporate Social Responsibility (CSR) funds, and revenue generation models, etc., particularly for SLWM.

SBM (G) Phase-II has been uniquely designed to leverage the capacity of individuals and communities in rural India to create a people's movement to ensure that the ODF status of rural areas is sustained, people continue to practice safe hygienic behaviour and that all villages have solid and liquid waste management arrangements.

This manual has been developed to support rural local bodies implement ODF Plus initiatives effectively and efficiently in their settings. It provides detailed information on various technologies, estimated cost, Operation and Maintenance (O&M) arrangements, etc. This manual should be able to provide comprehensive guidance to achieve effective solid and liquid waste management in rural areas.

It is hoped that all implementers of Swachh Bharat Mission Phase-II would find this manual useful and a good guide for achieving ODF Plus objectives in their villages.

Department of Drinking Water and Sanitation

June, 2021

Glossary

Aerobic: A system / material where free oxygen is available so that aerobic reactions can take place

Aerobic composting: A controlled process involving microbial decomposition of organic matter in the presence of oxygen

Agricultural waste: Waste material generated from agricultural activity e.g., straw, husk etc.

Anaerobic digestion: A controlled process involving microbial decomposition of organic matter in absence of oxygen.

Biodegradable Waste: Any organic waste that can be degraded by microorganisms into simpler stable compound

Biomethanation: A process which involves the enzymatic decomposition of the organic matter by microbial action to produce methane rich biogas.

Bulking Agents: A material used to add volume to another material to make the second material more porous, which increases airflow.

Composting: A controlled process involving microbial decomposition of organic matter

Community storage bins: A common dustbin placed at public place for collecting waste

Dry waste: Waste other than food waste and inert & includes recyclable waste, non-recyclable waste

Emission: Gases released into the atmosphere

Humus: The end product of composting which is a dark organic material that forms after the decomposition of organic waste also called compost.

Inorganic waste: waste composed of material other than plant or animal matter, such as sand, dust, glass, and many synthetics

Leachate: The liquid that seeps through solid waste.

Non-biodegradable Waste: Any waste that cannot be degraded by microorganisms into simpler stable compounds.

Pathogens: Disease-causing agents, especially microorganisms such as bacteria, viruses, and fungi

Recyclable Waste: Waste that ca be recycled for example glass, metal etc.

Solid Waste Processing Centre: Where all the collected waste segregated into different waste streams and processed further.

Vermicomposting: A process of conversion of bio-degradable waste into compost using earthworms

Village segregation shed: A designated place/building where all the collected waste from the village is brought for further processing.

Wet Waste: Biodegradable waste like food waste, garden waste etc.

Abbreviations

ASHA	Accredited Social Health Activists
CB	Capacity Building
CSR	Corporate Social Responsibility
DTMU	District Training Management unit
GPDP	Gram Panchayat Development Plan
GP	Gram Panchayat (Village Panchayat)
HH	Households
IEC	Information, Education and Communication
NGO	Non-Government Organization
ODF plus	Open Defecation Free plus
PVC	Polyvinyl Chloride
PRIs	Panchayati Raj Institutions
SBM (G)	Swachh Bharat Mission (Grameen)
SHG	Self Help Group
SWPC	Solid Waste Processing Centre
SLWM	Solid and Liquid Waste Management
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
15th FC	15th Finance Commission

CHAPTER 1

Introduction

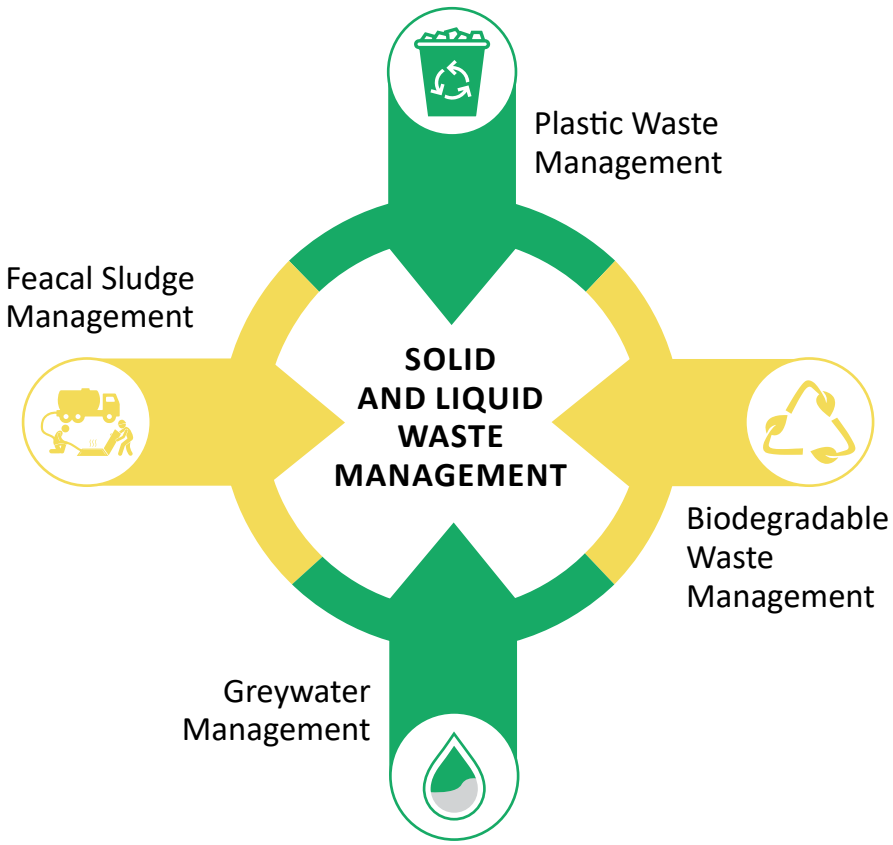
1.1 Background

Presently, much of the biodegradable waste are disposed off in unsafe ways – burning, unscientific dumping or discharging into water bodies. Moreover, bio-resources such as animal dung cakes, crop residue and firewood are commonly burned as cooking fuel, causing indoor air pollution. Bio-waste has the potential to be harnessed as energy, fuel and fertilizer. Organic wastes such as cattle dung, kitchen waste, poultry droppings, pig excreta, human excreta and crop residues can be converted to organic manure and biogas through aerobic and anaerobic digestion. By biomethanation process, this form of bio-waste can be used to generate biogas, which can be used as a clean fuel for cooking, lighting, running biogas-based engines and generate compressed biogas (CBG).

1.2 Need and importance of Biodegradable Waste Management

Swachh Bharat Mission (Grameen) (SBMG) Phase II aims at sustaining the open defecation free (ODF) status of villages and improve the overall cleanliness in rural areas through the implementation of solid and liquid waste management activities. SBMG Phase II is being implemented from 2020–21 to 2024–25 as a national mission to achieve the goals of ODF Plus in the villages across the country. It has been conceived as a novel model of convergence between different verticals of financing and various schemes/programmes of the Government of India and State Governments.

Solid and liquid waste management comprises four components: (i) biodegradable waste management, (ii) plastic waste management, (iii) greywater management and (iv) faecal sludge management.



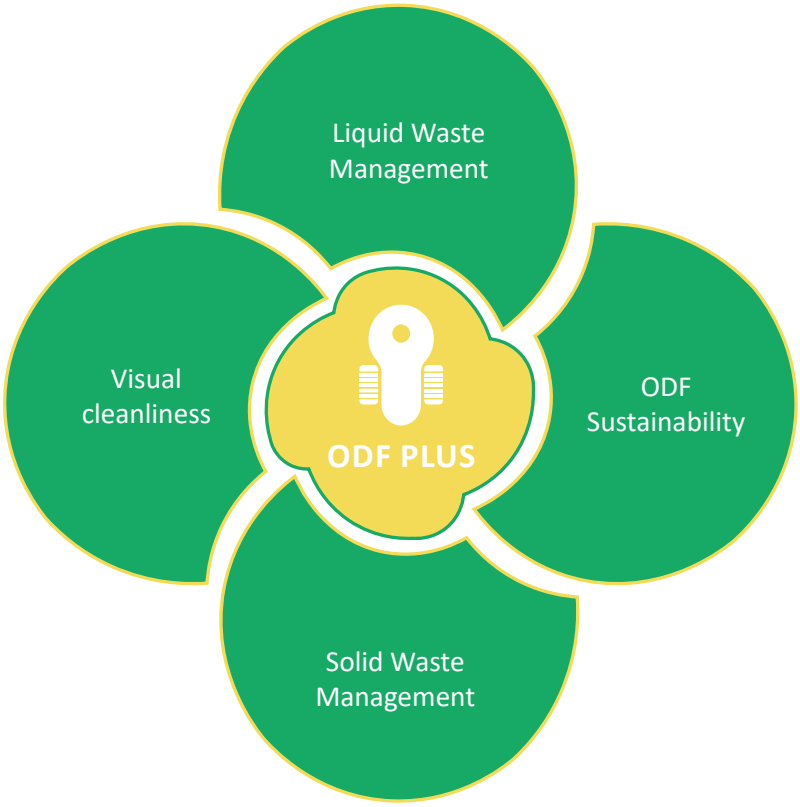
1.3 SBM (G) Phase-II

In rural areas, the generated waste poses a severe threat to public health and cleanliness. Although this waste is predominantly organic, incorrect disposal practices lead to serious problems such as causing water-borne and vector-borne diseases such as diarrhoea, malaria, dengue, cholera and typhoid. Improper management of solid waste may also lead to environmental pollution and contamination of water bodies, particularly in the monsoon season.

Rural India faces several challenges in both solid and liquid waste management. The ground challenges in rural waste management such as the following need to be focused upon:

- Low awareness on segregation at source
- Gaps in waste management assets
- Non-availability of low-cost technologies suitable for rural areas.
- Lack of involvement of community in planning/decision making process which results in low accountability of the community.
- The low involvement of school students and youth in IEC activities.

ODF Plus primarily focuses on visual cleanliness in rural areas, sustaining ODF status and proper management of solid and liquid waste, as represented in the accompanying infographic.



