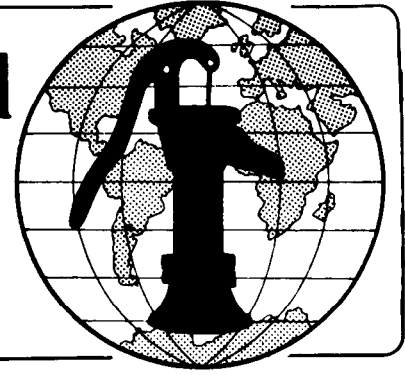


# Water for the World



## Methods of Solid Waste Management Technical Note No. SAN. 3.M

The primary methods of managing solid waste are to collect it near the source and either reuse it, bury it, or find some other means of disposal. These methods reduce the chance of contaminating water supplies and of spreading disease since they prevent rats, flies, and mosquitoes from breeding in solid waste (see "Means of Disease Transmission," DIS.1.M.1). They also remove the physical hazards, odors, and unsightliness of solid waste.

The methods of solid waste management described in this technical note are landfill, composting, and biogas systems. A solid waste collection system must go along with all three management methods. All these methods can be built and operated using locally available materials.

**SPECIAL NOTE:** As a part of their culture, members of the community may already recover and reuse solid waste. Rubbish may be reused for building materials, refashioned into tools or utensils, or burned as fuel for cooking. Garbage may be fed to pigs, chickens, or other domestic animals. Ashes from cooking fires may be used in the operation of pit privies. See "Operating and Maintaining Privies," SAN.1.0.1. These practices, where they pose no health hazard, should be continued and encouraged.

## Collection

Collection means gathering solid waste from its source--house, yard or marketplace--and transporting it for reuse or disposal to a compost pile, biogas plant or landfill. All systems of solid waste management require a method of collection. The method depends on the system of waste management and should be compatible with it.

## Useful Definitions

**BIOLOGICAL** - Relating to living organisms.

**COMPOST** - A dark, fairly dry, crumbly, odorless material that can be used to improve soil for crops; it can be produced by stacking garbage, animal manure, and straw in piles or windrows.

**CONTAMINATE** - To make unclean by introducing an infectious (disease-causing) impurity such a leachate or bacteria from animal manure.

**GARBAGE** - Food and crop wastes from growing, harvesting, storing, preparing, cooking or serving of food; these materials rot quite quickly.

**GROUNDWATER LEVEL** - The level to which subsurface water rises during any given time of year.

**LEACHATE** - A liquid formed when rain, surface water, or ground water passes through a landfill and accumulates dissolved and suspended matter and organic wastes; leachate can contaminate water supplies.

**RUBBISH** - All materials other than garbage that is thrown away, including broken dishes, utensils, and furniture; useless scraps of wood, metal, or glass; sweepings from house, yard, or street; and anything else that is discarded.

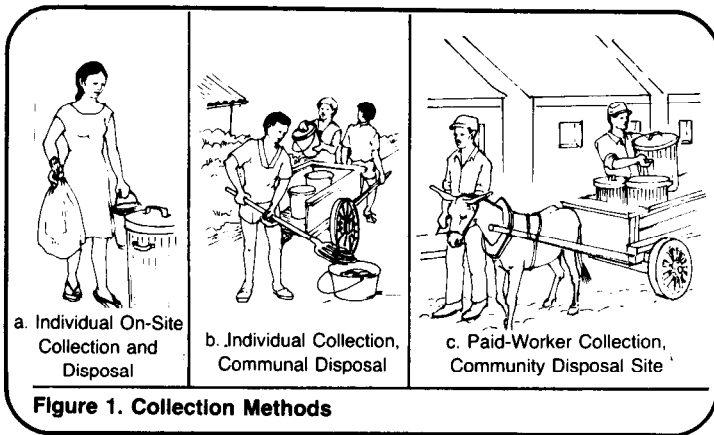
**SOLID WASTE** - Garbage, rubbish, animal manure, dead animals, and ashes.

Three basic types of collection are:

1. Household members collect their own solid waste in shovels, buckets, baskets, or other containers and carry it to an on-lot landfill, compost pile, or biogas plant.

2. Members of a number of households gather their own solid waste and carry or cart it to a communal landfill or composting area.

