

Home composting systems

Compost making has been a common practice by farmers and gardeners across the world to recycle waste and use them for their own home gardening practices. Home composting depends on traditional or small scale simplified composting technologies. To facilitate this, various home composting technologies are available in other countries. Simple pit methods, heap methods, and Jeewakotu methods have been widely used in Sri Lanka for many years.

Compost produced from home composting methods is in good quality compared to compost produced from mixed waste. It offers several benefits such as enhanced soil fertility and soil health which increases agricultural productivity, improved soil biodiversity, reduced ecological risks and encourages better environment.

This simple home composting technology has been identified as most sustainable solution to address the emerging solid waste management problems in many countries. Active community participation can be expected because; home composting enhances economic condition of urban poor people through home-gardening and selling of compost and/or recyclables.

The suitability of each composting system to a specified location primarily depends on site characteristics. Most traditional systems are not common in urban areas due to space limitations and pest attractions. Therefore, bin composting is preferred by most urban dwellers due to its convenience and as it has less impact on aestheticism. But all methods use the same scientific principle though it differs from its procedures and equipments that are used.

Conditions required in composting process

Aeration: Composting is a biological process that can happen either aerobically (in the presence of oxygen) or anaerobically (without oxygen). Oxygen is an essential requirement for aerobic microbes to thrive and they effectively break down organic Waste into simple components.

Anaerobic decomposition is comparatively slow and it produces unpleasant odours and therefore anaerobic composting is not a very popular or a common method. On the other hand aerobic composting is done under active or passive aeration methods.

Moisture: Moisture/water is a very essential component to precede all microbial activities. Water is the medium for most chemical reactions and 40% - 65% of moisture content is ideal for effective composting. When the moisture content is below 40%, microbial activity will continue at a slower rate. When the moisture content is above 65%, water will displace air from the compost pile leading to anaerobic conditions.

Temperature: Is essential for a well mixed compost pile, temperature can reach up to 65-70°C due to activities of the micro-organisms. This heat is desirable and helps to accelerate the degradation process. In addition to this, it destroys the weed seeds, pathogens in the composting material and makes it unsuitable for fly breeding.

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Particle Size: When the particles are smaller it will be turned into composting very fast. Smaller particles have a larger surface area that can be attacked by microbes. A shredder can be used to reduce the size of larger particles. Tree leaves also can be shredded to prevent them from forming layers. But too smaller particles disturb the aeration process and it is better to maintain a good texture (mixture of different size particles -Ideal size is 2-3 inches).

Nutrients: Carbon serves as both a cell building block and an energy source for microbes. Nitrogen is also required for the growth and metabolism of the microbes. The ideal carbon to nitrogen ratio (C: N) in a composting pile is 25-30 (25-30 parts carbon to 1 part nitrogen). Some Agricultural wastes (eg. straw) are low in nitrogen and to adjust the C: N ratio, it can be mixed with nitrogen rich material like cow dung, green twigs (eg. Gliricidia) or urea.

Common home composting systems in Sri Lanka

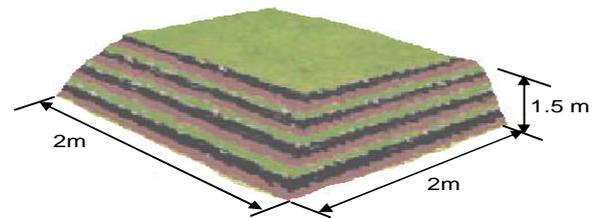
- Heap method
- Pit method
- Traditional 'Jeewakotu' and basket methods
- Composting bin systems
- Rotating drums

Heap method

During the rainy seasons or in areas with heavy rainfall, compost may be prepared in heaps. A small shed can be used to protect the heap from excessive rains and a small bund is sometimes built around the pile to protect it from wind and runoff water (the place should not be water-logged). This method is more common with agricultural waste and may construct several heaps if enough waste materials are available.