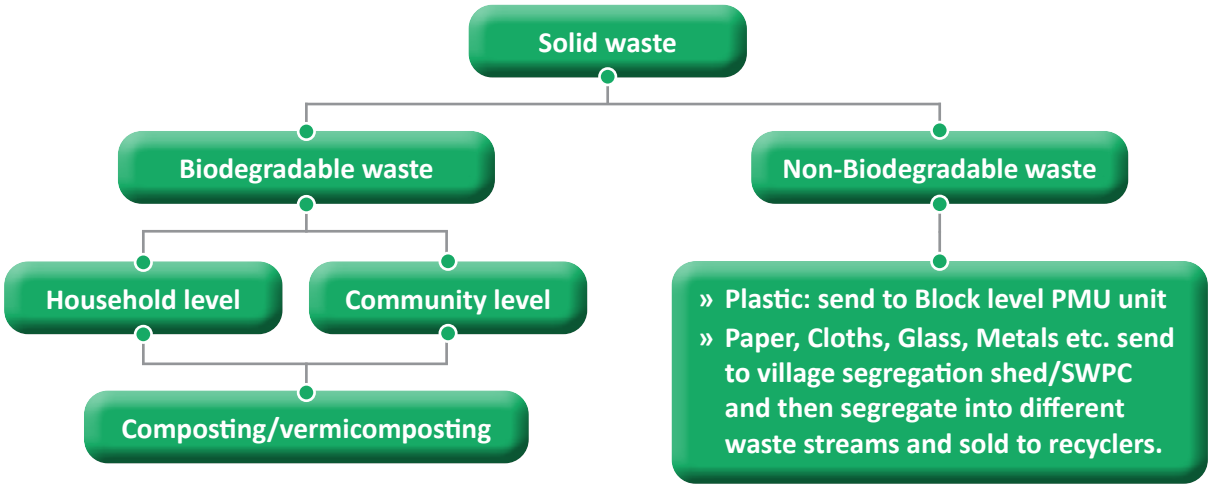
CHAPTER 2

Biodegradable Waste Management

2.1 Solid waste in rural areas

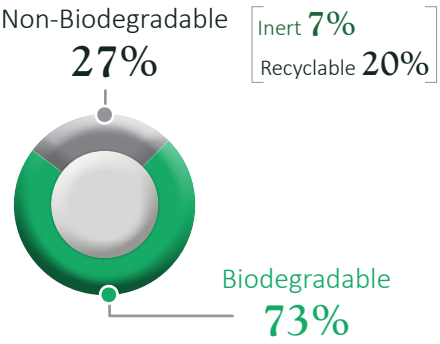
It is estimated that 0.3 to 0.4 million metric tons of solid waste are generated in rural areas per day (NIRD, 2016). Organic waste constitutes about 60–80 per cent of this waste. Cattle dung and crop residues constitute a major part of organic waste, which is estimated to be 1,650 million ton/day and 650 to 725 million ton, respectively.

Biodegradable waste is generally composed of kitchen waste (fruit/vegetable peels, leftover food) and animal waste, crop residues and market waste.



2.2 Composition of waste in rural areas

The waste generation rate in small towns in India is 0.41 kg /capita/day while the surrounding villages generate around 0.08 kg/capita/day of solid waste (IJERMCE 2018). Biodegradable waste generated in villages includes waste from the kitchen, agricultural waste and cattle dung, among others.



2.3 Components of biodegradable waste management

The components of biodegradable waste management include:

- Segregation
- Collection and transportation
- Treatment
- Disposal

Due to smaller quantities of biodegradable waste (from household chores, excluding agriculture and livestock-related biodegradable waste), local usage (at generation level itself) and its resource value, its management does not need all the steps mentioned above in rural areas.

2.3.1 Segregation of waste

As far as possible, solid waste should be managed at the household level so that minimum waste is delivered for management at the community level. This may involve the following steps:

- Household waste should be segregated at the source. This can be achieved by generating awareness among people to segregate waste at the household level into dry and wet waste in two different bins/containers.
- Reusable segregated non-biodegradable waste may be reused at the household level or sold to the recyclers/***kabadiwala.***
- The common types of wet and dry wastes are as follows:

- Efforts also should be made to treat the segregated biodegradable waste at the household level by adopting a suitable composting method.

2.3.2 Collection and transportation

For the collection and transportation of solid waste in rural areas, the following strategy may be followed:

Self-help groups (SHGs) or groups of unemployed youth in the village could be identified for collection and transportation of household waste into the village segregation shed/solid waste processing centre (SWPC). Each member may be responsible for the collection of waste for about 75–100 households. SHG members need to be provided with a suitable number of carts or tricycles for collection and transportation of waste to community storage bins. The number of tricycles may be decided based on the size of the panchayati raj institution (PRI) and the density of the population. Normally one tricycle should suffice for 100–200 households.

At least few spare tricycles have to be kept so that the collection system is sustainable even in the case of breakdown of few tricycles.

Indicative photos of tricycles and pushcarts.

2.3.3 Treatment and disposal

Waste collected at the village segregation shed/solid waste processing centre can be segregated into different waste streams. Whereas biodegradable waste can be converted into compost by simple composting methods, recyclable waste can be sold to the waste recyclers/kabadiwalas by Gram Panchayats.

For effective management of biodegradable waste in rural areas, the following two methods can be adopted:

i. Composting

ii. Biogas/biomethanation

CHAPTER 3

Composting - Process and Types

Composting is a process of controlled decomposition of the organic waste in which the organic matter breaks down under bacterial action, resulting in the formation of humus-like material called compost.

Factors affecting the composting process

- Microorganisms: Microorganisms breakdown organic matter and produce carbon dioxide, water, heat and humus.
- Moisture content: Moisture is necessary to support the metabolic activity of the microorganisms.
- Temperature: By affecting the growth of microorganism, temperature plays an important role in composting process.
- Carbon to nitrogen (C/N) ratio

Materials to be avoided in composting

- Non-biodegradable waste- like plastic, rubber, polythene packaging materials, Coal Ash.
- meat scraps, bones, grease, whole eggs to the compost pile/pit because these material decompose slowly, cause odours and can attract rodents/animal.

Advantages of composting

- Composting minimizes or avoids greenhouse gas (GHG) emissions.
- By proper decomposition, biodegradable waste gets converted into good quality organic manure.
- Composting also prevents vector breeding and breeding of rodents.
- In the aerobic composting process, considerable heat is generated, destroying pathogens and weed seeds.
- Insanitary conditions arising out of solid waste are removed and the environment looks neat and clean.
- The economic benefits of the use of composts include improved soil quality, enhanced water retention capacity of the soil, increased biological activity, micronutrient content and improved pest resistance of crops.

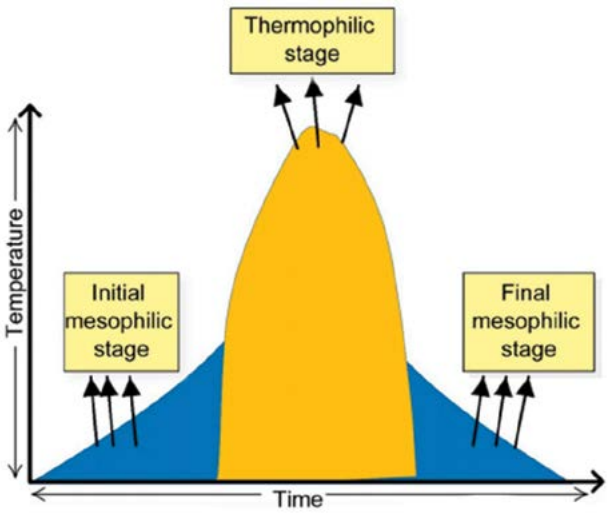
3.1 The composting process

Several biological, chemical and physical process takes place during composting.

A. Biological process

The process of aerobic composting involves two stages: **thermophilic and mesophilic**. Various organisms are known to play a predominant role in the decomposition of organic waste. Different types of microorganisms are therefore active at different times and locations within the mass of organic matter depending upon the availability of substrate, oxygen supply and moisture content.

(i) Thermophilic stage



This is the first stage of composting wherein microorganisms decompose the easily degradable organic substances, resulting in the production of heat due to intense metabolic activity. In most cases with the moisture content of 55–60 per cent and airspace of 20–30 per cent in the bed of biodegradable waste, temperature rise from 35°C to 55–65°C is achieved within 2–3 days. Typically, thermotolerant fungi, thermophilic bacteria and actinomycetes are the predominantly active microorganisms at this stage. Heaps of waste are flipped at regular intervals to expose the material in the inner core to air so that temperature in these fresh sections rises again, and gradually the whole waste is sanitized from pathogens.

(ii) Mesophilic stage (decomposition)

This is the second stage in the biological process of composting. Due to the reduction in available nutrients and readily available carbon, the microbial activity reduces, causing a decline in the temperature of the heap. There is a shift in the type of active microbial species in the compost heaps. The composted material turns dark brown during this stage due to humus formation and starts to stabilize.

B. Chemical parameters

i. **Moisture:** Moisture is a critical factor in establishing stable conditions conducive for composting because the microbes need moisture for survival and growth. Moisture tends to occupy the free airspace between the decomposing particles. Hence, when the moisture content is very high, anaerobic conditions set in.

ii. **Aeration:** The composting process requires an adequate supply of oxygen for biodegradation by microbes. Under aerobic conditions, the decomposition rate is 10–20 times faster than under limited oxygen supply or anaerobic conditions. High oxygen levels in air voids should be maintained within heaps of waste through turning and mixing at regular intervals.

iii. **Carbon-to-nitrogen (C/N) ratio:** The organisms involved in the stabilization of organic matter utilize about 30 parts of carbon for each part of nitrogen. A C/N ratio below 25:1 results in the production of foul smell and a higher C/N ratio will result in impeding the decomposition process. Whenever the C/N ratio is less than the optimum, carbon sources such as straw, sawdust and paper should be added. Higher C/N ratios may be reduced by adding biodegradable material having high nitrogen content, such as green biomass.

How to ensure 1 part of nitrogen (greens) and 30 parts of carbon (brown) in composting?

This is only a thumb rule. The moisture level, weight, and bulk density of the greens and browns you use in your composting might vary on different days. Therefore, you shall better keep C: N ratio 30:1 as a thumb rule.

What you clearly need to bear in mind is that browns you add must be much higher in quantity than the greens. Greens as such, plus a few shredded paper or a handful of dry leaves, does not help composting unless you make sure your browns outweigh your greens.

Greens (high in nitrogen-N source) and browns (high in carbon-C source)?

To maintain the optimum C: N ratio in the composting, the addition of carbon- and nitrogen-rich material must be regulated during composting.

By greens, we mean the 'kitchen wastes'. By brown we mean dry leaves, dry grass, saw dust and shredded paper. Let us try to list out 'greens' and 'browns' so that we understand our C:N ratio better, in other words, the greens-to- browns ratio.

