

Need for Composting of Household Waste at Community Level

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Abstract: With steeply increasing population and high rate of consumption, the household waste generated is also increasing. Lack of efficient management of waste, owing to growing pile of garbage leads to increase in heights of landfills, in which more than half of the waste comes from household and is biodegradable. In USA, around 27% of all solid waste comprising of food scraps and yard waste ends up in landfills [1]. Similarly, India generates around 62 million tonnes of waste annually with nearly 50% of total waste being organic and instead of being composted, it ends up in the landfills [2]. Landfills are not only eye soring sights, but they also amount to third biggest cause of greenhouse gas emissions in India [2]. This calls for need of composting household waste at community level to tackle the problem at the source of generation. This paper aims at identifying current practices for composting in India, and identify challenges faced by authorities and individuals while implementing composting initiatives. This paper seeks to find answers to the posed research questions revolving around composting challenges with a possible suggestion for implementing composting activities in schools, household complexes and community parks and gardens.

Keywords: community composting; household waste management; composting practices; composting in India; individual composting; composting by citizens; suggested composting practice

1. INTRODUCTION

Household waste management is a complex issue in countries like India and composting practice often seems to be a failure when it occurs at community level even when it needs least amount of technology and investment. The quantity of waste generated in households amounts to more than fifty percent of the waste found piled up in the landfills. The quantity of household waste keeps on increasing day by day in contrast to the waste management at the landfilling sites. One can even mistake the landfill site at Delhi, India to be a mountain rather than a huge heap of garbage with birds hurling above it. This unbelievable ugly sight itself clearly points towards the systematic failure in waste management both at individual as well as municipal levels. The landfill site in city like Delhi, India is just one example. All countries over the globe are currently facing huge issue with managing waste as the households continuously generate it. Composting seems like an effective method for household waste management. The composting method, if followed at community level, has the potential to eradicate the problems faced by labors directly involved in waste management and can also help the citizens become more aware about the high amount of household waste generation so that they can make conscious choices regarding their consumption habits.

This research paper is an attempt towards finding answers to the following questions:

1. What are the easy methods to implement for composting at individual levels?
2. Can these methods be used to compost in community level? Why or why not?
3. What challenges are faced by individuals while composting individually and collectively?
4. Can we mitigate these challenges through simplification of composting methods?
5. Suggestion for composting methods at community level.

Before getting into these mysterious questions, one should first know about composting.

1.1 What is Composting?

Composting is the process of decomposition in a controlled environment, i.e., the natural process of breakdown of organic waste materials and transform into a biologically balanced and humic substances that make brilliant soil alterations [3]. Compost is easier to manage and store, when compared to manure and other raw organic materials [3]. In composting, usually the microorganisms help in breaking down of the waste to formulate it into useable form known as compost. During composting, processes occur from beginning till end, i.e., till the compost is made as per Figure 1.

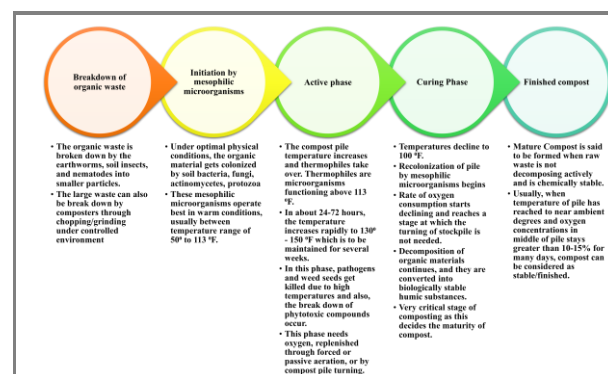


Figure 1. Process of composting and various stages [3]

1.2 What are various types of composting methods?

Composting methods can be divided into three main types depending on the decomposition process involved, i.e., aerobic composting, anaerobic composting, and vermicomposting. In aerobic composting method, as the name suggests, the composting of biodegradable waste occurs with the help of oxygen and the mixture needs regular turning. It produces a little amount of CO₂ along with other nutrients

required by the plants. In anaerobic composting, the process happens in absence of oxygen due to which a foul odour is generated along with methane gas which is another source of greenhouse gas emissions like CO₂. In both these methods the composting happens due to bacteria whilst in vermicomposting, worms break down the biodegradable waste and produce compost. This method doesn't produce any odour.

