Water for the World

Designing a Composting System
Technical Note No. SAN. 3.D.2

A composting system is a means of turning garbage, animal manure, other organic wastes, and, in some cases, excreta, into compost. Designing a composting system involves determining the method of composting, selecting a location, deciding on the configuration of the system, and determining the labor and tools needed to operate the system. The products of the design process are: (1) a location map, (2) design drawings of the compost pile, and (3) a detailed materials list. These products will be given to the construction supervisor prior to operation of the system.

This technical note describes how to design a composting system and arrive at the essential end-products. Read the entire technical note before beginning the design process.

Useful Definitions

COMPOST - A dark, fairly dry, crumbly, odorless material that can be used to improve soil for crops; it is produced from organic wastes.

EXCRETA - Human body wastes.

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

ORGANIC - Derived from living organisms.

Materials Needed

Measuring tape - To obtain field information for a location map.

Ruler - To draw a location map.

General

Composting is the natural process by which organic material is fed on and broken down by soil bacteria and fungi to form compost. This process requires a balance between two types of organic materials. The first type includes dry vegetable matter such as street sweepings, straw, cane stalks, pea vines, potato tops, banana stems, dead leaves, wood chips and paper. The second type includes excreta, animal manure, fresh food scraps, and septic tanks or aqua privy sludge. The correct proportion of each type depends on a variety of factors and is best judged by mixing the materials in the field. Inorganic materials such as metal, glass, plastic, rocks, gravel, and sand and some organic material such as tree branches and large pieces of wood will not readily decompose and must be separated out.

When compost is added to the soil, it increases the soil's porosity, increases moisture retention, lightens heavy soils such as clay, improves the texture of light sandy soils, facilitates the growth of plant root systems, and adds trace elements required by plants. Compost contains about one percent each of nitrogen, phosphorous, and potassium. Composting is an aerobic process that requires oxygen from the air for good and rapid action.

Determining the Method of Composting

There are three basic methods of composting: (1) household, (2) community, and (3) paid-worker.

Household. This is suitable for small amounts of waste and on-lot use of compost. Organic waste material from a single farm or household is processed into compost, and the compost is worked into crop land or the garden by members of the household.

Community. This is suitable for larger amounts of waste and community use of compost. Organic waste from a number of households, farms or an entire village is processed by a composting system operated by members of the community. The compost is used by several households or farms. To function properly, this method requires unfailing cooperation among members of the community and a fixed work procedure that is strictly followed.

Table 1. Factors Influencing Composting Methods

Method	Factor
Household	Small amounts of organic waste; on-lot use of compost
Community	Larger amounts of waste; community use of compost; community cooperation
Paid-worker	Larger amounts of waste; community use of compost; money to pay workers

Paid-worker. This is suitable for larger amounts of waste and community use of compost. Workers are paid to operate a large composting system, and the compost is either sold or given to community members. This method requires money to pay workers.

Table 1 summarizes the factors that influence the selection of a method of composting.

All methods of composting require a system for collecting the organic material and transporting it to the composting site. The system of collecting should be compatible with the method of composting. See "Designing a Solid Waste Collection System," SAN.3.D.3. If excreta from bucket latrines is to be composted, see "Designing Bucket Latrines," SAN.1.D.5.

Selecting a Location

The site for the composting system should meet the following conditions:

1. It must be large enough for the system. See "Estimating the Size of the Site."

2. It should be near the crops or garden on which the compost will be used.

3. If it is a community composting system, the site should be no more than one kilometer from the community.

4. The site should be on relatively level ground with enough drainage to prevent pools of water from forming.

5. It should be downwind from dwellings in case the pile becomes anaerobic.

6. There should be water available at the site.

Estimating the Size of the Site

The size of the composting system, whether for a household or community, depends on the nature and amount of the organic wastes being composted, on the rate and season at which they are produced, and on the climate of the region. These factors vary greatly from place to place, and the true size of the site can only be found by operating the system. However, a rough estimate can be made in the beginning by allowing $10m^2$ for every person served by the system.

