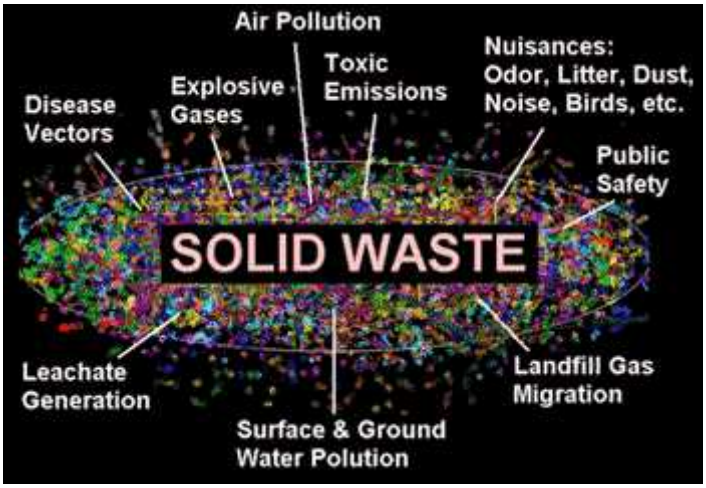
SOLID AND LIQUID WASTE MANAGEMENT (SLWM)

"Any material or liquid that is left over after productive use or which is beyond any use in its current form and is generally discarded as unwanted; it can also be defined as any material linked to human activity in comparison to nature which has its own system of recycling waste such that it eventually becomes a resource: for example, organic matter such as leaves, branches, and so on, decompose to form manure". (World Bank Water and Sanitation Programme (2012).



Hence, Solid and liquid (storm water and sewerage) waste management are part of the essential infrastructure in the rural area to be handled in a more technical approach.

OBJECTIVES:

a) to protect human health and improve quality of life among people living in rural areas.

b) To reduce environment pollution and make rural areas clean.

c) To promote recycling and reuse of both solid and liquid waste.

d) To convert bio waste into energy for ensuring greater energy security at village level.

e) Accelerate sanitation coverage in rural areas by providing privacy and dignity to women.

Effective management of SLWM includes management of biodegradable and non-biodegradable waste, management of all grey water generated in the village and general cleanliness of the village. The activities under SLWM include:

a) Solid Waste Management:

- Construction of compost pits/common compost pits,
- System for collection, transportation, segregation and composting and disposal of remaining garbage at earth fill.

b) Liquid Waste Management:

- Construction of low cost drainage,
- Construction of soakage channels/ pits reuse of waste water,
- Construction of stabilization ponds.

Full technical details of the works in this section are available with the Ministry of Drinking Water Supply and Sanitation, Government of India.

SLWM UNDER MGNREGA:

i) Guidelines for solid and liquid waste management have been issued by the Ministry of Drinking Water & Sanitation (MDWS), implementing Swachh Bharat Mission-Gramin. To support the MDWS in accelerating the sanitation coverage in the rural areas so as to comprehensively cover the rural community through strategies and saturation approach, rural sanitation works (such as IHHLs, solid and liquid waste treatment) are being carried out under MGNREGA.

ii) Guidelines for solid and liquid waste management issued by the MDWS are to be followed under MGNREGA also. However, there are number of activities in SLWM which are of repetitive/ contractual/ replacing unskilled manual labour by machine nature, which are not permitted under MGNREGA. Therefore, for solid and liquid waste management under MGNREGA in a GP should be made on saturation mode i.e. starting from collection to land fill in convergence with SBM (Gramin).

There are three key problems associated with improving the SLWM, i.e. lack of institutional capacity, lack of financial resources and public attitude.

i) PARTICIPATORY PLANNING:

a) The data collected is to be analysed along with the representatives of the community.

b) The community should be informed about various technology options for SLWM both at household as well as community level and accordingly technology options should be decided.

c) Based on the discussions with the community, SLWM action plan should be prepared.

ii) SOCIAL MOBILIZATION AND AWARENESS:

a) Generation: It should focus on inter personal communication, focused group discussion, technology demonstration and exposure visits to successful sites.

b) Technology options: Household and community level technological options with approximate cost estimates should be worked out.

c) Operation and maintenance: Success of a technology depends upon proper O&M (Operation and Management) at the household and community level. This aspect should be discussed in detail during planning process and incorporated in the action plan.

