

## Article History

Received: 30 – 12 – 2023

Revised: 08 – 05 – 2024

Accepted: 02 – 07 – 2024

## Decentralized Composting- A Sustainable Approach For Organic Waste Management

Sheeza Siddiqui and Saba Khan

**Abstract:** Over the past few years, there has been a rapid shift towards a sustainable waste management in the country with the launch of Swachh Bharat Mission. The mission stipulates source segregation, material recovery and to move from 'linearity' to 'circularity'. Urban India generates between 1,30,000 to 1,50,000 metric tonnes (MT) of municipal solid waste/day. (Ministry of Housing and Urban Affair, 2021). 51% of this waste is biodegradable; indicating through composting, its volume can be reduced to half. **Decentralized composting (Dc)** is a localised solution for composting wherein waste generators from one or more urban housing societies, collaborate to compost organic waste at a specific site. It has the potential to manage large quantity of organic waste at- or near-source, thereby avoiding it to be diverted to landfills, reducing the resultant carbon emissions, environmental externalities and waste disposal transportation cost. Realising its importance, the researcher in the present study chose an apartment for starting Dc by installing a compost bin in the parking area. The residents in society's monthly meeting were informed of the initiative, its environmental and financial benefit and were encouraged for waste segregation. Furthermore, the cleaner was directed to fill the compost bin with segregated waste collected from separate dustbins kept at each floor. In a year, the organic

compost and its monetary benefit were gained by the residents. Thus, sustainable waste management through composting is an important step towards bringing cleanliness and sanitation in the society for which, the community (people) have to come together and take active participation in reaching this goal.

**Keywords:** Decentralized composting, organic waste, environmental benefit, sanitation, community participation

### Introduction

In recent years, the waste management sector in India has garnered significant attention with the launch of Swachh Bharat Mission (Urban) 2.0 on September 1, 2021. There has been a significant enhancement in the endeavours towards sustainable waste management, leading to a comprehensive overhaul of the waste management policy in the country. The current approach is centred on a well-defined strategy that prioritises the separation of waste at its source, the efficient treatment of both biodegradable and non-biodegradable waste, and the reduction of waste that is ultimately disposed of in landfill sites. As per the SBM 2.0 guidelines, only waste that is inert and process rejects and does not exceed 20% of the total waste can be disposed of in landfill sites. This waste should not be suitable for either biodegradable or non-biodegradable waste treatment. Consequently, it strives to achieve a zero-landfill urban concept within the nation.

As urbanisation increases, the pressure to provide high-quality urban services by municipality also grows, and the local authorities often lack the necessary capacity to meet the established goals of urban service delivery. The amount of waste per person also increases as societal wealth grows. Urban India is estimated to produce approximately 1,30,000 to 1,50,000 metric tonnes (MT) of municipal solid waste (MSW) per day, which amounts to around 330–550 grams per urban resident daily (Ministry of Housing and Urban Affair, 2021). The total annual amount is approximately 50 million metric tonnes, according to the Energy and Resources Institute (TERI), 2021. Based

on current trends, this figure is projected to increase to around 125 million metric tonnes per year by 2031, as reported by the Indian Central Pollution Control Board (CPCB) in 2021. Only 43 metric tonnes (MT) of waste are collected, with 12 MT undergoing treatment before disposal, while the remaining 31 MT are dumped in dumpsites.

The handling of solid waste in urban areas of developing nations is widely acknowledged as a substantial environmental concern. The characterization or composition of waste determines the approach to its management. In India, urban municipal solid waste is comprised of 51% biodegradable materials, 17.5% recyclable materials, and 31% inert materials. Composting can effectively halve the volume of waste by managing biodegradable materials. Composting is an essential component of sustainable waste management and has the potential to effectively solve the current challenging waste management issues. Composting has significant potential for future utilisation, but it requires collaborative efforts. Individuals must collaborate from the outset by engaging in source separation of biodegradable materials, recyclables, and inert substances. Source separation is an essential element that requires people's active involvement. By involving the community in composting initiatives, this is possible. It is imperative for every urban area at present.