For example, a household with five members should allow:

$5 \times 10m^2 = 50m^2$

A village of 1000 persons should allow:

$1000 \times 10m^2 = 10000m^2$

When the site has been selected, draw a location map similar to Figure 1 showing the size of the site and the distance to dwellings and crop land. Give the map to the construction supervisor.

Determining the Configuration of the System

The two basic configurations of composting systems are stacks and windrows. For either method, leave ample space for turning the piles to aerate them. Some provision must be made for disposing of materials that cannot be composted. The best option is to bury them at the compost site.

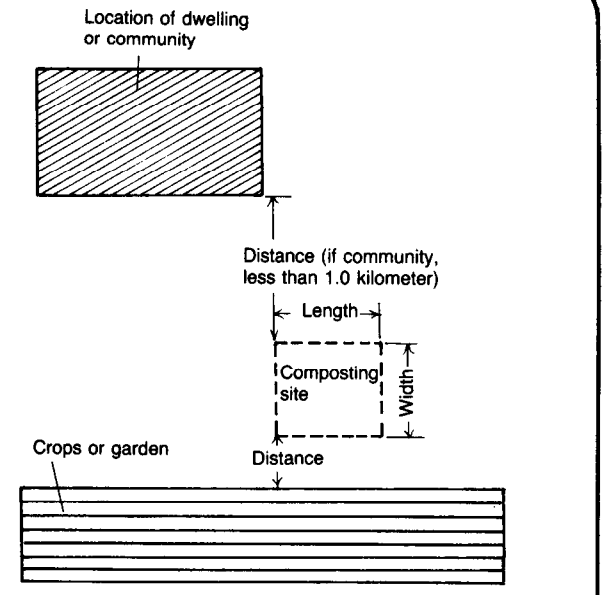

Figure 1. Location Map

Stacks are 1.8-2.4m^2 at the base, 1.2-1.5m high, and rounded at the top. See Figure 2. One or more stacks may be used depending on the amount of material to be composted. For large systems, stacks are laid out in units of four stacks each with a roadway between each unit as shown in Figure 3. Stacks are appropriate for both household and community composting systems. They should be used if excreta or sludge is part of the composted material.

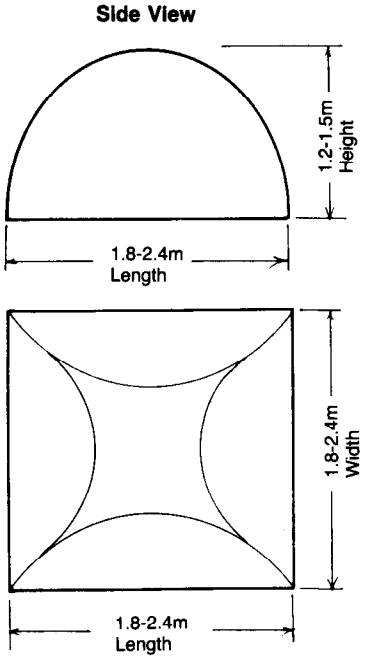

Figure 2. Design of Stack for Composting

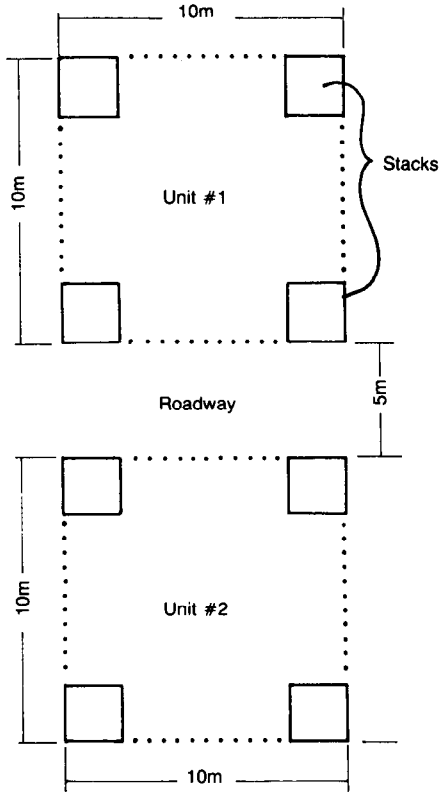

Figure 3. Stacks Arranged in Units

Windrows are 2.5-3.0m wide at the base, 1.5-2.0m high, and rounded at the top. They may be of any convenient length. See Figure 4. One or more windrows may be used. In large systems, they are laid in parallel lines 5-6m apart. See Figure 5. Windrows are appropriate for community composting systems, particularly if mechanized equipment is used to stack or turn the material. They should not be used if excreta is part of the composed material.