Some carbon- and nitrogen-rich material for adjustment of C:N ratio

Nitrogen – N source materials (green)	Carbon – C source materials (brown)
» Discarded vegetables/vegetable peels	» Dry leaves/garden shrubs gathered
» Food waste/leftover food	» Corn stalks (broken)
» Coffee and tea grounds, tea bags	» Sawdust, wood chips
» Stale bread, eggshells	» Paddy straw, hay
» Leftover salad, citrus	» Shredded paper, newspaper
» Cut flowers/fresh grass clippings	» Paper napkins, tissue papers
» Cattle dung	» Soil can be added to the compost because organic carbon is generally present in garden soil.

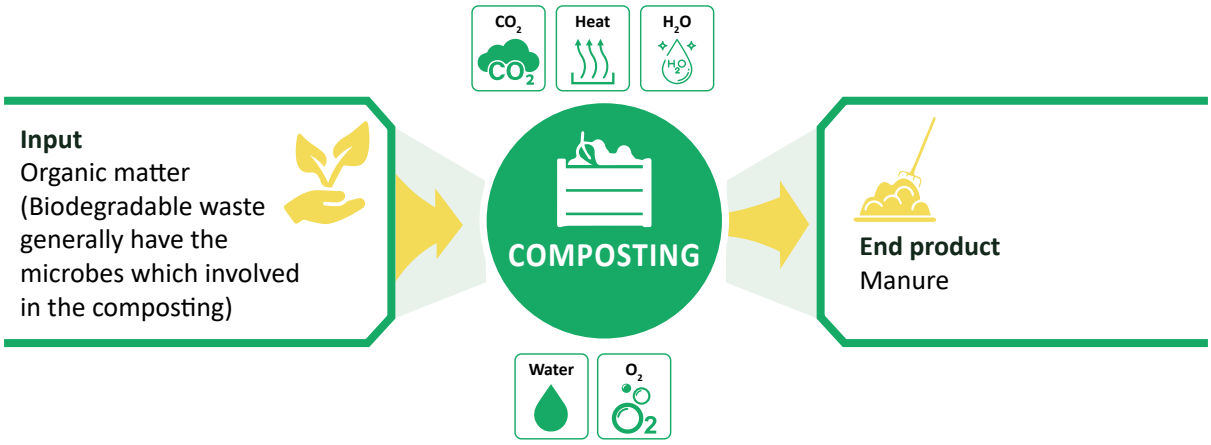
3.2 Types of composting

Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting is an organized method of producing manure by making use of this natural phenomenon. Composting can be carried out in two ways:

- Aerobic (in presence of oxygen)
- Anaerobic (in absence of oxygen)

Aerobic composting

Aerobic microorganisms oxidize organic compounds to carbon dioxide, nitrite and nitrate. Carbon from organic compounds is used as a source of energy while nitrogen is recycled. Due to exothermic reaction, the temperature of the mass rises.



Aerobic composting takes place when you use above-ground containers, a freestanding pile or a simple basket with perforations. As long as the air is available, aerobic decomposition takes place much faster than the anaerobic method, meaning you do not have to wait long for the compost to form. However, if during the process supply of oxygen gets limited, the process may slow down.

To make sure that decomposition takes place at a faster rate, you would have to add some perforations to your container. Alternatively, keep your pile of organic materials so that there is sufficient air circulation in that area. One simple precaution is to stir the pile once in a while and mix it well. Typically, you would need to do this twice or thrice during the entire decomposition process.

Usually, the bacteria which breakdown the food also release a lot of heat. This heat kills off most of the pathogens present and makes composting safe. Ideally, the composting process is free of any foul odour. In case, you sense a bad odour, your compost is too wet or was not mixed well. Adding brown parts such as twigs, fallen dry leaves, coffee or coconut fibre like moisture-absorbing materials can help. A well-made compost pile has a very pleasing, earthly aroma.

Anaerobic composting

Anaerobic decomposition takes place conditions of lack of oxygen supply, primarily in underground pits. During the process, anaerobic microorganisms breakdown the organic compounds through a process of reduction. A very small amount of energy is released during the process and the temperature of composting mass does not rise much. The gases generated are mainly methane and carbon dioxide. An anaerobic process is a reduction process and the final product is subjected to some minor oxidation when applied to land.

In this type of composting, you just need to dig a hole and prepare an organic mix to fill it. Seal the hole with a layer of soil and the process begins. Typically, anaerobic digestion takes longer than the aerobic digestion process.

Compost and its quality

Compost is the final product of composting process which have fertilizer value and safe to be used as manure.

The compost obtained can be checked for its quality before the use. Following parameter need to checked:

- pH
- Moisture content
- C/N ratio
- Nitrogen
- Potassium
- Phosphorus

For the quality testing of compost, Gram Panchayat may reach out to Depart. of Agriculture through the nearest Krishi Vigyan Kendra (KVK) for sample testing.

Biomethanation

It is the anaerobic (in the absence of oxygen) fermentation of biodegradable matter in an enclosed space under controlled conditions of temperature, moisture and pH. The waste undergoes decomposition due to microbial activity, thereby generating biogas, comprising mainly of methane and carbon dioxide (CO_2), and also slurry, which is almost stabilized, which can be used as biofertilizer after suitable treatment.

The details regarding biomethanation process, types of biogas plants and financial details provided in a separate Manual on Biogas Plants.

CHAPTER 4

Technologies of Biodegradable Solid Waste Management

4.1 Decision matrix for management of biodegradable waste

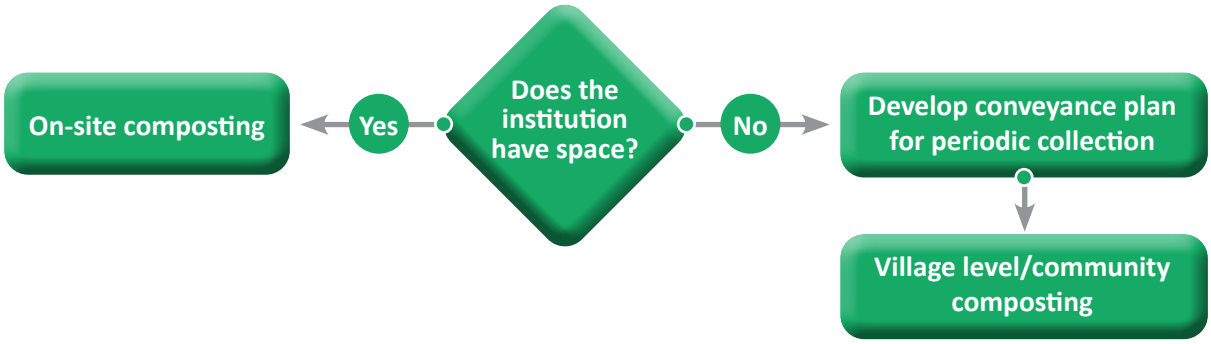
The components of biodegradable waste management include waste generation, segregation and collection, transportation, treatment and disposal. The provision for each of these components is not required in majority of the rural areas due to smaller quantities of biodegradable waste generated, and its local usage and resource value.

As far as possible, and especially for smaller Gram Panchayats, decentralized household level processing of biodegradable waste is preferred. Similarly, generation-level processing is also preferred for bulk generators such as institutions, markets, hotels and temples. For large Gram Panchayats and peri-urban areas, or in areas where household level processing is not feasible, community level and village or even a village cluster processing could be considered.

4.1.1 Biodegradable waste management at Household

S. No	Does household have space?	Does household have cattle?	Composting option
1.	Yes	No	Household composting
2.	No	Yes	Feed to cattle or community composting
3.	Yes	Yes	Feed to cattle and household composting
4.	No	No	Community composting

4.1.2 Biodegradable waste management at Institution/Commercial areas



4.2 Household Level

The suitable technology for composting depends upon selected based on the local conditions, availability of space and amount of waste generated. A list of technologies for household level is given below:

S. No	Technology option	Factors for selection
1	**Pit composting**	**Suitability** Adequate space availability in the backyard, and located away from drinking water source, suitable for small to large families. **Limitations** Not suitable for areas with high water tables.
2	**Single pot composting**	**Suitability** Compatible—requires less space, suitable for small families generating up to 2 kg waste per day **Limitations** Should be protected from the rain.
3	**Tripot composting**	**Suitability** Can be kept in the garden as part of aesthetics, compatible—requires less space, suitable for small families generating up to 2 kg waste per day **Limitations** Should be protected from the rain.
4	**Kitchen bin composting**	**Suitability** Compatible—requires less space, can be kept in the kitchen, suitable for small families generating up to 2 kg waste per day, easy to maintain. **Limitations** Should be kept away from rodent attacks.

(Continued)

(Continued)

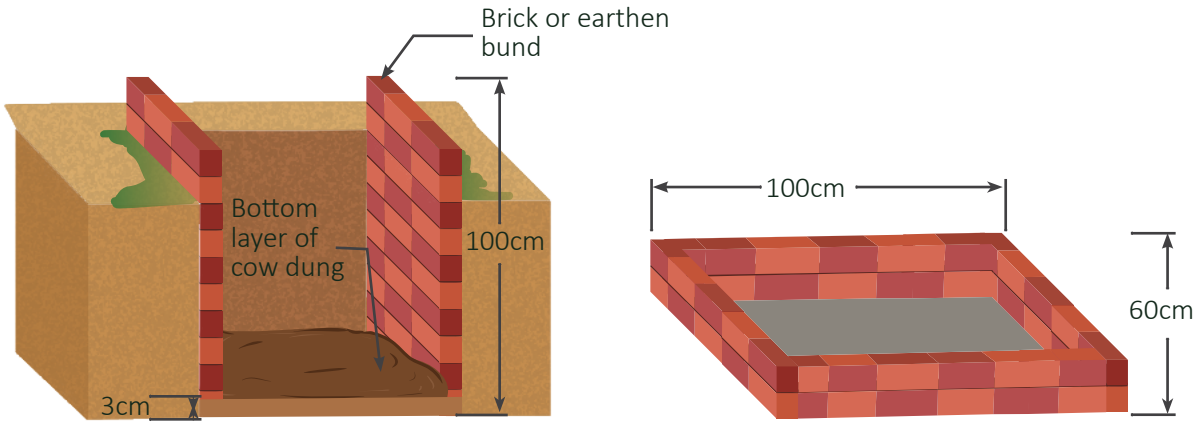
S. No	Technology option	Factors for selection
5	**Portable bin/ bucket composting**	**Suitability** Compatible—requires less space, suitable for small families generating up to 2 kg waste per day, easy to maintain **Limitations** Should be protected from the rain.
6	**Ring composting**	**Suitability** Suitable for households and institutions **Limitations** Should be protected from rain
7	**Pipe composting**	**Suitability** It can be adopted for a small family