Decentralised composting is a method of recycling organic solids that involves multiple waste generators from urban housing societies working together to compost organic waste at a designated location within or near the society's premises. It is carried out at a small scale, closer to the source of waste generation. Composting is an ecological process that involves the conversion of organic waste into organic fertiliser or soil additives through natural or controlled conditions (Diaz, De Bertoldi, & Bidlingmaier, 2021). Decentralised composting systems have become more significant in recent years due to their potential advantages in integrated urban waste management (Kumar, 2010). The uneven distribution of centralised biological waste treatment facilities has facilitated the emergence of decentralised solutions.

Various case studies and feasibility studies have examined the practicality of decentralised composting, particularly in developing nations. Decentralised composting is closely linked to various solutions, including urban carbon sequestration, urban green spaces, municipal solid waste (MSW) treatment and prevention, waste reduction, cooling trees, and the concept of circularity in food cities. Decentralised composting significantly minimises the need to transport waste for processing and treatment. The primary advantage of decentralised composting is its ability to effectively handle a significant amount of organic waste at or near its source. This reduces the expenses related to transporting and managing organic waste for the municipality, including collection and treatment costs, as well as the fees associated with landfill disposal. Composting allows for the local recycling of organic material, and the resulting compost is frequently utilised on-site or by community members as a replacement for fertilisers. It can be used for cultivating fruits and vegetables within society or for maintaining parks and gardens in the community (Bong et al., 2016). By substituting chemical fertilisers, this practice enhances soil health, air quality, water quality, and soil quality. It fosters a sustainable and resilient food system by utilising compost to support individual or community kitchen gardens, thereby reducing reliance on external food sources. Additionally, compost serves as a food source for birds, promoting biodiversity.

Furthermore, the involvement of residents and local institutions is necessary for decentralised composting systems. This participation promotes the development of social capacity by enhancing awareness and understanding of the environmental aspects of waste management. Since citizens are the driving force behind the entire process, social cohesion develops. This composting system necessitates the practice of source separation, where individuals are responsible for separating their food waste. This practice has been proven to effectively decrease the amount of organic waste produced (Schlesinger, 2016). The transformation of organic waste into a viable product has a positive impact on the environment by diminishing the quantity of waste that is deposited in landfills. By redirecting organic waste to these

decentralised systems, the lifespan of current regional landfills is prolonged, resulting in a decreased necessity to build new disposal facilities. Municipalities can also derive advantages from diverting organic waste from material in order to achieve their zero-waste objectives (Platt, 2014).

Due to the relatively small quantities processed by each decentralised system, the composting technologies employed are technologically straightforward and require minimal training. This fosters economic growth in the region by establishing local microenterprises. It generates supplementary revenue for the community through the sale of compost. Urban farms that are integrated with decentralised systems can enhance farm revenue and decrease expenses related to fertiliser procurement (Davis, 2014).

### Methodology

An action research was carried out for decentralized composting system. For this, an apartment of 12 individual units was chosen as the waste produced is dumped in a common trash can and is handled by a single cleaning person appointed for the whole apartment. In society's monthly meeting, the idea of installation was composting bin was proposed. The discussion took place and members agreed with the idea. Following this the materials were purchased:

**Table 1: Materials purchased for compost bin preparation**

Materials	
Small closed green-coloured dustbins (For each floor)	3
Two large drums	50 litres each (to prepare the compost bin)
Compost	As a starter
A large hand rake tool	To mix the waste upside down
Brown materials	To mix with wet waste

Iron stand with a meshing iron frame (placed inside the drum at the bottom)	To support the weight of the waste and prevent deterioration of the drum's base
---	---

Holes were made in two large drums for aerobic composting, and a plastic tap was installed at the bottom to drain out leachate; and was kept in a corner of the parking area of the apartment.

After this a message in the society's social media group was circulated, informing them to separate their kitchen waste and direct their house help to dump it in the green dustbins only. The idea of composting and an additional income for society from the sale of the compost was suggested to encourage the practise of source separation. The researcher also met the women of each flat in the apartment and told them about the types of items to be included and excluded in the waste. The cleaning person of the apartment was directed to collect the waste from the green dustbins on each floor and empty it into the compost bin along with dry leaves and grass clippings, occasionally mixing the waste every 3–4 days and sprinkling water as needed. The researcher personally kept a check on all the activity. An e-message on the group was sent occasionally to remind them of the practice. When full, it was replaced by the second bin to collect fresh waste. After 4-5 months, the manure was collected, dried, sieved and weighed. Packets of manure were prepared and distributed among the society members.

