

Low-Cost Sustainable Composting for Sustainable Landscaping

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Abstract: Management of dry leaves and garden waste is a major problem in Indian cities. Avenue trees along the roads, private residential gardens in apartment complexes, and commercial complexes produce large quantities of leaves and garden waste every day. The problem becomes acute during the autumn season with deciduous trees shedding their leaves. Local municipalities refuse to collect such waste in many cities and issue guidelines and directives to local communities to manage the garden waste. Lack of space to compost the garden waste by traditional methods leads to the practice of the environmentally hazardous method of burning leaves. Composting and curing are slow processes that require several months to convert garden waste into manure. Commercially available composters get filled quickly and are not capable of handling large quantities of garden waste. Installation of additional composters requires fresh investment and space. In this paper, a comparative study of composters available for urban dwellings is presented. Turning compost piles for aeration speeds of the composting process. Drums and barrels are traditionally used as turning-type composters. A novel low-cost composter design based on used chemical barrels is presented. The design uses a standard turning unit mechanism and recycled chemical barrels that get mounted on the turning unit. After the barrel is filled, it is labeled and kept in one corner for curing and another barrel is mounted on the turning mechanism. Filled and labeled barrels are vertically stacked in a corner with limited space usage and used after the compost is completely cured. A prototype is built and results are reported. Detailed drawings and references are provided so communities can build similar units with locally available materials.

Keywords: Barrel composter, Composting, dry leaf waste management, garden waste management, low-cost composter, Sustainable landscaping.

1.0 INTRODUCTION

Sustainable Landscaping is a relatively modern concept incorporating the environmental issue of sustainability. Designing gardens in residential and commercial complexes in urban India is a challenge due to scarce resources. The supply of water by local municipalities is inadequate and just meets the drinking water requirement in large buildings. Depleting underground water compels residential and commercial societies to buy water tankers. Landscaping designers need to use the concept of Xeriscaping to conserve limited water resources ("Xeriscaping" 2022).

Rainwater harvesting and recycling of greywater from showers and sinks are solutions to address the issue along with the selection of hardy plants.

Apart from water for irrigation, sustainable Landscaping design involves soil management usage of organic fertilizers, organic pest control, and recycling of garden waste. Composting is a biological process to decompose organic garden and food waste from residential and commercial buildings to produce organic fertilizer for gardens. Disposing of garden waste in Indian cities is a real problem that requires a sustainable solution. Deciduous trees shed tons of leaves during their natural shedding season. Local municipalities refuse to collect leaf waste and issue just guidelines to residents to handle them on their own (The Hindu 2015). Lack of space to do traditional composting forces residents to resort to the environmentally hazardous practice of burning leaves. This not only contributes to pollution but also leads to the wastage of natural organic waste which can be converted into useful manure and recycled. Commercial composters are expensive and get filled quickly. Lack of space and funds for additional investment in new units is a major constraint.

This paper presents various techniques and methods that are in practice for composting. A novel low-cost barrel composter design is proposed to achieve sustainable composting which in turn will support sustainable landscaping. The proposed design has just one fabricated modular turning unit for speedy composting. Main composting happens in a recycled chemical barrel. When the barrel is full, it is labeled and kept for curing. A fresh barrel is fitted to the turning unit to collect fresh organic waste. Barrels are vertically stacked in one corner for compost curing which typically takes several months. The prototype is built and results are reported. Detailed drawings, pictures, and bills of material are given to enable communities to design their own low-cost composting units with locally available material.

2.0 COMPOSTING

Ancient Indians mastered the art of waste management. Indus cities designed elaborate systems for waste management. Modern composting and organic farming have a great Indian connection. Sir Albert Howard is considered as the father of modern composting. He developed the technique after studying the traditional organic farming techniques of Indian farmers in 1905 and it is popularly called as Indore method ("The Legacy of Waste Management in Ancient India", n.d.).

The Indore method is a traditional Indian organic farming technique. Albert Howard refined it and documented it for the benefit of farmers across the globe. It was done during his stay in India in the earlier part of the twentieth century. In the later period development of chemical fertilizers slightly diminished the use of organic farming. However, environmental and sustainability issues have revived global interest in organic farming. It is relevant and needs of the hour to achieve sustainable food production.

In the Indore method of composting, organic waste is spread in the cattle shed as bedding. Organic material is Urine-soaked (“The Compost Pit - Tradition Meets Science at Indore India”, n.d.). Along with dung it is removed every day and formed into a layer about one inch thick at suitable sites on the farm. Urine-soaked earth scraped from cattle sheds is mixed with water and sprinkled over the layer of waste twice or thrice a day. The layering process is continued for two weeks. A thin layer of well-decomposed compost from previous compost batches is sprinkled over the top and the heap is given a turning. Old compost acts as inoculum (population of microorganisms or cells) for decomposing the material. The heap is left undisturbed for about a month. Then it is thoroughly moistened and given a turning. The compost is ready for application in another month.