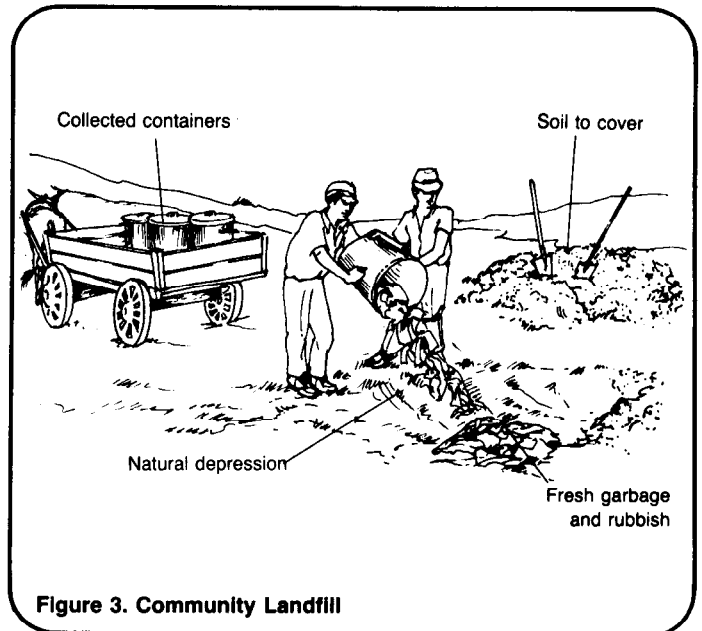
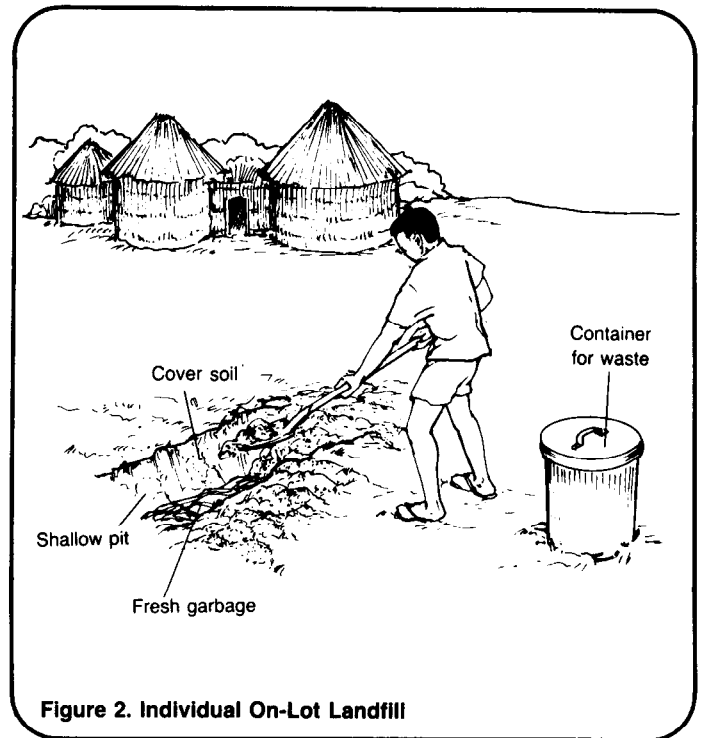
3. Household members, marketplace vendors, factory workers, and shopkeepers dispose of solid waste in barrels, baskets, or other containers and paid workers collect the containers and cart them to a community site, usually a landfill. See Figure 1.



Two factors important to all types of collection are care and cleanliness. Care must be taken when handling solid wastes to prevent cuts from sharp-edged scraps and to prevent injuries from lifting heavy objects and containers. Cleanliness is important to prevent the spread of disease. Workers and household members must wash their hands after handling solid wastes, especially before preparing or eating food.

### Landfill

A landfill is a burial site for solid waste. It can serve a single household or an entire community, and it usually begins as a trench, shallow pit, or natural depression in the ground. Solid waste is transported to the site, dumped in the trench, pit, or depression, compacted and covered daily with soil. The soil keeps away rats, flies, and mosquitoes, prevents children from playing in the waste, and eliminates odors and unsightliness. See Figures 2 and 3.

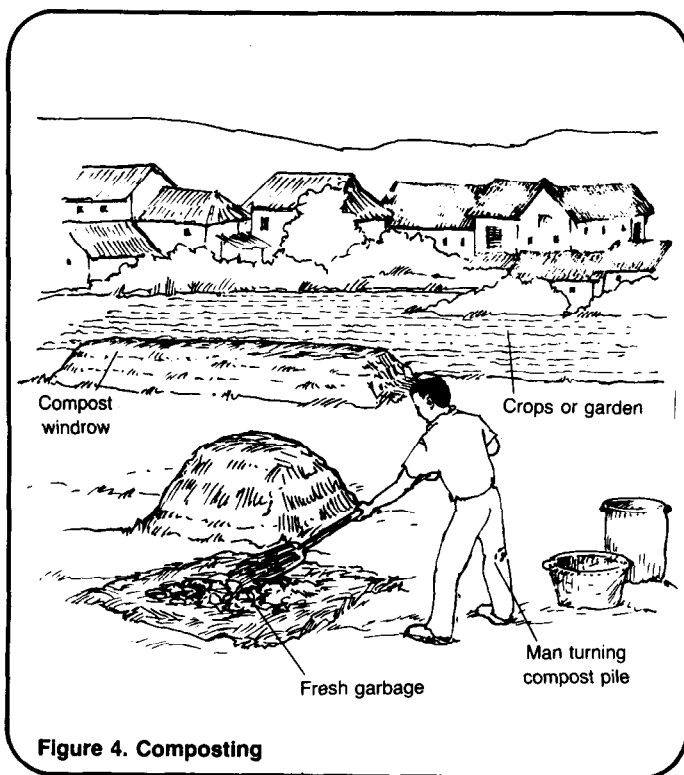


The bottom of a landfill must be no closer than 1.0m above the highest groundwater level to prevent contamination from leachate. Landfills for large communities may require mechanized equipment to transport, compact, and cover solid waste.