### Result and Discussion

In this section the result of decentralized composting activity is formulated and discussed. The total amount of Organic Waste produced in an apartment and the resulting manure is presented in the table below:

**Table 2: Total amount of organic waste produced and resultant manure obtained.**

Months	Organic waste/ month (kg)	Total amount of organic waste (kg)	Total amount of manure produced (kg)	Time Taken (months)
<b>April-July</b>	100.87	415.04	103.76	5-6
	138.68			
	64.56			
	110.93			
<b>Aug-Nov.</b>	166.96	624.89	156.22	6-7
	141.77			
	155.28			
	160.88			
<b>Dec.-March</b>	124.35	544.27	136.07	7-8
	131.13			
	139.89			
	148.90			
<b>Total amount (in year)</b>		1584.20	396.05	

From the above table it is inferred that the decentralized composting resulted in efficient utilisation of 25-30 kg of biodegradable kitchen waste produced by a single family per month and converted into useful manure, which would otherwise be dumped alongside other waste,

resulting in an additional burden to the municipality and the environment in the long run.

The composting helps in conversion of 1300-1500 kg of organic kitchen waste produced in an apartment of 12 families in a year by into useful manure which is 350-400kg/year, which would otherwise be dumped alongside other waste, resulting in an additional burden to the municipality and the environment in the long run. Furthermore, the final compost product is comparatively of higher quality due to efficient separation and less inter-contamination of wastes (B. Cecelia, et al (2020).

The activity of source separation of organic waste for composting not only helped in the management of organic kitchen waste, but the sorted non-organic /recycled waste of the kitchen (plastic, glass, packaging material, cardboard, etc.) were also collected and sold by the cleaning person, making an additional income for him that was earlier not feasible due to mixed waste.

### Costing

**Table 3: The amount of initial investment for compost bin preparation**

Materials Used	Cost (Rs.)
Green Dustbins (3)	360
Compost Bin (2)	1400
Rake Tool	400
Iron mesh stand	1000
Compost(starter)	50
<b>Total</b>	<b>Rs.3,210</b>

**Table 4: The amount of money generated by sale of compost p.a.**

Compost prepared (in a year)	Selling Price of compost prepared (@ Rs.40)
396.05 kg	Rs.15,842

\*p.a. - per annum

The above table indicates monetary gain of Rs.15, 842 in a year. If the investment cost of Rs.7, 110 [initial one-time investment of Rs.3, 210; recurring cost of Rs.100/batch of compost (Rs.300/year) and; fee of the janitor (Rs.300/month= 3,600/ year)] is deducted, the resultant monetary profit is Rs.8, 732.

This money profit is utilised as contingency money by the apartment for their work. The activity of source separation and composting on site not only helped in the management of large organic kitchen waste, but the sorted non-organic/recycled waste of the kitchen (plastic, glass, packaging material, cardboard, etc.) were kept and sold by the cleaning person, making an additional income for him that was earlier not feasible due to mixed waste. Along with money income, the organic manure is also available for the apartment together with the satisfaction among society members for their contribution in sustainable waste management. This type of decentralised composting facility also acts as an example for others to follow. It can be established in apartments and small colonies (having 15–20 houses), lessening the burden of waste management on the municipality and environment. Decentralized composting holds significant potential as a sustainable business venture that mitigates environmental impacts, lowers expenses associated with waste transportation and disposal, and promotes long-term soil health and agricultural productivity.

### Conclusion

Decentralized Composting is a crucial measure for achieving cleanliness and sanitation in society by promoting sustainable waste management. It can be implemented with flexibility at various levels,

ranging from individual households to large-scale centralised facilities with minimal initial capital and operating expenses in different community settings. It enhances a city's waste collection programme and incorporate existing informal sectors engaged in waste collection, separation, and recycling. It improves waste management by diverting more waste away from final disposal and improving recycling and incineration processes by eliminating organic matter from the waste stream at its source. This helps to reduce the need for landfill space. Additionally, it produces a valuable soil amendment that is essential for sustainable agriculture and helps to decrease soil erosion and contamination of surfaces and groundwater.