4.2.1 Details of different household-level composting methods

Pit composting

S. No	Description
1	**Specification and size** » Pits of adequate size to bury the biodegradable waste of 6 months in each pit. » Pits of the length of 1 m and width 60 cm and depth 1 m for a family of five or six members. » Bigger size pits for bigger families according to requirements.
2	**Infrastructure requirements** » Two pits of adequate size to be dug » Tarpaulin or PVC roofing sheets to cover the pits » Cow-dung, loose earth » Tools like shovel, spade, etc.
3	**Operation and maintenance protocols** » Choose an elevated area where water does not get collected. Otherwise, make necessary provisions to prevent the entry of water into the pit by constructing a small bund around the pits. » Spread a layer of cow dung slurry or decomposed waste in the bottom of the pit before dumping the waste. » Spread the waste over the cow dung or decomposed waste layer. » Bigger sizes of the waste are to be cut into small pieces for easy decomposing. » A small layer of soil may be sprinkled over it daily to avoid a bad smell from the pit. » Repeat the procedure daily. » Once the pit is filled up fully, close the pit by spreading a layer of 15 cm of earth. » Once the first pit is closed, use the other pit in the same way. » The waste in the first pit becomes compost after a period of 4–6 months, clear the pit and make it ready for further use. The compost can be disposed of or used as manure. » Protect the pit from rainwater, keep it covered using a tarpaulin or polyvinyl chloride (PVC) roofing sheet.
4	*Cost:* The estimated unit cost ranges from Rs. 700 to 1,050.

Pit Composting



Section **Plane**

Single pot composting

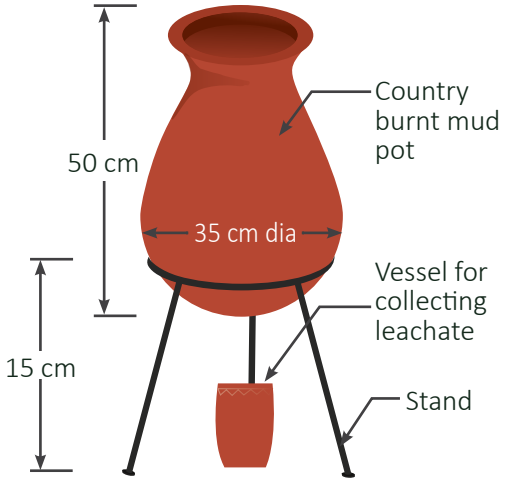
S. No	Description
1	**Specification and size** » Mud pots about 50 cm height and about 35 cm diameter at the centre with lid covers – 2 nos. » Tripod stand 50 cm high of appropriate design made of steel, wood, plastic- steel or brick pedestals for keeping the pots—2 nos.
2	**Infrastructure requirements** » Plastic vessel 10 cm high and of half-litre capacity, for collection of leachate coming out of the pots – 1 no. » Trowel small size – 1 no. » Painting brush, ½ size – 1 no. » 1 brick cut into 2 pieces » Plastic covers—2 nos.
3	**Operation and maintenance protocols** » Make a small hole in the bottom of the pots. » Place the pots with lids on the tripods at a convenient place. » Place the half-litre capacity plastic vessel below the first pot. » Start filling the segregated biowaste (do not put slow degrading items and non-degradable items into the pots) daily into one pot and keep the pot closed. This type of waste treatment is capable of treating 1 to 2 kg of waste per day only. » Leachate coming out of the pot gets collected inside the plastic vessel placed below the pot. » Put some salt powder into the plastic vessel to avoid the entry of flies into the vessel. The leachate collected can be diluted with water and used as manure in the garden. » Once the first pot is full, start using the second pot. » By the time the second pot becomes full, the waste in the first pot gets converted into compost. » After the first week of commencement, a lot of worms will be seen in the pot. Do not try to kill them. They activate the composting process and die after 3 weeks.

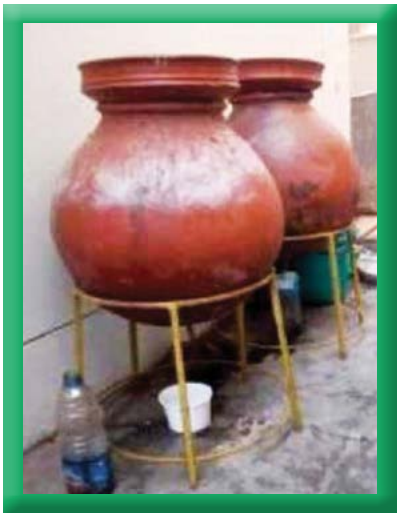
(Continued)

(Continued)

S. No	Description
	» During the rainy season, spread the plastic sheets over the pots and place the brick pieces over the sheet to protect the pots from rains. » If the quantity of the water inside the pot is high, add some sawdust to absorb the water. » If too many flies are seen around the pot, make a solution of camphor in coconut oil (dissolve 2 tablets in 25 ml of oil) and apply it on the bottom and top cover of the pot using the brush. » Sprinkling diluted rotten curd or cow dung solution into the waste will speed up the composting process.
4	*Cost:* The estimated unit cost ranges from Rs. 700 to Rs. 1,050.

Pot compositing





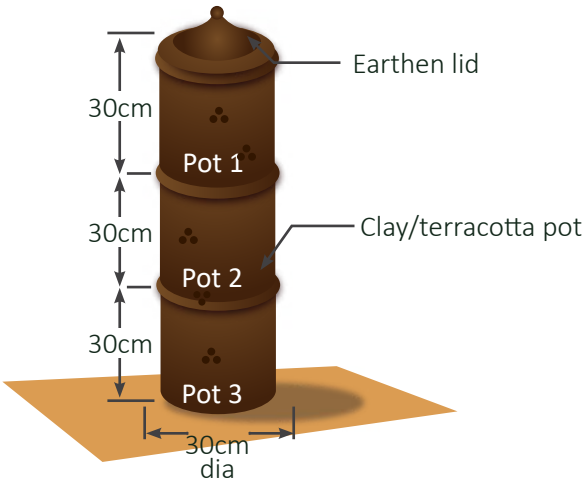
Tripot composting

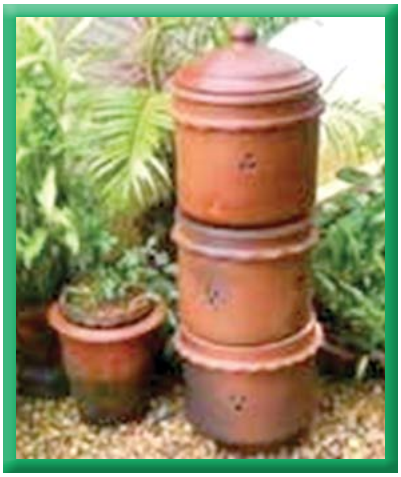
S. No	Description
1	**Specification and size** » The three pots to be kept vertically one above the other and the pot on the top is to be covered by a lid. » Pot number 1 and 2 are kept at the top and middle position and are open on the top as well as the bottom. The bottom open portion is weaved with plastic wires. » Pot number 3 is kept at the bottom and is open at the top and closed at the bottom.
2	**Infrastructure requirements** » Clay pots of 30 cm internal diameter and 30 cm high each – 3 nos. » Lid cover for pot – 1 no. » Old newspaper » Hand pump (sprayer) » Bio-compost or sawdust » Specially prepared bio-culture (dahi [curd])

(Continued)

(Continued)

S. No	Description
3	**Operation and maintenance protocols** » Place newspaper sheets at the bottom of pot numbers 1 and 2 over the plastic thread to form a bio-platform. » Spread starter material in a 1-inch-thick layer over the bio-platform (either prepared bio-compost or sawdust treated with bio-culture be used as starter material). Mix sawdust with diluted bio-culture (bio-culture:water ratio 1:50) and keep it in a sack bag duly tied. After two days, the sawdust mixture becomes hot by the activities of the bacteria. This hot mixture can be used as a starter. » Spread the shredded waste over the starter layer. » Spray the diluted bio-culture mixture over the waste. » Before closing the pot with the lid, sprinkle the starter mixture over the waste layer. Ensure water used for mix-ing the bio-culture does not contain chlorine. To ensure this, keep the tap water in an open vessel for two days. » Keep spreading the waste daily as above. » From the third day onwards, stir/mix the old waste layer by using a fork without tearing the paper at the bot-tom before placing the fresh waste on the top. » Each time you stir or mix, spray the bio-culture mixture and then sprinkle the starter over it before closing the lid. » Once the top pot is full, shift the middle pot to the top and the top pot to the middle portion and repeat the pro-cess of spreading the waste into the new pot on the top pot in the same way as done earlier. » Once the second pot also becomes full, clear the paper layer on the first pot (now in the middle position) and push these semi-decomposed waste into the bottom pot. » Shift this emptied pot to the top position and the top pot to the middle position. Continue filling the waste into the top as per the same procedure done earlier. » Now all the pots are full and the waste inside the bottom pot must have become compost and ready for use as ma-nure in the garden. Empty it and continue the process as a routine. » Do not use excess water. » This type of composting is useful for a family of four to five members, generating around 2 kg waste per day.
4	*Cost:* The estimated unit cost ranges from Rs. 700 to Rs. 1,050.