Solid and liquid waste management is a much larger issue which requires a range of options depending on several factors in rural areas particularly density of population, standard of living and consumer habits, availability of land and so on. Therefore, it is necessary to develop situation specific options and launch a massive IEC and capacity building experience

The scale of operation for different types of waste management should be decided based on the following factors:

i) Type of waste (i.e. dry, wet, electronic, etc.)

ii) Quantity of each type of waste generated per day

iii) Technology

iv) Economics of scale

v) Distance from village

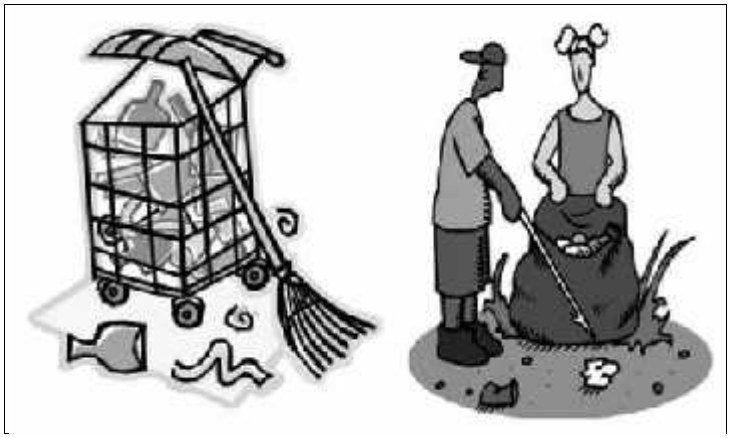
vi) Access and availability of market, processing facilities in the vicinity

vii) Finance

viii) Population/ level of administration

Using administrative boundaries to define the area of service provision is a practical way to operationalize solid waste services. Technology selection at each level of operation should be based on need, affordability, quantity and type of waste generated.

Different type of solid and liquid waste to be managed in the rural areas are solid waste, septage, cattle waste, biomedical waste, plastic waste, hazardous waste, E-waste and industrial solid and liquid (black water and grey water etc.) waste.



SPECIFIC APPROACH FOR EACH TYPE OF WASTE:

SOLID WASTE MANAGEMENT:

The different elements of solid waste operations/ management are:

a) Generation, segregation & recovery

b) Storage, collection and transportation

c) Processing

d) Disposal

a) Generation, segregation & recovery

At household level, the best way to handle solid waste (Biodegradables and Non-Biodegradables) is to segregate it at source and recover what is possible. E.g. dry waste as paper, plastic, glass, metal and wet organic waste. The solid waste management system can be designed so that recovered dry waste is stored at the household level and then at the GP level for a fixed number of days, after which it is collected by a designated collector for transporting to a market place in the vicinity. From here trader either process the waste or transport it further to a cycling facility

b) **Storage, Collection and Transportation**

In the case of wet/ compostable waste, primary storage has to be done at the household level and open dumping should be strictly prohibited. The waste can be composted or converted into biogas (mixture of methane and carbon-di-oxide). For transporting refuse (left over garbage after recovery and processing) a different strategy for a group of villages/ GPs (depending on population and the quantity of left over refuse) will have to be developed depending on the availability of landfill facilities in the area. In some cases the closet facility may be municipal facility

(c) Processing:

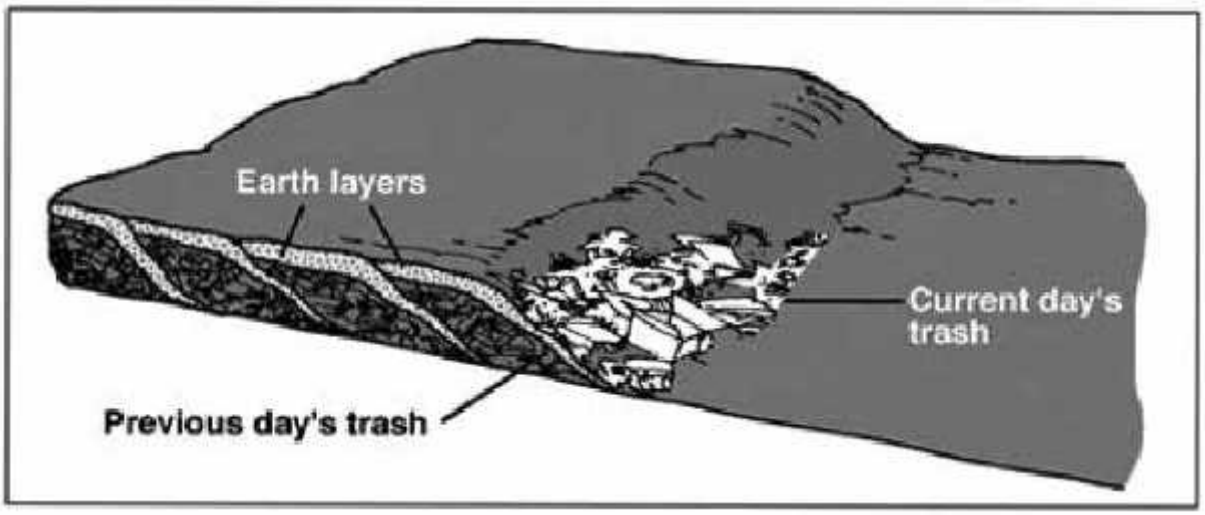
For wet compostable waste, local processing (at household level, village level or GP level) is the best option. If GPs are located in proximity to an existing facility or if there is a possibility to establish a large composting facility collectively, it could be given preference during the planning phase providing that local community concerns are considered Community, village or GP level biogas plants are also a possibility where there is a willingness to adopt more advanced methods of waste disposal. The viability of any project can only be determined after conducting an extensive feasibility study.