Then depending on the method used for piling the biodegradable waste, composting methods can also be categorized as sheet composting, trench composting, cold-bin composting, and heap composting.

1.3 What are the benefits of compost?

The question about benefits of composting is like asking about benefits of food. But, keeping sarcasm apart, the compost is not only beneficial for providing nutrients back to soil, it also is a great way to manage biodegradable waste irrespective of its generation sources (restaurants, households, schools, cafes, industries, hospitals and so on). The compost serves as the final missing gear in a complete lifecycle for a biodegradable material. Take food for example. The soil we use to grow our food in is then returned back its nutrients in the form of compost as a gratitude. It may seem like philosophical talk but it's true and makes sense.

Composting is eco-friendly and has minimal effects on environment, except for the GHG emissions in form of CO₂ and CH₄ when the process is not properly controlled and supervised.

2. HISTORICAL BACKGROUND

During the 1930s, municipal solid waste management and disposal were least priority. There was few or even no formal management present to tackle the issue of waste [4]. Even though it has huge public health and environmental significance, it was not considered such between 1930 to 1940. Despite the objectionable elements and attributes, the open dump of waste was a common practice for waste disposal [4]. In some places, it is still practiced. But the discussion about current waste disposal practices will come a little later in the paper.

The publications dedicated to solid waste management were few until the 1960s, especially when literature for composting is concerned. Mostly it was found as project reports and articles in obscure journals or periodicals which were quite challenging to acquire. [4] In early 1970s, professional disinterest persisted until resource conservation, ecology and environmental quality started to get public attention [4]. Farming and Organic gardening were the major areas accounting for interest and activities in composting prior to 1970s [4].

If one were to look at the change in type of waste by comparing pre-industrial and post-industrial era, one could easily notice that the waste generated in pre-industrial era was less toxic, low in quantity and easily biodegradable even though waste management was a failure in both eras [5]. In Indus valley civilization, people used cotton clothing and the city of Mohenjo-Daro had houses with garbage chutes and Harappa city had toilets [5]. As the human population started increasing steeply, around 8000-9000 BC, waste dumps were established away from settlements to keep away wild animals, insects, and odours [5]. The Minoans used to cover waste with layers of soil and by 2100 BC, cities on the Crete Island had trunk sewers. The transition from nomadic communities towards settlement started initially around Neolithic

revolution. [5] The first records of solid waste management were found in Athens, Greece during 500 BC and the first municipal dump was built in Athens for people to dispose off their solid waste [5]. Greek municipalities started town garbage dumps for discarding food trash, fecal matter, etc. in the 5th century BC [5]. The waste disposal was not treated like human health hazard until the authorities started to realize the connection between epidemics like plague with solid waste disposal methods. When in 1350s, approximately 25 million people were killed in span of five years owing to "The Black Plague", that was the time when Britain made a law to clean front yards mandatory but it was not taken seriously [5]. Britain was the first to introduce garbage men for solid waste collection as per historical references [5]. They were called 'rakers' because they used to rake up solid waste on weekly basis into a cart [5]. Then in the year 1551, the use of packaging was first recorded in Germany [5]. The use of and manufacturing of paper spreading from China to medieval Europe, developments in operation and dyeing of wool in 13th century, introduction of paper making techniques in England in 1310, invention of low-density polyethylene in 1942, etc. are just a few activities generating huge amount of waste which added more obstacles [5]. Heaps of waste was also a problem for Paris which was then removed by employing 800 carts as they were interfering with the city's defence [5]. Owing to the plague epidemic, the solid waste management became of utmost importance in Europe, but not in Asia and Africa, in spite of being colonized by Europeans [5].