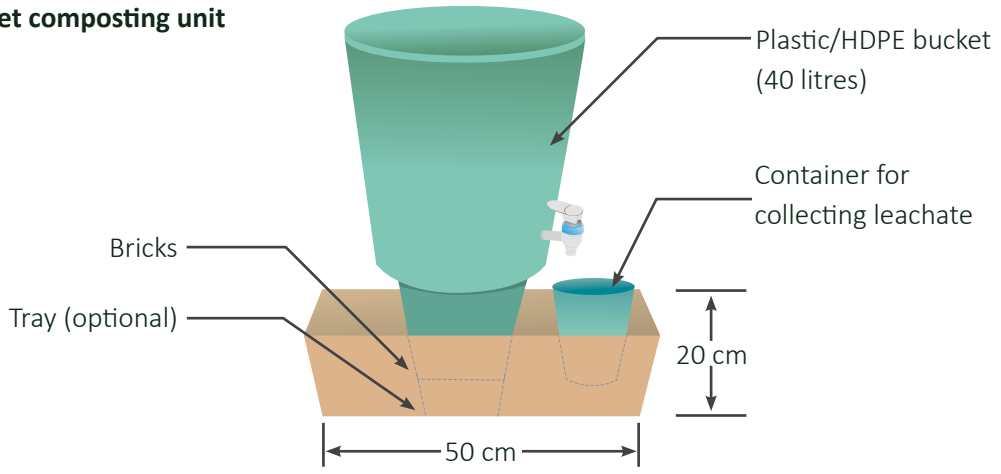




Portable bin/bucket composting

S. No	Description
1	**Specification and size** » Plastics or high-density polyethylene (HDPE) buckets/pots with 40-litre capacity with lid cover, duly fitted with a tap outlet on the side at the bottom-most point (The tap should be removable and fitted using a socket/coupling) – 2 nos.
2	**Infrastructure requirements** » Coconut shells – sufficient numbers » Bricks 4 nos. for placing the buckets/pot inside the tray » Small plastic vessel/mug 15–20 cm high for collection of leachate » Plastic net 0.5 m × 0.5 m size » Plastic tray approximately 0.5 m diameter to keep the bucket inside » Wooden spoon
3	**Operation and maintenance protocols** » Stock a layer of coconut shells in an inverted position at the bottom of the bucket/pot. Place the plastic net cut to the shape over the layer of coconut shell. » Place two sets of bricks inside the plastic tray and keep the prepared bucket/pot above the bricks for the convenience of draining the leachate into a plastic vessel to be placed inside the plastic tray just below the tap outlet. Placing the bucket inside the tray is optional. » Start loading the biowaste into the bucket/pot on the layer of coconut shells daily. » Occasionally mix the fresh waste with the old waste by using the wooden spoon. Keep the bucket/pot closed with the lid cover. » One bucket/pot will be filled in 25–30 days in a family of five members. » Close the bucket/pot with the lid cover and start using the second set. » Keep sprinkling a mug of water into the waste inside the bucket once a week. Drain the leachate as it comes out. The drained leachate can be used as manure in the garden. » Once the second bucket gets filled, the waste in the first one will be ready as compost. » Empty it and reuse the bucket/pot for further storing the waste.
4	*Cost:* The estimated unit cost ranges from Rs. 1,200 to Rs. 1,500.

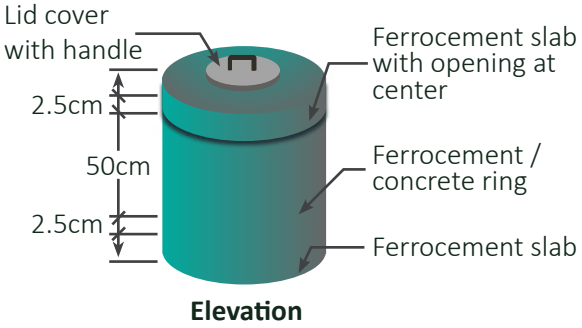
Portable bucket composting unit



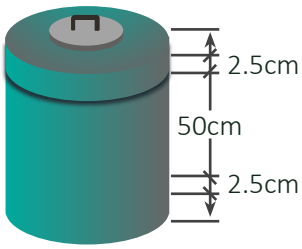
Ring composting

S. No	Description
1	**Specification and size** » Ferrocement ring of internal diameter 0.7 m, thickness 2.5 cm and height 0.5 m is placed over a circular ferrocement slab of diameter 0.75 m and thickness 2.5 cm (without fixing). The ring to have a 30 cm x 30 cm opening on the side with a ferrocement slab cover of the same curved shape, which can be removed and refitted back tightly with a locking arrangement for removal of compost when ready. » The ring will also have a hole of diameter of 2.5 cm at the bottom for the leachate to flow out. » Circular ferrocement cover slab of 0.75 m diameter and 2.5 cm thick with a central circular hole of 0.30 m diameter to cover the ring. The hole will have a lid cover that can be removed and refitted back for loading the waste into the ring and closing it tightly after loading the waste. » A HDPE sheet of 15 mm thickness instead of ferrocement slab at the base can also be placed, which will reduce the cost.
2	**Infrastructure requirements** » Two sets of circular ferrocement rings resting on circular ferrocement slabs and covered by another circular ferrocement slab with a provision for loading the waste from the top and removing the compost from the bottom, when ready. » A base layer with cow dung (5 kg) powder » Surgical hand gloves for handling waste and manure.
3	**Operation and maintenance protocols** » First apply a base layer with cow dung (5 kg) powder in the ring. » Chop the waste to a size less than 5 cm before placing it in the basin. » Remove the top central lid cover of the ring and drop the waste inside the ring. » Spread the waste evenly within the ring. » Use the first ring for the first 90 days and then use the second ring after the first ring is filled. » After 175 days, compost from the first ring can be emptied from the side opening and the ring can be used for further waste feeding. » Renew the base layer annually.
4	*Cost:* The estimated unit cost ranges from Rs. 2,500 to Rs. 3,000.

Ring composting

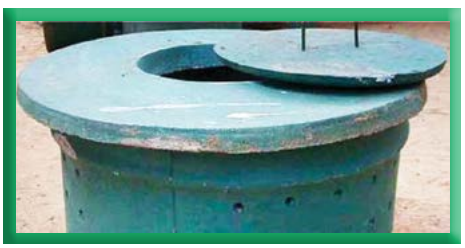


Elevation



Section

Plan



Kitchen bin composting

S. No	Description
1	**Specification and size** » 25-litre plastic bin with lid – 1 no. » Grow bag – 3 nos.
2	**Infrastructure requirements** » Trowel small size » Small fork
3	**Operation and maintenance protocols** » Place the plastic bag inside the bucket. » Spread starter material in a 1-inch-thick layer over the bio-platform (either prepared bio-compost or sawdust treated with bio-culture be used as starter material). Mix sawdust with diluted bio-culture (bio-culture:water ratio 1:50) and keep it in a sack bag duly tied. After two days, the sawdust mixture becomes hot by the activities of the bacteria. This hot mixture can be used as a starter.
	» Spread the shredded waste over the starter layer. » Spray the diluted bio-culture mixture over the waste. After the third day, use the fork to mix the contents of the old layer and the new layer. » Repeat the procedure till the bin is filled. » Tie the grow bag, remove it and store it. » Keep the second grow bag inside the bin and continue the process. » Once the second bag is filled, remove it and store it. Open the first grow bag and remove the contents and start using it again. If the waste quantity is more than 2 kg/day increase the number of grow bags to give at least 20 days of storing time for filled grow bags.
4	*Cost:* The estimated unit cost ranges from Rs. 750 to Rs. 1,000.

Portable household bio bin composting

S. No	Description
1	**Specification and size** » Around 40–45 kg of kitchen waste can be composted in this system. The dimension of the bin is in the order of 180 cm and 75 cm in width and height, respectively. » Bio bin—2 nos.
2	**Infrastructure requirements** » Sprayer: A sprayer of one litre capacity to spray dung water. » Steel fork: 1 large and 1 small. » Steel pot: A steel pan of 40 cm diameter to draw out the compost. » A 2 m flex sheet to dry out the compost. » A steel cutting knife. » The size/number of bio bins can be increased if there is an increase in the family members. » A bin can be easily produced by joining rectangular fibre layers. » More holes must be provided in the sides of the bin for the proper air circulation/ventilation.
3	**Operation and maintenance protocols** » The putrescible waste sorted from the source is cut or chopped into small pieces. » These chopped pieces are then put in the bin (avoid plastics). » Occasionally spray dung water. » Repeat the process daily. » One bin is suitable for 15 days. » After that, cover it with a stopper. » When the second bin is full, the waste in the first bin would have become compost. » This compost has to be sowed on the terrace for a day to get it dried and can be used as fertilizer for plants.
4	Cost: The estimated unit cost ranges from Rs. 2,200 to Rs. 2,500.

Pipe composting

S. No	Description
1	**Material required and process** » Two or more PVC pipes of 200 mm diameter and 1 m long each are placed in the household where kitchen waste and other biodegradable waste can be added to the pipes and mixed with water and cow dung. » The pipes are placed in a 30-cm deep pit. The pipe should be kept covered with a lid. Cow dung or other inoculums can be added periodically with the wet waste to activate the decomposition process. » Once the first pipe has reached its maximum capacity, the second pipe can be used. The decomposed waste from the pipe can be dried and used as compost in gardens or farms.
2	**Operation and maintenance** » Pipe composting is one of the most cost-effective methods for composting biodegradable waste at the household level. It requires low operation and maintenance. Occasionally the waste should be turned to allow air circulation and sprinkling cow dung and soil on the waste should also be prioritized to avoid the foul smell and worm infestation. » The compost can be removed by lifting the pipe.
3	*Cost:* The estimated unit cost ranges from Rs. 1,200 to Rs. 1,500.

4.3 Community/ Institutional Level Composting

In areas where household waste management is a challenge due to the constraints of space, community-level interventions become a viable option. In villages where all the waste cannot be managed at the household level, segregated and non-managed household waste needs to be transported either to the community bins at the village level or to the treatment plant sites at the community level where household-level biodegradable waste can be treated by a community treatment plant and recyclable and non-biodegradable waste can be sorted out and sold to the *kabadiwalas* by Gram Panchayats.

4.3.1 Technologies for the community-level waste disposal

S. No	Technology option	Factors for selection
1	**Pit composting**	**Suitability** Villages having adequate space located away from drinking water source. The underground pit composting is also suitable for areas having a rocky terrain. **Limitations** Not suitable for areas with a high water table.
2	**Pile composting**	**Suitability** Villages having adequate space located away from drinking water source. **Limitations** Not suitable for areas with a high water table.
3	**NADEP composting**	**Suitability** Compatible – requires less space **Limitations** Should be protected from rain
4	**Windrow composting**	**Suitability** Compatible – requires less space **Limitations** Should be kept away from rodent attacks.
5	**Drum composting**	**Suitability** Compatible – requires less space, easy to maintain **Limitations** Should be protected from the rain
6	**Vermicomposting**	**Suitability** Suitable for community level **Limitations** Avoid direct sunlight and waterlogging.