(d)Disposal:

Final disposal of refuse which should not exceed 20%, however, with effective segregation, recovery and processing, it can be brought down to less than 10 %, of the total garbage generated. Final disposal should be

done at an engineered sanitary landfill site, if available. If such a facility does not exist, efforts may be made to coordinate with the biggest municipality nearby and development of regional engineered landfill site can be advocated for at higher levels of government.

• **Sanitary landfills** (used for the disposal of non-biodegradable and non-recyclable inorganic solid waste) are facilities for final disposal of rural area solid waste on land, designed and constructed with the objective of minimizing impacts to the environment. The Municipal- Solid waste (Management and Handling) Rules 2000 and draft revised Rules 2013 provide comprehensive regulations on the site, design and operation of sanitary landfills. Design of Sanitary landfill is given below:



Design of Sanitary landfill

- **A modern landfill:** complying with these requirements is a complex facility with various activities to minimize environmental impacts. Sanitary land filling is necessary for the following types of waste:
  - Waste that is by its nature or through pre-treatment non- biodegradable and inert
  - Mixed waste not found suitable for waste processing
  - Pre-processing and post -processing rejects from waste processing plants
  - Non-hazardous waste not being processed or recycled
- **Site selection for a landfill**

A landfill operation with minimized environmental impacts starts with the selection of an appropriate site. The MSWM Rules 2000 and draft revised rules 2013 stipulate that the minimum distance that needs to be maintained from the habitation clusters, forest areas, airports, water bodies, monuments, national parks, wetlands and places of cultural, historical and religious importance and accordingly select an appropriate site. (Areas to be avoided such as Flood plain/wet land, fault, seismic zones, landslide-prone areas).

- **Preparation of the sanitary land-fill:** All the waste that is not bio-degradable (called 'rejects') is to be Isolated from the other garbage from contaminating air, water and soil. After segregation of the rejects, it should be sealed in a 'land fill', which a site is specially prepared. This involves digging up, putting clay liner, compacting the rejects in thin layers and sealing it with a 1.5 mm HDPE liner or soil layer (including drainage). The minimum size of sanitary land fill is to handle 250 ton of waste per day and approximately cost Rs. 5 to 8 cr per year depending on the groundwater level and angle of repose.

Properly designed sanitary landfills shall (a) prevent water infiltration and leaching of toxic fluids (b) Prevent water pollution (c) Reduce Vermin and pests (d) reduce smell, toxic gases and fire hazard.

Disadvantages: (a) requires space (b) Produce methane gas (c) Not a long term remedy

e) Since the core objective of the MGNREGS is that, "Providing not less than one hundred days of unskilled manual work as a guaranteed employment in a financial year to every household in rural areas as per demand, resulting in creation of productive assets of prescribed quality and durability". Secondly, as per Para 4. (3) of schedule -1, MGNREGA, "works which are non-tangible, not measurable, repetitive shall not be taken up". Therefore first two elements of solid waste management i.e. generation, segregation & recovery and storage, collection and transportation of waste cannot be linked with MGNREGA. The creation of infrastructure for processing and disposal of waste can be linked with MGNREGA.