By offering incentives to support the establishment and functioning of decentralized composting initiatives, educating all relevant parties about the advantages of composting, the programme can achieve long-term viability. Government entities should actively engage with the community to offer technical aid, facilitate loans and financial assistance, and allocate land for compost facilities on a long-term lease basis through public-private partnerships. However, in order to achieve this objective, community participation is indispensable. It is essential for the success of the clean India movement, as societal growth relies on cooperation within the community. While it may seem like a small action in the pursuit of cleanliness, it will actually have a significant impact on the overall health and prosperous growth of India.

### References

- Bobeck, M. (2010). Organic Household Waste in Developing Countries: An overview of environmental and health consequences, and appropriate decentralised technologies and strategies for sustainable management.
- Bruni, C., Akyol, Ç., Cipolletta, G., Eusebi, A. L., Caniani, D., Masi, S., ... & Fatone, F. (2020). Decentralized community composting: past, present and future aspects of Italy. *Sustainability*, 12(8), 3319.
- Comesaña, I. V., Alves, D., Mato, S., Romero, X. M., & Varela, B. (2017). Decentralized composting of organic waste in a European

rural region: A case study in Allariz (Galicia, Spain). *Solid Waste Management in Rural Areas*, 53.

De Souza, L. C. G., & Drumond, M. A. (2022). Decentralized composting as a waste management tool connects with the new global trends: a systematic review. *International Journal of Environmental Science and Technology*, 19(12), 12679-12700.

Kiyasudeen S, K., Ibrahim, M. H., Quaik, S., Ahmed Ismail, S., S, K. K., Ibrahim, M. H. & Ismail, S. A. (2016). Introduction to Organic Wastes and Its Management. *Prospects of organic waste management and the significance of earthworms*, 1-21.

Pai, S., Ai, N., & Zheng, J. (2019). Decentralized community composting feasibility analysis for residential food waste: A Chicago case study. *Sustainable Cities and Society*, 50, 101683.

Rathore, P., Chakraborty, S., Gupta, M., & Sarmah, S. P. (2022). Towards a sustainable organic waste supply chain: a comparison of centralized and decentralized systems. *Journal of Environmental Management*, 315, 115141.

Rao, J. N., & Parsai, T. (2023). A comprehensive review on the decentralized composting systems for household biodegradable waste management. *Journal of Environmental Management*, 345, 118824.

Retherford, L., McCarron, G. P., & Manela, M. (2017). Decentralized Urban Composting. In *International Conference on Sustainable Infrastructure 2017* (pp. 162-170).

Sánchez, A. (2022). Decentralized composting of food waste: a perspective on scientific knowledge. *Frontiers in Chemical Engineering*, 4, 850308.

Sharma, A., Soni, R., & Soni, S. K. (2023). Decentralized in-vessel composting: an efficient technology for biodegradable solid waste management. *Biomass Conversion and Biorefinery*, 1-18.

Zurbrugg, C., Drescher, S., Rytz, I., Sinha, A. M. M., & Enayetullah, I. (2005). Decentralised composting in Bangladesh, a win-win

situation for all stakeholders. *Resources, Conservation and Recycling*, 43(3), 281-292.

Community Composting for Multi-Family Residential Settings.(2018)  
<https://solusgrp.com/blog/post/community-composting-for-multi-family-residential-settings.html>

Community- scale composting  
<https://calrecycle.ca.gov/organics/compostmulch/community/>

---

**Ms Sheeza Siddiqui** is Research Scholar, D/o Home Science, F/o Agricultural Sciences, Aligarh Muslim University, Aligarh

**Dr Saba Khan** is Associate Professor, D/o Home Science, F/o Agricultural Sciences, Aligarh Muslim University, Aligarh

**Ms Sheeza Siddiqui** was awarded **ISSA – DR BINDESHWAR PATHAK MEMORIAL BEST PAPER AWARD** for presentation of her Research Paper at National Webinar on “Dynamics of NEP: Rethinking Future of Social Sciences & Research” Organised by Indian Social Science Association (ISSA) in collaboration with Madhyanchal Sociological Society (MSS) from January 13 – 14, 2024.

**Email: sheezasiddiqui14@gmail.com**

---