4.3.1.1 Details of composting technologies at the community level

1. Pit composting

Pit composting can be implemented in areas with lower rainfall and the site for construction must be at a higher level to prevent flooding of rainwater in the pit. In villages having constraints of space at the household level, community-level pit composting can be adopted. The following process can be adopted for pit composting:

- Dig/construct an adequate number of pits of not more than 1m (depth) x 1.5m (width) x 3m (length) dimension depending upon the quantity of waste generated.
- Make a ridge with the help of soil at the periphery of the pit and compact it by light ramming.
- Go on adding collected waste in the pits (only biodegradable waste).
- Wherever possible, it is advisable to add cow dung slurry to the waste to enhance the composting process
- Spread a very thin layer of soil over it (once a week) to avoid odour and fly nuisance.
- Continue to add waste every day.
- Follow the above procedure and repeat the layers till the pit is full. It is recommended to fill the pit up to about 300 mm above ground level.
- After 3–4 days, the waste above ground settles down.
- Plaster it with soil.
- Leave the pit as it is for 3–6 months for maturation and start other pits sequentially.
- After 3–6 months, take out the compost and use it in the fields.

Limitations

The prime limitation of this method is that the underground pit is not suitable for areas with heavy rainfall and water logging issues. The lining of the pit with soil if not done properly can cause fly infestation and pollute the surrounding areas.

Operation and maintenance protocols

- Choose an elevated area where water does not get collected. Otherwise, make necessary provisions to prevent the entry of water into the pit by constructing a small bund around the pits.
- Spread a layer of cow dung slurry or decomposed waste in the bottom of the pit before dumping the waste.
- Spread the waste over the cow dung or decomposed waste layer.
- Bigger sizes of the waste are to be cut into small pieces for easy decomposing.
- A small layer of soil may be sprinkled over it daily to avoid a bad smell from the pit.
- Repeat the procedure daily.

- Once the pit is filled up fully, close the pit by spreading a layer of 15 cm of earth.
- Once the first pit is closed, use the other pit in the same way.
- The waste in the first pit becomes compost after a period of 4–6 months, clear the pit and make it ready for further use. The compost can be disposed of or used as manure.
- Protect the pit from rainwater, keep it covered using a tarpaulin or polyvinyl chloride (PVC) roofing sheet.

Cost

The estimated cost for a pit composting unit ranges from Rs. 2,500 to Rs. 3,500.

2. Pile composting

Aerated static pile composting produces compost relatively quickly and is suitable for a relatively homogeneous mix of organic waste.

Compost pile should have enough void space to allow free movement of air as aerobic conditions fasten the composting process by 10–20 times and reduce generation of foul smell.

To aerate the pile, layers of loosely piled bulking agents (e.g. wood chips, shredded newspaper) are added so that air can pass from the bottom to the top of the pile.

Operation and maintenance

1. A layer of coarse material — corn cobs and husks, sticks, thick fibrous stalks from vegetables or flowers – should be put on top of the compost pile. This layer improves aeration at the bottom of the compost pile.
2. Do not turn regularly; the bottom layer gets quickly incorporated into the bulk of the mix, which pretty much defeats its purpose. As this happens, the longer items in particular — the plant stems, the sticks — can make turning quite difficult.
3. Put down a thin layer of brown material — leaves, chopped stems, wood chips — and sift over it a thin layer of soil, compost or manure.
4. Sprinkle these with water, then start the serious layering: six to eight inches of browns, followed by two or three of greens and then a sprinkling of the soil options. Water generously before starting the next layer. Keep building until the heap reaches 3–4 feet high.
5. Check the moisture level and, ideally, cover the pile without cutting off oxygen.

Cost:

The estimated cost for a pile composting unit ranges from Rs. 5,000 to Rs. 7,500.

3. NADEP composting

The NADEP composting method is named after its inventor, Narayan Deotao Pandharipande of Maharashtra (Pusad) (N.D. Pandharipande 2008). The NADEP method produces nitrogen-rich compost using the least possible amount of cow dung. The system also minimizes problems from pests and diseases and does not pollute the surrounding area because the compost is made in a tank.

After the NADEP tank has been filled with compost-making materials and sealed, it is left for the decomposition process to take place without any further handling until the mature compost is required.

Cost:

The estimated cost of a 4.86 cum size NADEP tank, which can cater to about 100–150 households is around Rs. 17,000/-

Selection of the site for the NADEP tank

The NADEP method uses a permanently built tank of mud or clay bricks or cement blockettes. It is therefore important to choose the site for the tank with care keeping in mind the below points:

1. The site should not be a low-lying area to avoid waterlogging.
2. The site should be easily accessible for transportation of waste and manure.
3. The site should have enough space to collect the materials together before filling the tank and where mature compost can be stored.
4. The site should have the facility/access of water to maintain the moisture content.
5. The site should be selected considering the wind direction so that the inhabited areas would not get any foul odour.
6. The site should be sheltered from rain and direct sunlight

Size of the NADEP tank

NADEP tank should be of the size of 3 m x 1.8 m with a 23 cm thick perforated brick wall in cement mortar with a height of 0.9 m above the ground. The perforated wall will facilitate the passage of air for aerobic decomposition. The floor of the tank should be laid with bricks. The tank should be covered with a thatched roof to prevent loss of nutrients by evaporation and that the contents are not exposed to sun and rain.

Filling of waste material in NADEP compost

The ingredients for making compost are agro-wastes, animal dung and soil in the ratio of 45:5:50 by weight. The ingredients are added in layers starting with vegetable matter, followed by dung and soil in that order.

A village must have at least two tanks so that when one tank is filled up the other tank is available for loading the waste.

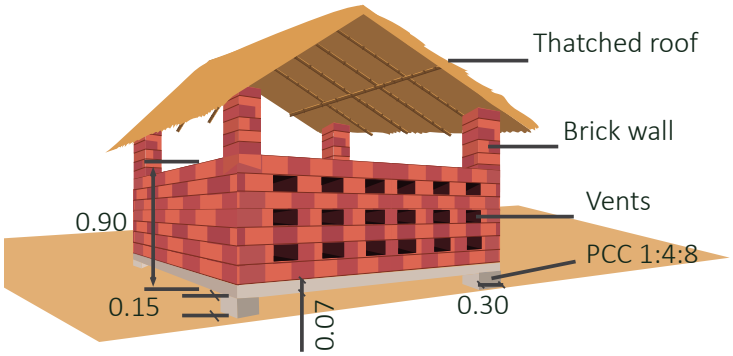
Advantages of NADEP

NADEP method of composting has the following advantages:

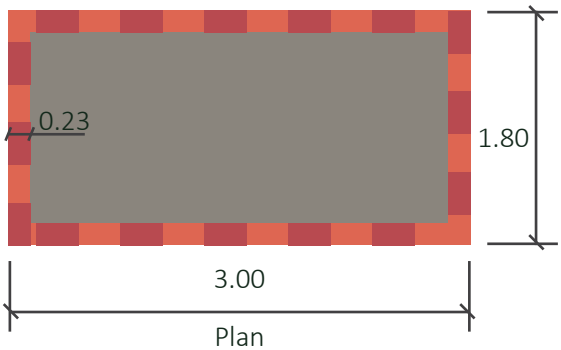
- It is very simple to construct and easier to operate.
- Labour is required only for the construction and one-time filling of the tank and excavation of manure.
- There is no loss of plant nutrients in the compost. Therefore, the percentage of nutrients in manure is high in comparison to other composting methods.

Limitations of the NADEP method

- Filling of the tank is cumbersome during the rainy season.



Cross section



Nadep compost pit

Operation and maintenance

- After 15–30 days of filling, the organic biomass in the tank gets automatically pressed down to 2 ft and the same should be maintained.
- The tank to be refilled by giving two to three layers over it and is resealed.
- The tank is not to be disturbed for 3 months except for moistening it at an interval of every 6–15 days.

- The entire tank is covered with a thatched roof to prevent excessive evaporation of moisture.
- Under no circumstances should any cracks be allowed to develop. If they do, they should be promptly filled up with slurry.

4. Windrow composting

In areas/regions where higher ambient temperatures are available, composting in open windrows is to be preferred. The biodegradable waste generated at the village level can be converted into a stable mass by aerobic decomposition. Aerobic microbes oxidize organic compounds to carbon dioxide and oxides of nitrogen and carbon from organic compounds are used as a source of energy, while nitrogen is recycled. Due to exothermic reactions, the temperature of mass rises.

The windrow composting process consists of placing the segregated biodegradable waste in long narrow piles called 'windrows' that are turned on a regular basis for boosting passive aeration.

Operation and maintenance of windrow composting

The segregated biodegradable waste is arranged in windrows on the compost pad. The compost pad must be stable, durable and impervious. It is to be constructed with an appropriately designed combination of reinforced cement concrete (RCC) and plain cement concrete (PCC). The compost pad should have a slope of about 1 per cent to drain the excess water (storm water or leachate) from the windrows into a leachate collection tank. The leachate tank is placed in the lowest corner of the compost pad area. This leachate should be reused for recirculation of nutrients and for maintaining the moisture content of windrows.

The ideal windrows height is between 4 and 8 feet with a width of 14–16 feet. This size pile is large enough to generate enough heat and maintain temperatures. It is small enough to allow oxygen flow to the windrow's core. Windrows are typically trapezoidal in cross-section.

Cost:

The estimated cost of windrow composting depends upon the available quantity of biodegradable waste and can start from a minimum Rs. 2,500.

5. Rotary drum composting

The rotary drum composting is suitable for rapid composting of kitchen and other organic waste generated from a group of households without causing any odour, vector and leachate in all seasons. The stabilized compost is achieved within 15–20 days. Community-scale continuous rotary drum composter of 3.5 cum capacity is used for high-rate composting of 150–200 kg organic waste per day.

The rotary drum can be successfully applied in a small land area for rapid composting of all kinds of organic waste (kitchen, cow dung, dry leaves, etc.,) generated from households, institutions and dairies.

Feeding of material in rotary drum

The inner side of the drum should be coated with anti-corrosive red oxide to avoid any rusting. To provide the appropriate mixing of wastes, baffles should be welded longitudinally inside the drum. The waste can be filled in the drum up to 70 per cent capacity to provide sufficient space for proper mixing. Aerobic conditions have to be maintained by opening up both half side doors of the drum after a certain period of rotation, which ensures proper mixing and aeration.

Operation and maintenance

1. Rotary drum provides agitation, aeration and mixing of the compost to produce a consistent and uniform end product without any odour or leachate related problems. The same needs to be followed diligently.
2. In warm, moist environments with ample amount of oxygen and organic material available, aerobic microbes flourish and decompose the waste at a quicker pace. This reduces the composting time drastically to 2–3 weeks.
3. The main function of rotation is to expose the material to air, add oxygen and release the heat and gaseous products of decomposition. There are two openings in the drum, that is, inlet for waste feeding and compost outlet and both needs to be maintained properly.
4. Two holes/ports at middle and an outlet at bottom of the drum should be provided to drain possible excess water and to collect compost samples. This has to be done properly.