The process requires ample space, cattle waste, and a curing time of several months. It is not feasible to implement the same in the urban setting (“ORGANIC FARMING: Composting”, n.d.). Today composting is a matured and well-documented process and is the backbone of the organic farming movement across the globe.

3.0 COMPARISON OF COMPOSTING TECHNIQUES

Composting can be achieved by two distinct methods. The aerobic method is a composting technique in the presence of Oxygen. The anaerobic method is composting without oxygen. The aerobic method is environmentally friendly and fast. It just produces carbon dioxide as a byproduct. Anaerobic composting produces methane a greenhouse gas that is harmful from an environmental standpoint. This paper focuses only on the aerobic process (“Home Composting” 2022).

Master Composter manual is a treatise on composting techniques. It has been an inspiring manual to encourage communities to adopt composting to recycle organic waste into rich manure (Cornell Waste Management Institute 1998).

The following techniques can be easily adopted. The salient feature of the technique is to provide holding units with ample space to collect and store organic waste with sufficient aeration. Periodically turning the heap is essential to speed up the natural process. Availability of space is a major constraint to sustaining the process. For small households, trash cans can be modified to act as holding units.

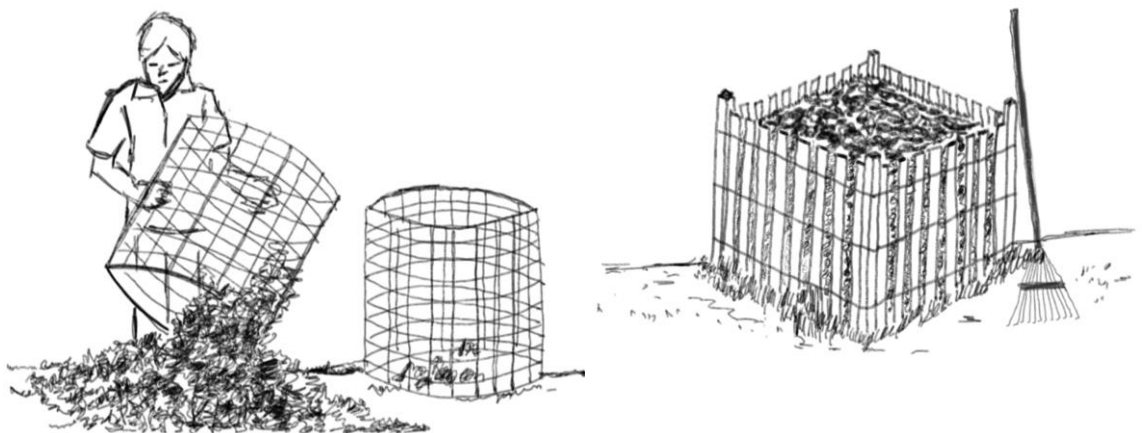
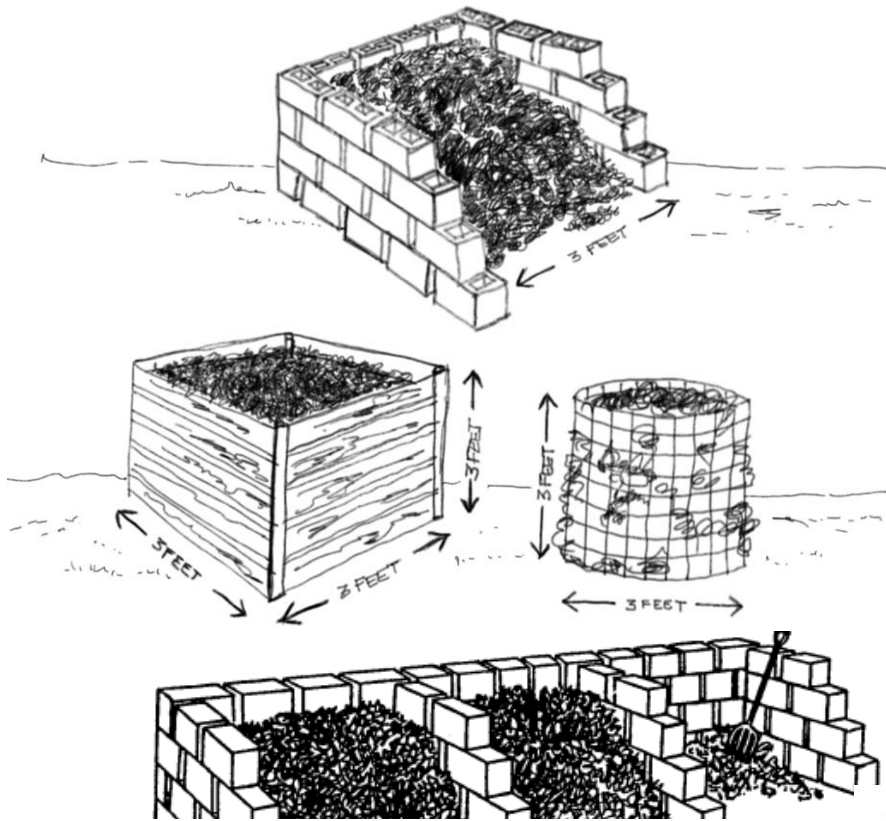