The solid waste management was already taking a backseat owing to lack of laws and interests when the globe was hit with industrial revolution. As the production and evolution of new products started quickly, the manufacturing also increased due to industrial revolution [5]. It's natural that waste automatically increased as the market capacity increased. Now, the question comes to mind, if there were so much technological advances, then it might appear that waste management would also be efficient. Was the waste management in post-industrial era more efficient as compared to pre-industrial era? Let's take a look at it. As industrialization led to new and enhanced products, it also consequentially led to change in waste quantity and quality [5]. All over the globe, 'waste management' entered in many municipal acts [5]. This doesn't mean that implementation of waste management acts also dramatically changed for good. In fact, implementation was still inadequate because municipalities were not being supervised by any outside agency, no punishable law for officers in charge of enforcing the waste management acts, no laws for industries outside municipalities, to just name a few [5]. The industrial revolution made manufacturing cheaper which led to increased consumption and that led to more waste production.

The United Nations Conference held in Sweden in 1972 on Human Environment was a turning point for waste management [5]. Representatives of 113 nations attended UN's first international environmental conference [5].

In the 20th century, Plague caused widespread havoc in India and Vietnam with more than twenty-five thousand deaths. This forced Indian authorities to take extensive measures to manage solid waste [5]. The world population kept rising with the coming years and societies started wasting food more than ever especially in developed worlds [5]. Waste generation capabilities can also be linked to financial capacities per capita for every country. Higher the income per capita, higher consumption and hence, higher waste generation.

In all this chronological discussion about solid waste management, where did composting come in historical timeline? Composting has been a part of human life since the time of Neolithic period when human beings started settling instead of living a nomadic life. In the process, their habits shifted from hunting and gathering towards farming and breeding. [6] Waste pits came into common existence. The first waste pit was made using stones outside the houses in Sumerian cities about six thousand years ago [6]. These pits were used to store organic urban waste to be eventually used in agricultural fields [6]. In countries like India, China, South America and Japan, the early civilizations used to utilize residues from agriculture, animals, and humans as fertilizers due to intensive agriculture practices [6]. Traces of advanced systems being developed in Imperial Rome for urban waste management could be found. Periodic Urban waste collection, its disposal outside the town and application to agricultural soils eventually were done to preserve hygiene of the city. [6] One of the most accurate descriptions for composting could be found in the manuscripts of the thirteenth century which reported techniques of recovering fertility in depleted and arid soils, used by the Templars [6]. These descriptions included preparation of various materials for obtaining different types of compost for variety of crops, careful determination of ratios between wood and animal manure and moisture, reduction of moisture loss via evaporation by covering windrows with soil or branches, etc. [6] At the time when terms like soil chemistry and microbiology were unknown, the accuracy of these descriptive documents is rather fascinating. This depicts that the Templars' understanding of various aspects of soil biology, geology, basic elements of agronomy & soil fertility, and the art of composting is commendable. [6] Then came the advances in area of composting during the 20th century. It was in 1933 in India when first major advance was made by Sir Albert Howard in modern compost history. [6] He with his workers came up with a process by the name of "Indore process" which used animal manure initially but later stacked alternate layers of readily biodegradable materials (like human faces, straw, garbage, leaves, animal manure, stable waste and municipal refuse) on open ground [6]. The height of pile was kept at a meter and a half or compost was placed in less than one meter deep specially constructed pits [6]. This process used to take minimum six months during which compost piles was subjected to aerobic decomposition for a short while and anaerobic decomposition for the remaining time [6]. This Indore process was so widely used in India by many that the Indian Council of Agricultural Research even changed the name of this process to 'Bangalore process' after some improvements [6]. A significant improvement in this process was maintaining aerobic conditions by frequent turning [6]. The results of study conducted by Scott and others before World War II relating to agricultural sanitation in northern China revealed problems dealing with composting human wastes in rural areas [6]. Many researchers were studying the composting process and the effects of various elements like the type of waste used, time taken for decomposition, type of decomposition, etc. on the quality of compost in the twentieth century [6]. The mechanization efforts were happening in Europe while countries in China, India and Malaysia were refining the process [6]. The mechanization of composting led to many innovations, and these were mainly focusing on aesthetic improvement of composting process, time reduction for stabilization of compost and making it more economical. The designing for enclosed and mechanized processes was being applied in urban areas primarily. [6] For example, in Italy, the Beccari process composted material in an enclosed structure to avoid