The basic heap size is about 2 m wide at the base, 1.5 m high and 2 m long. Any length can be used if enough space and waste materials are available. The sides are tapered so that the top is about 0.5 m narrower in width than the base.

Forming the heap



The heap usually starts with a 15-20 cm layer of carbonaceous material such as dry leaves, hay, and straw. This is then covered with a 10cm layer of nitrogenous material such as kitchen waste, fresh grass/weeds or garden plant residues. This alternative layer pattern is followed until the pile reached 1.5 m high and then the material is kept wet so that it may feel damp but not soggy. The pile is sometimes covered with soil or hay to retain heat and is turned once in fortnight. The process takes 2-3 months to complete depending on the material and conditions used.

When waste material that is to be composted is limited, batch composting method cannot be practiced as the method needs sufficient material to make a complete heap. But Gradual construction of the heap (adding daily waste for a period of 10-15 days) is possible with alternate layers of nitrogenous and carbonaceous materials. Mixing of old material with fresh material can be practiced when it is added to the heap. It will accelerate the composting process but we cannot expect a good heat up due to poor insulation as in completed composting heap. This may result poor quality compost with high weed seeds and high pathogen counts.

Advantages and disadvantages of heap method

Advantages	Disadvantages
<ul style="list-style-type: none"> • This is a very simple method • Involves low cost or no cost at all • Can handle large amount of waste at once • Easy maintenance 	<ul style="list-style-type: none"> • Attraction and disturbances from animals like dogs, pigs and crows • Breeding places for some pest like rats flies etc. • More suitable as batch method • Aesthetically not pleasant • Not applicable for congested areas

Pit method

Pit method is recommended for dry areas with less rainfall. This is the most common home composting system in rural and peri-urban areas of Sri Lanka. The site selected for the compost pit should be at high level so that no runoff water or ground water enters the pit. It should be in a convenient location, preferably not very far from the place of waste generation. A temporary shed should be constructed over the pit to protect the compost from heavy rainfall.

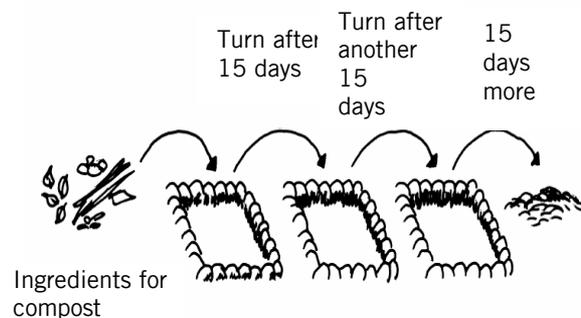
In this system waste can be composted in batch or continuous method. Continuous method can be practiced with kitchen and garden waste and batch method is common with agricultural waste.

Here a pit or trench is constructed about 1m deep and 1.5-2m breadth. The length of the trench depends on the availability of land and the amount of material to be composted.

Batch process

In this method organic wastes are placed in alternate layers as mentioned in the heap method (15-20 cm layer of carbonaceous + 10cm layer of nitrogenous material). After filling to the top level, the pit is covered with 15-20 cm thick layer of garden refuse (brown) or thin soil layer to prevent fly breeding and other pest attraction. The materials are allowed to remain in the pit with turning and watering for 2-3 months. Turning can be done every other week and care should be taken to avoid compacting the material in the pit.

Continuous process



When enough waste materials are not available to fill the pit at once, continuous filling can be practiced for several days. Smaller size 3-4 pits are required for this method and once first pit is completed in 10-15 days it can be closed and can move to the second pit. In this manner it is possible to continue adding raw material to the pits and composted material can be removed in cyclic manner.

As management practices, material should be turned 3-4 times during the whole period of composting; first turning can be done 15 days after filling the pit, the second turning is done after another 15 days and the third after another month. Mixing can be done in each pit or by shifting the whole material from one pit to adjacent pit (pits should be locate closely). At each turning, the material is mixed thoroughly, moistened with water and replaced in the pit.

Required number of pits can be calculated on the time taken to complete one pit.

Eg .