The waste Hierarchy

CATTLE WASTE MANAGEMENT:

a) Cattle waste (both dung and urine) is an important resource in rural areas and thus multiple values in Indian culture. It has many uses including, as a soil conditioner, for biogas generation, as a source of fuel, as a sanitizing cleanser, as a raw material for generating organic compost and as a construction material.

b) The biggest problem with cattle dung comes from its improper collection and storage rather than its use. Improper collection and storage methods lead to the creation of unhygienic conditions in communities and to environmental pollution. A special emphasis must be given to cattle waste management when designing

SLWM interventions. The primary responsibility for its management should rest with the households which created it.

c) At Para 4(1) II. (v) of schedule-1, MGNREGA, "Creating infrastructure for promotion of livestock such as, poultry shelter, goat shelter, piggery shelter, cattle shelter and fodder troughs for cattle" are permitted under MGNREGA. Therefore, while constructing such shelters, provision of collection & storage of dung and urine should be kept

d) d) At Para 4(1) III. (i) of schedule-1, MGNREGA, "Works for promoting agricultural productivity by creating durable infrastructure required for bio- fertilizers" are permitted under MGNREGA, therefore, infrastructure for liquid bio-manure, and Farm Yard Manure can be constructed under MGNREGA.

PLASTIC WASTE MANAGEMENT:

a) The Plastic Waste (Management and Handling) Rules, 2011. can be used as guiding rules for the management of plastic waste in rural areas.

b) It is expected that establishing a processing centre at a GP will not be financially viable. Responsibility related to segregation at source and temporary storage at home (or property) must rest with households or property owners, whereas, collection and transportation may be carried out by a range of locally based stakeholders including, local youth groups, entrepreneurs, CBOs, scrap dealers etc. A suitable mechanism, for supporting the inclusion of these groups in the process should be developed during the preparation of a GP SLWM plan under SBM-G.

HAZARDOUS WASTE MANAGEMENT:

Hazardous waste shall be handled in accordance with the Hazardous Wastes (Management & Handling) Rules issued by the Ministry of Environment and Forest. Since the hazardous waste that may be generated at village level is likely to be limited in quantity and difficult for the community to identify, emphasis should be placed on educating stakeholders under SBM-G in how to identify such waste and where necessary how to segregate such waste at source ready for the correct disposal. GPs should monitor the situation and create the necessary awareness amongst stakeholders.

E- WASTE MANAGEMENT:

As per the E-waste (Management and Handling) Rule, 2011 every producer, consumer or bulk consumer involved in the manufacture, sale, purchase and processing of electrical and electronic equipment and components, collection centres, dismantlers and recyclers of e-waste shall comply with these rules locally. The GP should monitor the implementation of the rule locally and create the necessary awareness amongst stakeholders under SBM-G (NBA).

INDUSTRIAL SOLID AND LIQUID MANAGEMENT:

State Pollution Control Boards (SPCBs) are responsible for the implementation of the legislation relating to the prevention and control of environmental pollution. As such the SPCBs will bear direct responsibility for enforcing regulation on industries located in rural areas. Small and tiny industries engaged in and generating

waste should also be handled at the appropriate level as they are larger in numbers and quite often violators. Experience has shown that industries should comply with regulation if proper SLWM is to be expected from the GP.

TECHNOLOGIES:

i) CHOOSING TECHNOLOGY:

A particular technology may be perfect technically but unless it works for people socially, institutionally and financially it may be useless. Who should make the decision on which technology to use in a particular context! One of the principles of a participatory approach is that the community should make the decision. The engineer's role is to define the range of feasible technical options and explain them, their advantages and disadvantages, so that the community can make its own choice to suit their circumstances. The external agent should facilitate the process to help the community to define their selection criteria (recognizing that the diversity of people in the community) and how they will manage the service.

SPECIFIC TECHNOLOGIES FOR SOLID WASTE MANAGEMENT:

a) Organic solid waste: Composting, either naturally, through vermi-composting or through thermophilic composting is the most effective way to manage organic solid waste. There are many different ways to compost, some require initial infrastructure, and others just require space. Table at Annexure xII outlines the options for composting in rural India. The most appropriate method for a given area is primarily dependent on the type of waste being composted (e.g. does it include human waste or not) and the level of operation and maintenance that people are willing For every GP, if the garbage is assumed to be 50 ton per day, it will require 3 acre of land, which GP has to identify. Once done, this site can be developed for production of bio-fertilizers under MGNREGA. Approximately it will cost Rs. 3 crore for 1 year.

b) Processing of dry waste is not possible at village or GP level due to its economic viability. Instead, district and regional authorities should devise a strategy to promote such facilities either at district level or use the existing (if any) facilities within nearby cities and towns. It will be crucial to link the processing of dry waste (and link GPs) with urban areas nearby, to achieve economies of scale.

c) Bio gas from organic solid waste-

Bio gas is created by the decomposition of organic waste in anaerobic conditions. The resulting gas can be tapped for burning as a fuel. As well as the biogas, the process also produces slurry which can be used as nutrient rich manure. This work can be taken up under the scheme of bio-gas being implemented in the area.