foul odours due to decomposition [6]. The innovations like Frazer process, Hardy digester, Earp-Thomas digester, Dano process, etc. are just a few to name [6]. The list of composting methods practiced in historical times in India, USA, London, or everywhere else in the globe is unending and even with modifications, one method doesn't seem to be fulfilling needs for everyone depending on the type of waste generated and geographical locations even though municipalities have been establishing demonstration facilities, waste management practices, and policies.

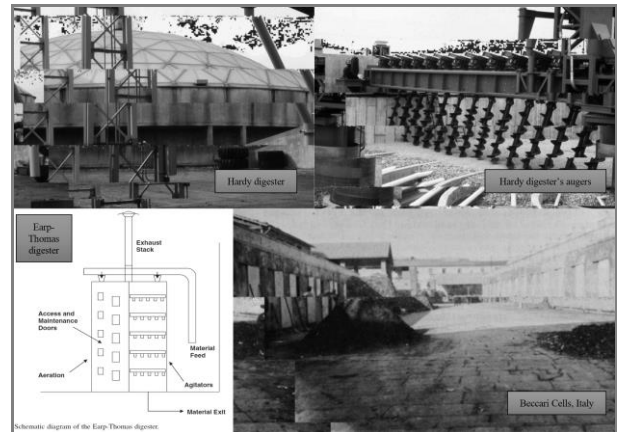


Figure 2. Innovations for composting methods [6]

3. STATISTICS ABOUT HOUSEHOLD WASTE AND LANDFILL SITUATION

As per World Bank report, an average person generates 0.74 kilogram of waste which varies between 0.11 to 4.54 kilograms. Globally, about two billion tonnes of municipal solid waste is generated, out of which 33% of total waste is not even managed safely in the environment. As we move towards 2050, the global waste is expected to grow by 69%. [7] In fact, countries in East Asia and Pacific region generates about 23% of global waste with European and central Asian countries producing 20%, which makes them major contributor towards globally generated waste [7]. Food and green waste amount to largest proportion of globally generated waste and makes about 44% of total value at international level [7]. 40% of total global waste gets disposed in landfills, only 19% of total global waste undergoes recovery through composting (5.5%) and recycling (13.5%) and 33% of total waste is still dumped openly. This practice of open dumping is prevalent more in lower-income nations which do not have proper landfills. These statistical data and figures are more than enough to highlight the potential of managing organic waste through composting. [7]

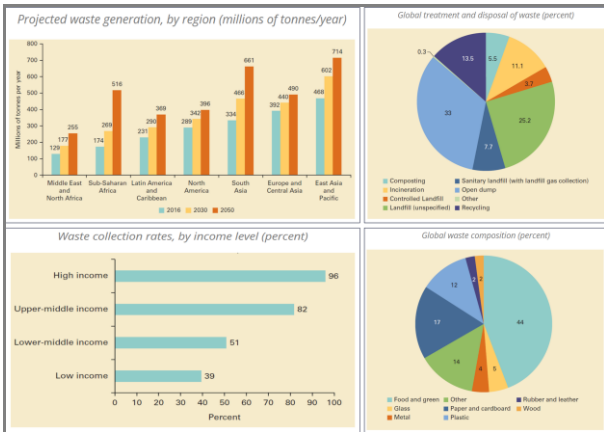


Figure 3. Statistics on global waste generated, collected, and dumped [7]

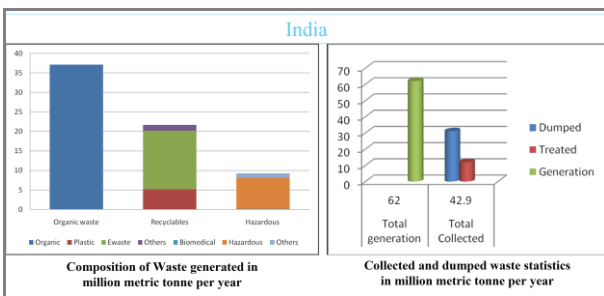


Figure 4. Statistics for waste generated, collected, and dumped in India [2]