Time taken to fill 1 pit = 2 wk

Tot. Time required for complete composting = 8 wk

Required no. of pits = $8/2 = 4$ pits

After the composting period, material can be screened and oversize material can be send back to the composting pits. Fine compost requires to heap up for 1-2 weeks (for maturation) before applying to the plants.

Advantages and disadvantages of pit method

Advantages	Disadvantages
<ul style="list-style-type: none"> • Easy to construct • Low cost or no cost for construction • Can handle any amount of waste • Easy maintenance • Good protection compared to open heap • Minimise moisture loss and wind problems 	<ul style="list-style-type: none"> • Pest attraction (animals, rats etc) • Comparatively a large space is required • Possible odour problems • Slow decaying due to anaerobic conditions

Basket composting and 'Jeewakotu'

Composting baskets have been constructed by sticks or poles arranged into a basket shape. Thread is used to tighten the poles together. When live sticks/sticks are used (mainly Gliricidia) for construction and allowed for rooting it is called as Jeewakotu. This is very common in integrated farming systems. This structure provides excellent aeration compared to other bin systems and it does not require any mixing or other maintenance. Also this keeps away from the pest.

The size of the basket/Jeewakotu depends on the amount of waste to be composted and space availability. Most of the bins vary 2 – 3 ft. in diameter and 3 -5 ft. in height. Maintaining proper dimensions are important for optimum aeration with minimum heat loss from the system. It is always preferable to locate the system in sunny place of the garden with minimum disturbance to the other activities.

Constructing of a Jeewakotu





Basket/Jeewakotu method is a continuous composting system. Waste material can be added to the basket as available and made compost could be removed continuously from bottom spaces (Space between poles). Mixing is not required in this system since this structure provides better aeration compared to the other composting structures. Adding balance substrates (green and brown) and maintaining proper moisture contents are the most important management practices for this method.

In organic farming systems, planting crops around the composting unit is a very common practice. Composting unit provides the necessary nutrients and moisture to the

growing crops. Growing green twigs of the poles can be used for mulching the crops or to incorporate as a substrate (green) for composting. This helps nutrient recycling through different components of the farming system.

Fine compost can be removed from the bottom spaces of the system and slowly degradable materials remain in the bin until it is broken down into smaller pieces. No maturation period is required after removing and can be applied to the crops and plants.

Advantages and disadvantages of basket/Jeewakotu method

Advantages	Disadvantages
<ul style="list-style-type: none">• Involves no cost at all or low cost incurred for construction• Simple and easy to construct• Allows rapid composting• No odour or vermin problems• System is completely natural• Allows nutrient recycling	<ul style="list-style-type: none">• Does not match with urban landscape• Can cause damage from wild animals some pest like monkeys

Composting Bin System

Bin composting is the advance version of basket composting system that overcomes most problems experienced before. There are different types of bins available for composting and generally it varies from 200-300L in size. They are made from different material such as cement/concrete, plastic, metal, etc. The bins allow higher stacking of composting materials and better use of floor space than free-standing piles. Bins can also eliminate weather problems, reduce odour problems and provide better temperature control. Most bins are constructed to suit the urban landscape.

Composting bins are more popular in urban areas with the emerging solid waste disposal problems, but care should be taken to minimise people moving away from composting bins due to various reasons. Both technical and

management problems have been identified as the main constraints to popularise the composting bins among citizens.

Technical considerations of the composting bin

A compost bin should be technically appropriate to provide optimum conditions for the composting process. Good aeration is required for all part of the bin and excess moisture must be drained to prevent possible anaerobic conditions. Material used for construction must be non toxic and long lasting. The bin must not allow any pests to enter and to use as the breeding grounds. It is important that the compost removing doors and lid should be able to handle easily.

Management practices

Bin Composting is a continuous system that can add organic waste daily to the composting bin. Care should be taken to put only suitable material for composting since this system is more suitable than the other systems discussed above. Moisture and nutrient balance is more important and use of improper mixture could result delay in composting, stink odours, and vermin problems. Different waste material can be mixed together to get balance mixture and kitchen waste alone give problems in composting process due to high

moisture levels. Mixing of kitchen waste with garden waste is a good solution to address above problems.