5. The shredded mixed organic waste is loaded into the drum by means of plastic container on a daily basis. While the loading of waste material into the inlet of the drum can be done continuously, it is usually done on a periodic basis during the day.

Cost:

The estimated cost of a rotary drum of capacity of 550 litres is about Rs. 25,000 to Rs. 30,000.

6. Vermicomposting

Vermicomposting is the process of using earthworms and microorganisms to turn kitchen waste/ organic solid waste into black and nutrient-rich humus. Vermicomposting involves the stabilization of organic solid waste through earthworm consumption, which converts the material into worm castings. Vermicomposting is the result of the combined activity of microorganisms and earthworms. Microbial decomposition of biodegradable organic matter occurs through extracellular enzymatic activities (primary decomposition) whereas decomposition in earthworms occurs in the elementary tract by microorganisms inhabiting the gut (secondary decomposition). Microbes such as fungi, actinomycetes and protozoa are reported to inhibit the gut of earthworms. Ingested feed substrates are subjected to grinding in the interior part of the worm's gut (gizzard), resulting in particle size reduction.

Materials for the preparation of vermicompost

Any type of biodegradable waste is suitable for vermicompost. Kitchen wastes, animal/cow dung, and leafy biomass are more suitable for vermicompost.

Earthworm species for vermicomposting

The following species of earthworm commonly found in India are used for vermicomposting:

1. *Eisenia foetida*
2. *Eudrilus eugeniae*
3. *Amyanthes diffrigens*

Advantages of vermicompost

1. Rich in all essential plant nutrients.
2. Easy to apply, handle and store and does not have a bad odour.
3. Improves soil structure, texture, aeration and water holding capacity.
4. Contains an earthworm cocoon and increases the population and activity of earthworm in the soil.
5. Free from pathogens, toxic elements and weed seeds.
6. Minimizes the incidence of pests and diseases.

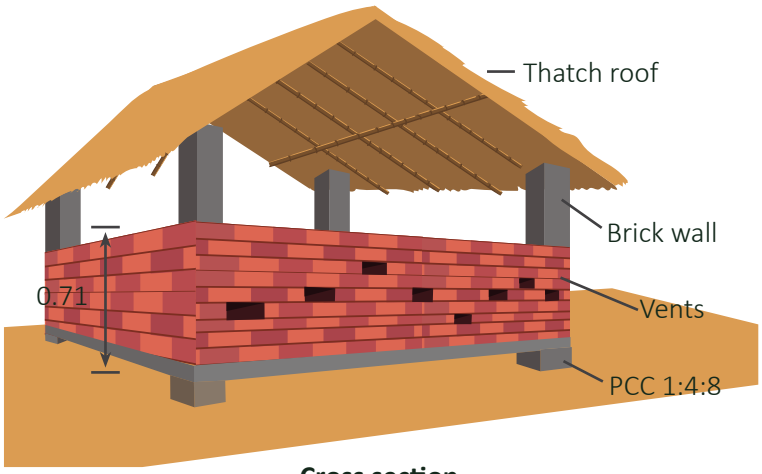
Operation and maintenance

1. Vermicompost tank should be covered with gunny bags to avoid direct lighting and maintenance of moisture content. Earthworms are nocturnal in nature. During day time, they stay in their burrows underground. At night, they come up near or on to the surface for to feed.

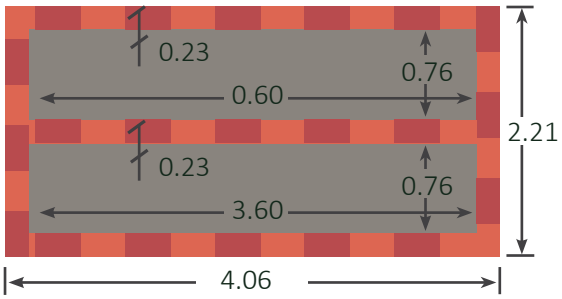
2. Check the tank frequently during the settling-in stage. For the first couple of weeks of use, there may be a very slight odour from the tank as the worms adjust to their new environment and the ecosystem starts to establish itself. Thereafter, any smell should disappear.
3. The first sign of a problem is usually odour. Check that water is draining satisfactorily from the tank after flushing. If you have used organic material which is too fine, such as sawdust, blockages are possible and the tank will fill with water, eventually drowning the worms.
4. A C/N ratio below 25:1 results in the production of foul smell and a higher C/N ratio will result in impeding the decomposition process. Whenever the C/N ratio is less than the optimum, carbon source such as straw, sawdust and paper should be added. Higher C/N ratios may be reduced by adding biodegradable material having high nitrogen content, such as green biomass.
5. The worms slow down a lot in colder temperatures. They do not eat as much and they do not breed as much. Check the tank more frequently during the winter and especially towards the end of winter. It is possible that materials accumulate faster than the worms can deal with . If this happens, it can slow down the rate at which water percolates through the tank and anaerobic conditions can potentially develop. Let the tank rest until the excess has been and the problem will usually correct itself.

Cost:

The estimated cost for a vermicomposting unit ranges from Rs. 25,000 to Rs. 30,000.



Cross section



Vermi compost tank

CHAPTER 5

Funding Provisions

Under SBMG Phase II, a large number of activities are targeted be undertaken for biodegradable waste management. Apart from the budgetary allocations under SBMG Phase II of DDWS and the corresponding state share, remaining funds will be dovetailed from 15th Finance Commission grants to Rural Local Bodies, MNREGS and revenue generation models for solid and liquid waste management (SLWM) activities.

Funding pattern for village level solid waste management

Scheme	Financial support
SBMG	» Rs. 60 per capita for villages up to a population of 5,000 people » Rs. 45 per capita for villages having a population of above 5,000 people
15th Finance Commission	» 50 per cent of tied fund allocated

The funding provisions under SBMG and other sources for biodegradable waste management activities are as follows:

Activities	SBMG Phase II funds (Centre + State)	15th FC	MGNREGS	Business model/ corporate social responsibility (CSR)	Beneficiary contribution
Biodegradable waste management					
Segregation bins at HH		✓			
Segregation bins at public places		✓			
Compost pit/tricycles/other vehicles	✓	✓	✓		
Setting up segregation, storage and compost premises			✓		
Wages for collection of waste		✓			
Equipment for cleaning the premises and segregation of waste		✓			
Operation and management for solid waste management				✓	


ग्राम पंचायत

CHAPTER 6

Role of Stakeholders

The roles and responsibilities of various stakeholders in managing the biodegradable waste are detailed in the following table:

Stakeholders	Implementation and monitoring	Information, education and communication (IEC)	Capacity building
State	» Develop strategy and action plan for implementation » Monitoring and IMIS reporting » Timely fund transfers to GPs » Fund convergence with other schemes	» IEC campaign to promote waste segregation and household level processing » Create IEC material » Collaboration with institutions like schools, Anganwadi centres to enhance the outreach of the waste management messages	» Each state to have a SLWM consultant » State to empanel an non-governmental organizations (NGO), private agencies for allied support » Orientation of swachhagrahis
District	» Preparation of Comprehensive swachhata action plan including convergence of various schemes and funds » Monitoring and IMIS reporting » Establish interdepartmental linkage with Agriculture/ Animal Husbandry/Forest Department	» Preparation of detailed IEC plan » Support of local NGO for triggering activities and selection of motivators » Providing funding for implementation of IEC to Blocks and Gram Panchayats » An IEC consultant at district level » Use of social media – Facebook, Twitter » Monitoring of IEC implementation » Collaboration with institutions like schools and Anganwadi centres to enhance the outreach of the waste management messages. » Encouraging and incentivizing household level for segregation and treatment	» Each district to have a SLWM consultant » Preparation of training calendar » Constitution of District Training Management Units (DTMU) » Training to district level functionaries for implementing IEC and CB plan for ODF Plus » Monitoring and evaluation

(Continued)

(Continued)

Stakeholders	Implementation and monitoring	Information, education and communication (IEC)	Capacity building
Gram Panchayat (GP)	» Preparation of Village Action Plan and incorporate it into Gram Panchayat Development Plan (GPDP) » Establishing community level infrastructure wherever applicable » Procure equipment for collection, transportation and processing of waste » Engage local manpower/ SHG for everyday operation » Exploring user fee collection through Gram Sabha if applicable	» Making mandatory segregation of waste at source and prevention of burning of waste through a resolution of Gram Sabha » Collaboration with institutions like schools and Anganwadi centres to enhance the outreach of the waste management messages.	» Conducting of training sessions for capacity building of School Teachers, swachhagrahis, accredited social health activists (ASHA), Anganwadi workers » Training for the service provider in construction, repairs and maintenance of assets » Engaging with local NGO if possible


जैविक खाद

CHAPTER 7

Case Studies

1. Madan Heri village, SAS Nagar district, Punjab

Madan Heri village is in Kharar tehsil of Sahibzada Ajit Singh Nagar district in Punjab, India. It is situated 5 km away from the subdistrict headquarters at Kharar and 12 km away from district headquarters Sahibzada Ajit Singh Nagar. The total geographical area of the village is 151 hectares. Madan Heri has a population of around 1,100 people. There are about 190 houses in the village.

Keeping in mind the objective of Swachh Bharat Mission (Grameen) and ethics of Mission Swachh and Swasth Punjab, Sarpanch Jaswinder Singh along with other members of the Panchayat took an oath of taking all possible actions to make Madan Heri a model village in waste disposal practices.

SBM Phase II initiatives: Planning to action

Before initiating the process, the Sarpanch and Panchayat Secretary (MGNREGS) decided to undertake exposure visits to solid waste management plants in different villages to understand their working as well as the scope of improvement, which they would further incorporate in their village. After extensive exposure visits and meetings with various Sarpanches and Panchayat members of different villages, they prepared an action plan with the support of an NGO.

Steps to a successful waste management initiative

Village/area recce: To understand the area and demography, site recce was undertaken where information on the current condition of the village, population, household, the standard of living, source of earning were collected.

Knowing the perspective: To understand the perception of people towards the management of waste, meetings and awareness sessions were held in the village separately with women and men.

IEC Session: In this session, the objectives and information about Mission Swachh and Swasth Punjab and terminologies that are used in solid waste were disseminated. The basic method of waste management, biodegradable and non-biodegradable waste was demonstrated.