SPECIFIC TECHNOLOGIES FOR LIQUID WASTE MANAGEMENT:

a) Septage management: In case of liquid waste management, approaches for scaling up operations should be decided based on the following factors:

1) Type of liquid waste

2) Quantity of liquid waste

3) Technology available

4) Finance

5) Geography and geology

b) Under normal circumstances, designing and implementing the interventions should be done at village or cluster of village/ GP level. The situation however, will differ for large and peri urban villages with more urban characteristics. Considering that some GPs are large, treating multi-village liquid waste may not be economically feasible. Table at Annexure-xI outlines the options for septage management in rural India

c) The 3 main types of wastewater are grey, black and septage. Each type contains different pathogens and requires different types and levels of treatment to make it safe to return to the environment. The types of technology required to collect and transport the wastewater depends on the type of wastewater in the system. For example, for grey water only, open drains can be used but if grey water is mixed with black water all the water has to be considered as black water and a closed system should be used.AnnexurexIII and Annexure-xIVoutline different options for collecting and treating waste water at the household level and at community level respectively.

d) The scale of operation may be decided based on suitability of technology in a given area e.g. soak pits, leach pits, sullage stabilization ponds or duckweed treatment ponds take a lot of land but can serve multiple villages in the vicinity, and such works can be taken up under MGNREGA. Ideally, household level and a village or cluster of village level systems should be the primary consideration for the most effective management of liquid waste.

e) Stabilization pond technology for liquid management in rural areas, (successfully implemented in Punjab):

- Under this technology pond is emptied, de silted and divided in to 3 to 4 compartments by using earthen embankments.
- The grey water collected via drainage system is passed to large shallow basins or ponds excavated at suitable land site and placed serially as a stabilization system in which grey water is stabilized.
- Its pathogenicity is reduced and the stabilized water becomes useable.
- In this system, the collected grey water is stabilized by natural processes involving algae, bacteria and natural oxidation processes. Hot climate is very suitable, solar radiation and light is good for efficient functioning of this system.

In this technology, 4 ponds constructed in series as given below

Anaerobic-cum-Sedimentation Pond: The depth of water in the pond is kept at 10 feet for the sedimentation of suspended solids and decomposition of organic matter under anaerobic conditions to reduce

BOD /COD .The surface area of the tank shall be equal to approx. 15% area of the existing pond area and having 5 days retention time

Facultative Pond: In this tank over flow of anaerobic pond is being discharged and BOD/COD shall reduce under aerobic conditions. Depth of water is kept at 1.5m. The outlet of this tank is fixed at 1.5m from the bed of tank to ensure that water depth does not exceed 1.5m. Its area is 25% of the existing pond area.

Maturation / Polishing Pond: (2 numbers) in this tank over flow of Facultative pond is being discharged, where pathogen load if any shall be reduced. Depth of water is kept at 1.5m. The out let of this tank is fixed at 1.5m. from the bed of tank to ensure that water depth does not exceed 1.5m. Its area should be 25% of the existing pond area.

Outflow: Normally in addition to evaporation, treated water is absorbed in the pond. The treated water is also used for irrigation purpose by the farmers

Design for Ponds:

- Preliminary survey was carried out, for each pond renovation area required was 2.50 acres. Total funds required for this pond was approximately Rs. 7.50 Lakhs.

-Slope of the embankments is kept stable with slope of 1 vertical to 1.5 horizontal.

-Top surface of the embankments is around 2.5m due to big area of pond

-Embankment is properly compacted to make it stable.

-PVC pipe used is of 6 kg/cm^2 pressure rating.