Compost can be removed after 2-3 months starting the bin and continue as it produces. Oversized/partly degraded particles can be sent back to the bin. Intermittent mixing of the bin accelerates the composting process and minimise possible odour problems.

Advantages and disadvantages of composting bins

Advantages	Disadvantages
<ul style="list-style-type: none">• Eliminate external weather problems• Minimum animal/pest attractions• Aesthetically good looking• Maximum use of space	<ul style="list-style-type: none">• High cost of purchasing (Rs. 1000-2500)• Improper/poor designs• Need proper maintenance (if not Vermin and odour problems may occur).

Rotating drum composting



Rotating drum composting systems are not very common in Sri Lanka. But it has been used in other countries both for large-scale facilities and backyard composting for many years. Although the rotating drum composting differs in details and process management, they share the basic idea of promoting decomposition by tumbling material in an enclosed reactor. The typical small drum is 4 or 5 feet in diameter and 8 to 16 feet in length, but drums up to 10 feet in diameter and 50 feet long are also available. Drums are oriented horizontally, sometimes at a slight incline. They slowly tumble/rotate material either continuously or intermittently. The key function of the rotation is to expose the material to air, add oxygen and release heat and gaseous products of decomposition.

Advantages and disadvantages of pit method

Advantages	Disadvantages
<ul style="list-style-type: none"> • Easy to construct • Low cost or no cost for construction • Can handle any amount of waste • Easy maintenance • Good protection compared to open heap • Minimise moisture loss and wind problems 	<ul style="list-style-type: none"> • Pest attraction (animals, rats etc) • Comparatively a large space is required • Possible odour problems • Slow decaying due to anaerobic conditions

Things to be composted and excluded from composting process

Materials to include	Materials to exclude
<ul style="list-style-type: none"> • Vegetables/kitchen refuses • Garden trimmings, grass clippings • Leaves, dry leaves (straw) • Twigs and shredded branches • Food refuses :bread, buns etc • Farm animal manure (e.g, Cow, Sheep, Goat , Poultry) • Egg shells • Wood ash • Fruit refuses 	<ul style="list-style-type: none"> • Non biodegradable waste: polythene, plastics, glass, metal etc. • Human feaces, pet manure(e.g.dog, cat) • Dairy Products • Fish , meat scraps and bones • Fats/cooking oils • Diseased plants • Slow degradable materials like coconut shells, coconut husk, komba etc. • Hazardous material like batteries, bulbs, electronic components, chemicals

Quality and use of made compost

Nature and Properties of finished composts from all above systems should be unique. But some qualitative parameters may change depending on the condition prevailed during the composting period. Generally finished compost should have the following features:

- Dark brown to black in colour.
- Practically insoluble in water.
- Has a C/N Ratio ranging from 10 to 20.

- Has a beneficial effect both on the soil and the growing crops
- Free from weed seeds and pathogens

Note: SLS quality standards are available on compost quality.

Compost can be used as

- **Soil amending:** Mix a 4–6 inch layer of compost deep into newly reclaimed or poor soils. Dig 1–3 inches of compost into garden beds at least once a year.
- **Mulching:** Spread compost 1–3 inches thick over soil around plants. Do not pile it against plant stems. Compost mulch adds nutrients, protects the soil, saves water and helps deter weeds.
- **On House Plants:** Apply a thin layer of compost over house plant soil to provide nutrients. Also can make a great potting soil by mixing compost with top soil, sand.

References and further reading

www.epa.gov/epaoswer/non-hw/composting/

www.dep.state.pa.us/dep/deputate/airwaste/wm/recycle/Compost/Home1.htm

www.montgomerycountymd.gov/deptmpl.asp?url=/content/dep/composting/home.asp

www.ci.seattle.wa.us/util/composting

SLS standards for compost quality (SLS 1246:2003)