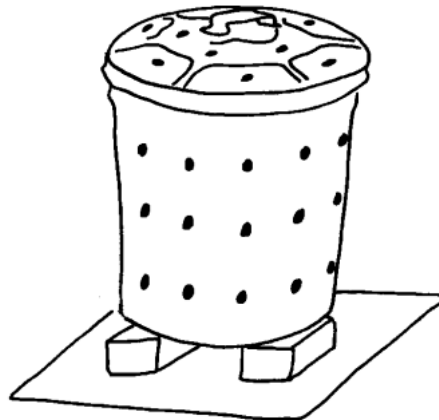
Figure 1: Composting Techniques for communities to adopt (Cornell Waste Management Institute 1998)



Materials:

- Trash Can (metal or plastic)
- Drill and 1/2" drill bit
- Bricks or Cement blocks
- Tray
- Optional: 6" Perforated Pipe

1. Drill at least three rows of holes, six inches apart, around the trash can (see diagram). Drill holes on the lid and the bottom of the can.
2. Place the cement blocks on top of the tray and the can on top of the cement blocks. The can is elevated to allow air to circulate through the bottom of the can. This vertical air flow is usually more efficient and supports aerobic decomposition within the can better than horizontal air circulation. For even more air circulation, a perforated pipe can be placed in the middle of the can. The holes can be covered with screening if fly activity is a concern.



Composter with rolling design for easy turning

Figure 2; Above images depict possible solutions for composting using wireframe mesh, Turning Barrels, wooden frame compost bins, and compost bins made with masonry (Cornell Waste Management Institute 1998)

For very small households, convenient tumbler composters are available in the market. They are easy to operate. However, they cannot handle large volumes of organic waste.

4.0 LOW COST RECYCLED BARREL COMPOSTER DESIGN

Students at Al Akhawayn University in 2017 presented a novel tumbler composter. It is fabricated using a metallic barrel to recycle organic waste produced in the university garden. The design is elegant. However, rusting of metallic drums drastically reduces the life of the unit (Toumi 2017).

R Divyabharathi, K Rajkumar, GC Dinesh, and M Ganesh in their research paper titled- Design and Development of In-Vessel Composter for Treating Agricultural Weeds, have proposed a unit based on PVC drum (Divyabharathi et al. 2020). Design is elegant for small volumes and cannot handle large volumes of organic waste.

This paper proposes a new design that consists of a stand-alone fabricated turning unit. Uses 210 liters (55-gallon) of chemical barrels are used to hold the organic waste. Aeration is achieved by the turning unit mechanism. The key elements of the turning unit are:

- A) Fabricated metal frame to house turning mechanism and composting barrel



- B) 20 mm Bearing and pillow block unit



- C) Turning Shaft



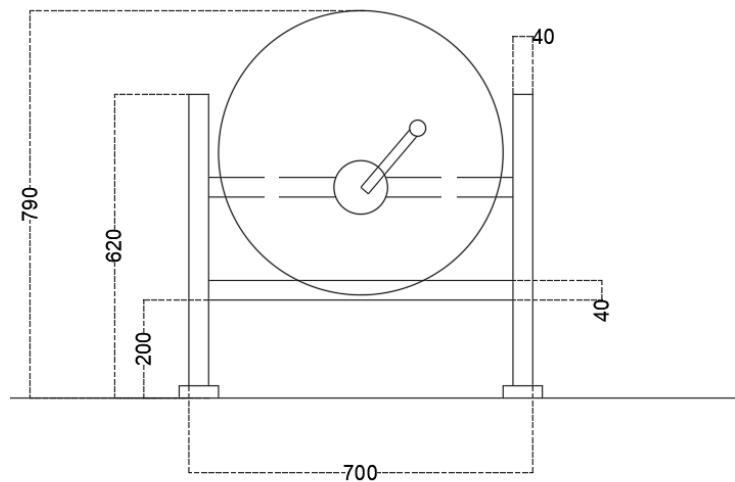
D) Rotating Handle- standard rolling shutter handle is procured from the market