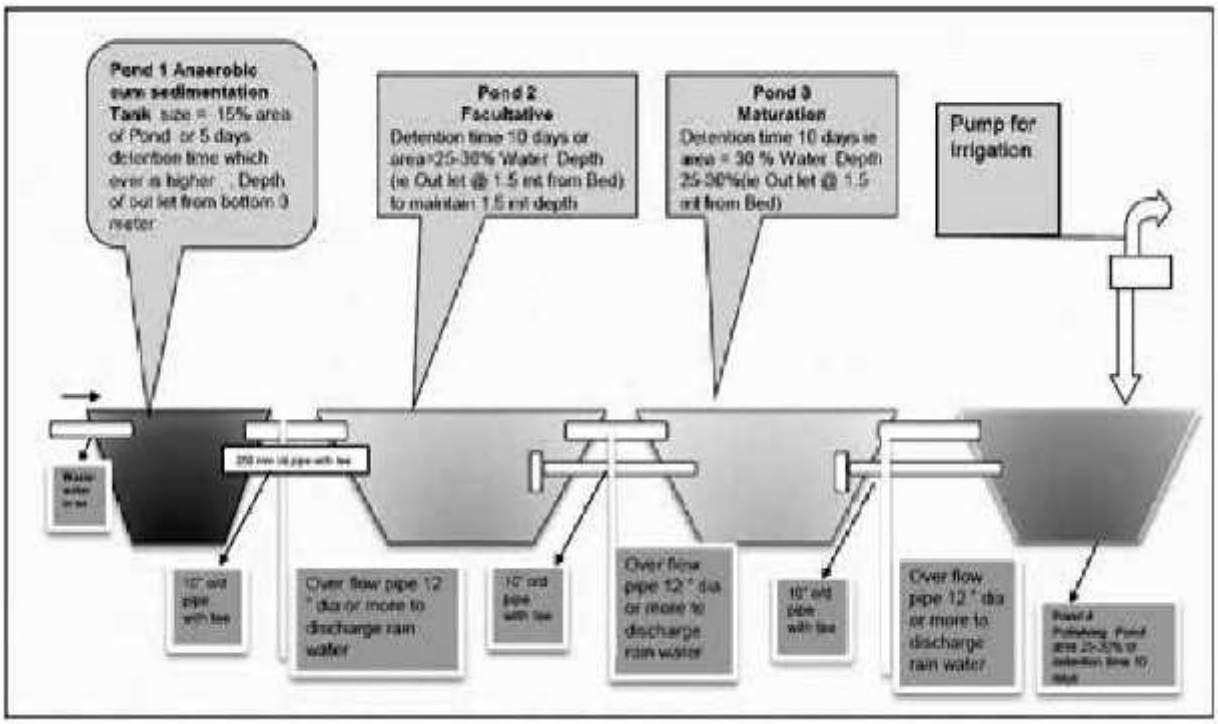
-Over flow pipe used is RCC pipe NP2 grade

-Grass is planted on the top of embankments and slopes to protect against erosion during rains or otherwise.

-Pucca floor is provided below inlet pipe in all the ponds to avoid soil erosion in the pond.

-Landscaping. Trees are planted around the pond.

-Size of ponds with respect to population



Flow Diagram of Stabilization Pond

- **Renovate ponds**

Image 6-1: Renovated ponds, Village Issewal Block Ludhiana II District Ludhiana (Punjab)-1

Image 6-2: Renovated ponds, Village Issewal Block Ludhiana II District Ludhiana (Punjab)-2

Benefits of stabilization pond technology:

-Improved sanitation in the Village

- Filthy ponds will become clean areas for recreation

-Acts as rain water harvesting structure

- Treated water can be reused for irrigation.
- Extra storage capacity is created due to renovated pond harvest excess rain water which

Prevents flooding of low lying areas of the village

- Waste stabilization pond technology is suitable to handle grey water in the village
- It helps in solving sanitation problems in the village
- It helps in rain water harvesting and recharging

ACTION PLAN FOR RURAL SANITATION:

i) To start with number of GPs will be identified as advised vide Ministry letter No. J-11017/41/2011-MGNREGA (part), dated 19th January, 2015 to make these GPs open defection free and carry out solid and liquid waste management. The work will be planned and carried out GP wise on project approach.

ii) To prepare GP wise project following data will be collected:

a) Total number of household, out of which how many are without IHHL and how many are proposed to be covered under MGNREGS

b) On an average how much wet compostable solid waste is available for composting

c) On an average, how much is the refusal for disposal in land fills

d) Availability of land for composting and for group of GPs land fill

iii) The technical and financial norms for toilets specified by the Ministry of Drinking Water & Sanitation will be followed.