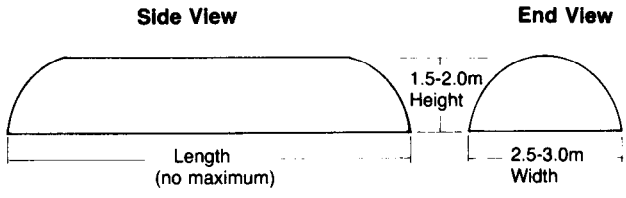

Figure 4. Design of Windrow for Composting

Table 2 compares the features of stacks and windrows.

When the configuration of the system has been determined, prepare design drawings similar to Figures 2, 3, 4, or 5 and give them to the construction supervisor.

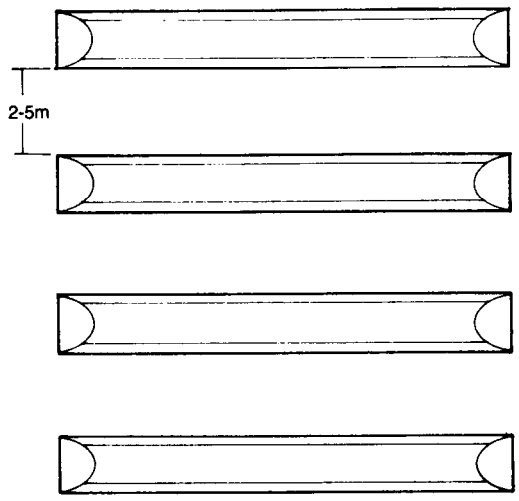

Figure 5. Windrows Arranged in Parrallel

Table 2. Comparison of Stacks and Windrows

Feature	Stack	Windrow
Height	1.2-1.5m	1.5-2.0m
Width	1.8-2.4m	2.5-3.0m
Length	1.8-2.4m	Any
Application	Household or community	Community
Other	Appropriate if excreta is composted	Appropriate if mechanized equipment is used

Determining Labor and Tools

A supervisor is needed to oversee the system. Laborers are needed to pile organic material into stacks or windrows, turn the material every third day, and transport the finished compost to garden or crop land. The number of laborers depends on the amount of material being processed and is best determined by field experience. For large, non-mechanized systems, it has been estimated that one laborer can handle 3.5m^3 of material per day.

Tools needed to pile and turn the material include pitchforks with long tines, long-handled rakes, shovels, coarse brooms, and, if excreta is being composted, broad-bladed hoes. Other tools include a 2m long wood or iron pole for testing temperature and moisture; carts or other vehicles for transporting compost to crop land; and boots and gloves for workers. Coarse wire screens are useful to separate non-compostable materials from the compost.

When labor and tools have been determined, prepare a materials list similar to Table 3 and give it to the construction supervisor.

Table 3. Sample Materials List

Item	Description	Quantity	Estimated Cost
Labor	Supervisor	1	____
	Laborers	3	____
Tools	Pitchforks	____	____
	Rakes	____	____
	Shovels	____	____
	Brooms	____	____
	Hoes	____	____
	Wood pole: 2m long	____	____
	Carts	____	____
	Boots	____	____
	Gloves	____	____
	Coarse wire screens	____	____
	Shredding tools, clippers, knives, machetes	____	____

Total Estimated Cost = ____

In summary, give the construction supervisor a location map similar to Figure 1, design drawings similar to Figures 2, 3, 4, or 5, and a materials list similar to Table 3.

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.

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