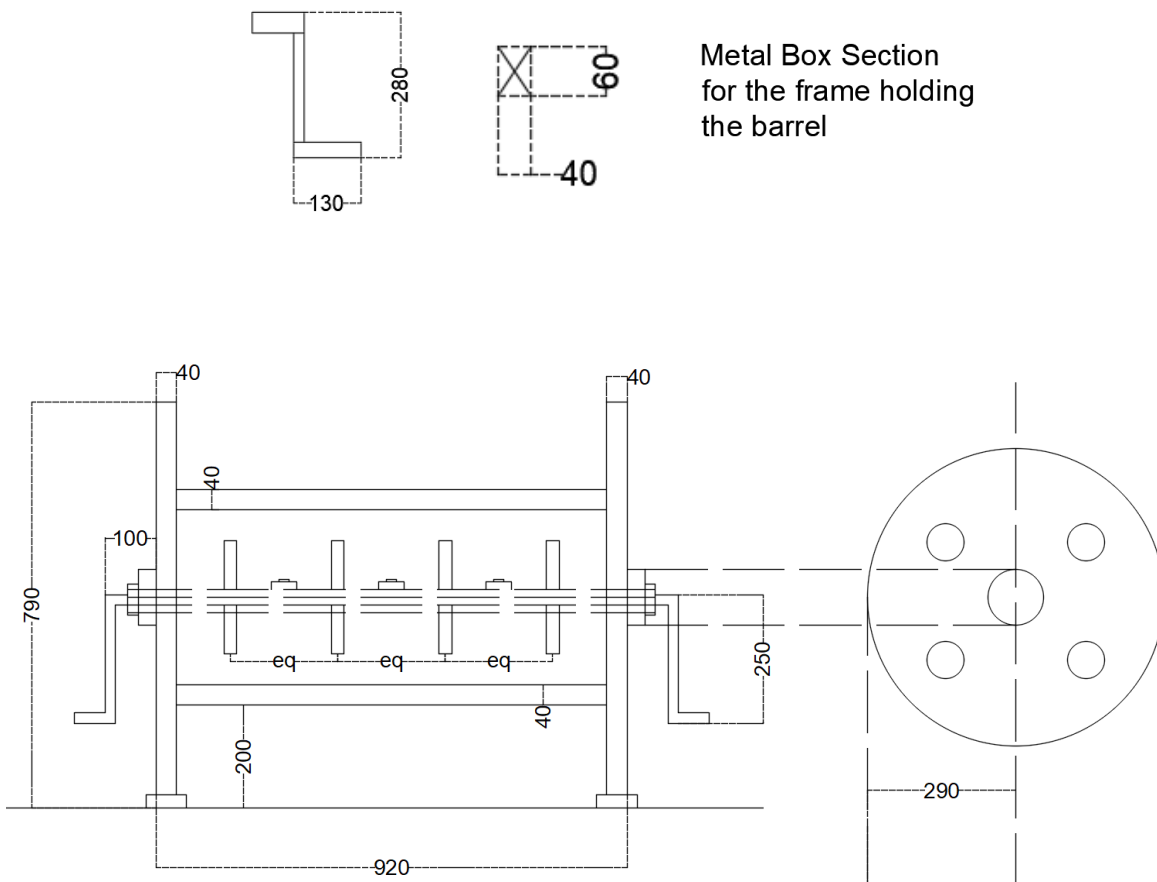


E) 55 Gallon used Chemical barrel. Holes are drilled at both ends for the turning shaft to move in. An opening is made in the front by cutting the plastic to feed organic waste.



The unit is assembled to make the composter unit. A detailed drawing of the unit is given below.





4.1 Bill of Material for low-cost barrel composter

Description	Cost in rupees
Fabricated metal frame	5,000
Turning shaft	1,000
Bearing and pillow	500
Rotating handle	500
Reused 55-gallon plastic barrel	750
Miscellaneous hardware	250
TOTAL	8,000

The unit is fabricated within Rs. 8,000/

5.0 EXPERIMENTAL RESULTS

Barrel composter is loaded with organic waste for several weeks. Organic feed is nicely aerated twice a day using a rotating shaft. After it is filled, the feeding shutter is sealed and the barrel is labeled and kept for curing.

After four weeks of curing composting unit produces fully cured compost.



6.0 CONCLUSION

Low Cost recycled Barrel Composter has given promising results. It can be easily designed and installed. It can be effectively used to achieve sustainable landscaping.

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