Solid waste management plant

It was decided for pit composting for treating the biodegradable waste and three pits having a depth of 5 ft. were constructed. The total area of the plant is 1,500 sq. ft. The plant cost approximately Rs. 3 lakh and was funded under MGNREGA. The plant was inaugurated in September 2020. Blue and green dustbins were distributed to the households for segregation of waste. A dedicated waste collection vehicle with a kit including medical ointments, gloves, jacket and cap was handed over to the appointed waste collector.

Process

The waste collector starts collecting waste from each household every third day of the week and segregates it into biodegradable and non-biodegradable waste from the blue and green dustbins. . With the help of the vehicle, the collector takes the waste to the plant site. The wet waste is treated and dry waste is separated for further use. Wet waste is then layered with cow dung, jaggery and water to convert it into a valuable compost. Generally, 2–3 litres of water and 3 kg of cow dung are spread in a layer depending on the waste. It takes 3–4 months to turn it into compost.

Shri. Gurpreet Singh, Panchayat Secretary, said that the villagers are sincerely segregating the waste and paying the waste collection fee.

According to Smt. Kuldeep Kaur, a resident of village, the solid waste management plant has been a great support for all women as well as residents as there is one dedicated person for collection and disposal of the waste.

Financial sustainability

Based on the amount invested and the returns, this project is not only adding financial value but also social value to the village. The dry waste collected is sold to the recyclers and the amount received is used for running the solid waste plant. Similarly, the compost is sold at good prices to farmers for agriculture purposes. This project also employs a waste collector who earns Rs. 4,200 per month.

2. Adimaly Gram Panchayat, Idukki district, Kerala

Adimaly Gram Panchayat, one of the beautiful hilly Gram Panchayats (GP) in Idukki district in Kerala was having serious issues with waste management. Stories with accompanying photographs on Adimaly's pathetic waste management interventions in leading newspapers were a regular occurrence. The town and its surroundings were full of littered plastic carry bags containing mixed waste. Every nook and corner of the town resembled a dumping yard. As Adimaly town is the gateway to Munnar, many tourists pass through the town. Besides, a portion of Neriamangalam forest and the two breathtaking waterfalls – Cheeyappara and Valara, two important tourism spots – belong to Adimaly. The waste-littered streets and roadsides caused inconvenience to the public and tourist alike. Adimaly Gram Panchayat authority became a target of criticisms. Adimaly Panchayat was ready to go to any extent to find a solution to this nagging problem.

At this juncture, Madhyamam Media Mission came into the picture. Instead of publishing negative news and defaming the Panchayat, this group wanted to arrive at a solution and so they approached District Suchitwa Mission and the Panchayat with a proposal to conduct a seminar as a preliminary step. They succeeded in arranging a productive seminar for the public involving sessions on basics of waste management. District Suchitwa Mission arranged an exhibition stall displaying source-level waste management devices along with descriptions of their operation and maintenance. Programme officers, representing the District Suchitwa Mission, conducted a session on source-level waste management stressing on waste segregation at source and Suchitwa Mission policies on waste management. They also assured wholehearted support and technical know-how in the Panchayat's waste management initiatives.

Inspired by these efforts, the Gram Panchayat decided to develop a comprehensive plan for managing waste and prepared a project named 'Green Adimaly, Clean Deviyar'. In 2016–17, the Panchayat made provisions for providing 1,070 ring compost units and 135 biogas plants, which can manage approximately one ton of waste. In addition, 250 households were provided with pipe compost units, 320 households with compost pits and 550 households with kitchen-bin facilities. All these together could manage another one ton. About 5,000 households possessed land-space of above 10 cents (4,356 sq. ft.) where they can manage wet waste through natural-pit composting method. A fixed-dome type biogas plant of one-ton capacity was installed at Adimaly market to manage the wet waste generated in the market. A total of Rs. 34.45 lakh and Rs. 27 lakh were respectively spent during 2016–17 and 2018–19 for installing source-level SWM facilities and the funding came from Swachh Bharat Mission (G) and Suchitwa Keralam Scheme of State Government.

The Panchayat issued a notification instructing all the existing buildings, institutions and households in the panchayat area to create adequate solid and liquid waste management systems within 6 months. For the new buildings, the notification fixed adequate solid and liquid waste management systems as mandatory for registration.

As a growing town, Adimaly was able to regulate source-level waste management slowly but with steady progress. Continuous awareness campaigns, distribution of freedom from waste campaign leaflets and source-level waste management related pamphlets to all households and institutions, ban on plastic

carry bags, passing of plastic by-law, planning and implementing source-level waste management strategies with public participation, dry waste collection system through Haritha Karma Sena (a team of volunteers undertaking door-to-door dry waste collection who work in an entrepreneurial manner) are some of the significant steps taken by the panchayat. Those who violate the rules are charged fines and those who give information on unauthorized dumping are rewarded generously.

Ring composting facilities are provided to 1070 households in the panchayat

Besides, local body representatives and the officials have set sanitation messages as their ringtones in their mobile phones with the help of BSNL. Beautiful wall paintings depicting sanitation messages decorated the walls of the Adimaly Taluk hospital. All these steps changed Adimaly as one of the cleanest towns and panchayaths of Idukki. The media is now praising Adimaly for its stellar achievements in waste management.

Community level composting facilities are installed at way-sides and market in-order to manage over-flow of waste

Boards are placed at different locations of the Gram Panchayat announcing that littering is a punishable offence and those who report such offences to the Gram Panchayat will be rewarded Rs.2,500.

The public is alerted by placing message boards in public places and besides water bodies. The Panchayat works in partnership with the local police station and is enlisting police support in identifying offenders and bringing them back to the litter spot to clear the litter at their own expense. So far the Panchayat has levied a penalty of almost Rs. 1.25 lakh and more people are sensitized on the matter.

3. Gram Panchayat Kali Billod, Depalpur block, Indore district, Madhya Pradesh

Gram Panchayat Profile:

- Households: 3,800
- Population: 40,000
- Area: 21 hectares
- Daily dry waste generated: 250 kg
- Daily wet waste generated: 2 tonnes
- The Gram Panchayat is located close to the Pithampur Industrial Area

Management of solid waste in the GP

An NRLM self-help group of five women was selected for the waste management drive and trained in solid waste management. They were taught to understand waste types, their segregation, collection, treatment and cost–benefit analysis to understand the waste economy. An agreement was signed between the SHG and GP for the management of waste. The GP also conducted a continuous IEC programme for segregation of waste at source.

Process

The SHG group starts at 6:00 A.M. in groups of two and collects the segregated waste from the households. They make a total of four rounds per day. In the shed, one person supervises the process of further segregation, storage and record keeping.

Biodegradable waste is composted with the help of employed labour. Every 15 days, dry waste is handed over to recyclers.

Financial sustainability

The Gram Panchayat imposed a spot fine for non-segregation of waste by households. They also imposed a Swachhata cess/collection fee of Rs. 50 per month, which is collected by the SHG. Currently, 2,000 households are paying the collection fees. The Gram Panchayat retains 10 per cent of the collected amount and transfers the remaining 90 per cent to the SHG. The panchayat produces approximately 3,000 kg of compost per month and the compost generated is sold at Rs 5 per kg.

4. Lalpur village in Lucknow district, Uttar Pradesh

Pre-intervention condition

Status of SLWM in Lalpur village

There was no community garbage collection facility in the village. Slum dwellers were dumping their garbage near the living areas. People often threw the garbage outside the garbage bins. The inconvenience of huge garbage on streets and sorting by the sweepers or presence stray animals on the streets presented a very ugly scene.

Main sources of solid waste

The main sources of waste were household waste, animal waste, plant waste, construction and demolition waste and sludge. Most of the households in the village did not store the waste at its source and instead disposed them in garbage bins, on roads, open spaces, drainage pipes, etc. Most of the recyclable material was also disposed of with domestic and trade waste. Therefore, recyclable waste was generally found mixed with rubbish on the streets, in the garbage bins and at the dumping zones from where part of this waste was picked up by the street sweepers. There was no door-to-door collection system available for waste. Street sweeping was the only process of primary collection of waste. There had been a momentous increase in the production of solid waste in Lalpur over the last few years.

Post intervention

The officials of SBMG, with the support of WaterAid, conducted a survey based study on the status of solid and liquid waste collection, treatment and disposal in and around Lalpur village in 2017–18. Dustbins were placed at individual households after a community meeting was held in the presence of District Heads and members of the Gram Panchayat. The villagers were educated about the advantages of throwing garbage into the dustbin and the adverse impacts of throwing garbage outside the bin. Several rallies and meetings were organized for mobilization and creating awareness among the public. In the second step, waste was collected and transported to the waste disposal site. In the third step, segregation of waste was done at the site and finally the non-biodegradable material like plastic and metals were sold to the market and management of biodegradable waste was converted into compost at SLRM.

Solid waste is now managed by the SLWM workers who are part of the SHG. They bought about 232 green dustbins for biodegradable waste and red dustbins for collecting non-biodegradable waste, which were distributed throughout the Village. Waste collection vehicles (tricycles) arrive around 10:00 A.M. to remove the waste. Two partitions of different colours are provided in the tricycle, that is, red and green, which are to be used for collecting non-biodegradable and biodegradable respectively. After collection of waste from the households, the garbage is dumped at the SLRM centre where they are segregated.

Management of biodegradable waste

In Lalpur village, a method of composting was developed for biodegradable or organic wastes like vegetable peels, waste food, leaves, dead flowers and eggshells. They are converted into manure by burying them in compost pits and compost drum.

Outcomes

1. **Waste is collected at pre-informed timings:** The arrival of waste collectors is announced through different methods like calling the name of head of the household or tapping on the tricycle. Waste is either kept inside or outside the house. Two dustbins of different colours are kept for putting biodegradable and non-biodegradable waste. SLRM workers collect Rs. 2 each day from each household, which is used as income for earning their livelihood and for maintenance of the SLRM activities.
2. **Improved disposal of solid waste:** Household waste contains 40–50 per cent organic waste. Vegetable waste contributes to a major portion of organic waste. The organic waste, which causes major hygienic and environmental problems in the village, is now subjected to treatment methods like composting and anaerobic digestion.
3. **Treatment of inorganic waste:** The inorganic portion of household waste is divided into recyclable and non-recyclable materials. The recyclable materials are separated from the solid waste. The inorganic waste is treated using an appropriate method depending on its physical and chemical characteristics and also on its reuse potential.

पेयजल एवं स्वच्छता विभाग
जल शक्ति मंत्रालय
भारत सरकार

DEPARTMENT OF DRINKING WATER AND SANITATION
MINISTRY OF JAL SHAKTI
GOVERNMENT OF INDIA