## Composting

These systems can serve individual households or groups of households. The two major requirements are a supply of animal manure and garbage and a use for composted material.

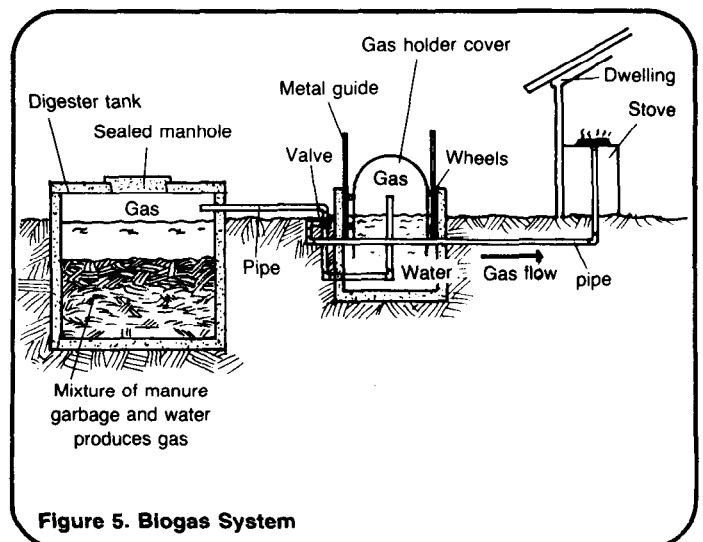
Animal manure, garbage, straw, dead leaves, and grass clippings are placed in a pile or windrow (an elongated pile). Rubbish must not be placed in the pile. The pile is usually covered with a mixture of manure and soil to prevent rainwater from soaking in, to retain moisture, heat, and odors, and to keep out flies. Depending on the contents, the pile is turned twice a week to provide oxygen for the composting process. The turning kills fly eggs before they can hatch. See Figure 4.



## Biogas System

The main components of a biogas system are one or more digester tanks and a gas holder. In some designs, the tank and holder are a single unit.

The system is operated when animal manure, bedding straw or hay, garbage and water are sealed in the digester and become subject to biological processes which produce, among other things, methane gas. The gas flows through pipes regulated by valves from the digester to the gas holder and then to the kitchen in a household, where it is burned as fuel for cooking. When the contents of the digester have completed their transformation, the remaining material is removed and used to fertilize crops. See Figure 5.



The digester tank and the bottom and walls of the gas holder are usually made from reinforced concrete. The cover of the gas holder is made from sheet iron and, because of its strict design specifications, is either purchased as a prefabricated unit or made in the community by skilled craftsmen. Gas pipes and valves must be purchased.

These systems may be especially appropriate in communities which presently burn animal manure for fuel because of the system's more efficient utilization of manure.

## Comparison of Methods

Table 1 summarizes three methods of solid waste management. Collection is not included in the table because it is required for all three methods and must be compatible with the method used. The

methods are listed across the top of the chart and the factors to be compared are listed down the left-hand side. The table can be used as an aid in selecting a method. See "Planning Solid Waste Management Systems," SAN.3.P.

**Table 1. Comparison of Solid Waste Management Methods**

Factor	SOLID WASTE MANAGEMENT METHOD		
	Landfill	Compost	Biogas
Type of waste managed	All	Garbage; animal manure	Garbage; animal manure
Requirements	Acceptable site; cover soil	Supply of garbage and manure; use for compost	Reinforced concrete construction; special metal cover, gas pipes, valves; supply of animal manure; use for methane gas and fertilizer
Operation	Solid waste is placed in depression, trench, or pit and covered with soil	Manure, garbage, and straw are stacked in piles or windrows and periodically turned; compost is spread on crop land	Manure, garbage and water sealed in tank; gas flow regulated; gas burned in household; digested contents of tank removed and spread on crop land
Cost	Inexpensive	Inexpensive	Moderate to expensive
Advantages	Disposes of all solid waste; helps prevent breeding of rats and flies; improves low-lying land by filling	Provides excellent soil conditioner; helps prevent breeding of flies	Provides gas for fuel; provides fertilizer; helps prevent breeding of flies
Disadvantages	May produce leachate, which may contaminate ground water	Does not provide rubbish disposal	Does not provide rubbish disposal; initial cost may be high

**Technical Notes** are part of a set of "Water for the World" materials produced under contract to the U.S. Agency for International Development by National Demonstration Water Project, Institute for Rural Water, and National Environmental Health Association. Artwork was done by Redwing Art Service. Technical Notes are intended to provide assistance to a broad range of people with field responsibility for village water supply and sanitation projects in the developing nations. For more detail on the purpose, organization and suggestions for use of Technical Notes, see the introductory Note in the series, titled "Using 'Water for the World' Technical Notes." Other parts of the "Water for the World" series include a comprehensive Program Manual and several Policy Perspectives. Further information on these materials may be obtained from the Development Information Center, Agency for International Development, Washington, D.C., 20523, U.S.A.