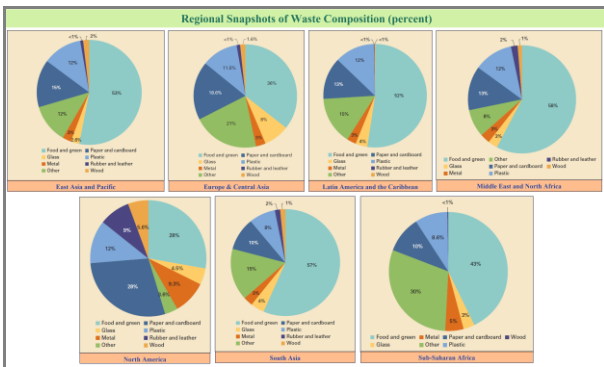


Figure 5. Statistical data for Global waste composition at regional level [7]

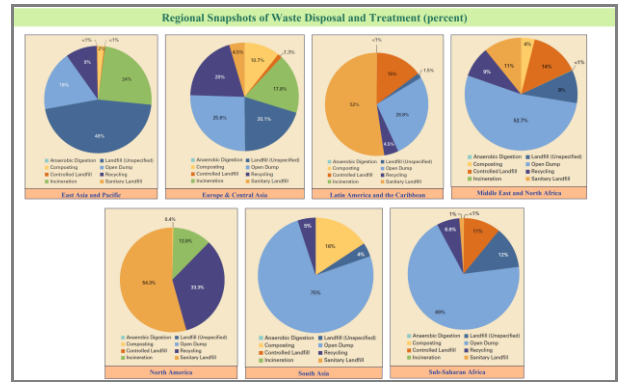


Figure 6. Data on Global waste disposal and treatment at regional level [7]

4. LITERATURE REVIEW

There are many composting techniques already used by people all around the globe from converting their organic waste matter into useable compost. The process may be aerobic, anaerobic or vermicomposting. But the technique for composting involves the modifications performed from collection of organic waste in certain manner to handling the various stages (mesophilic, thermophilic, cooling, curing) till finished compost is formed. There are conventional composting techniques along with the novel ones. Conventional ones include Windrow composting, in-vessel composting, aerated static pile composting to name a few. Windrow composting involves decomposition of piles of waste with aeration and simultaneous turning [8]. These are economical due to no heavy mechanical tool requirement for aeration. Depending on the type of waste and equipment used for flipping, the height of windrow varies. If the tool is small like a ladle, keeping height smaller makes logical sense while with a big tool like raking stick, the pile height can be elevated. In in-vessel composting, as the name suggests, the organic waste is kept in a closed container or vessel in controlled conditions. This composting system involves agitated bags and rotating drums to enhance decomposition process and boost the rapid composting through mechanical agitation and instinctive rotation [8]. In vermicomposting, the biodegradable waste is decomposed with the help of earthworms of different species like *Eisenia foetida*, *Eudrilus eugeniae*, and *Perionyx excavatus* [8].

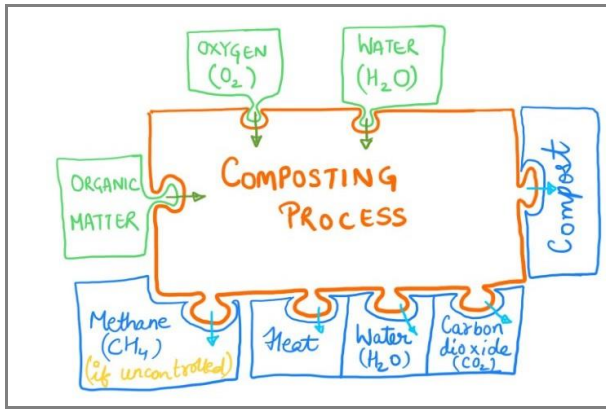


Figure 7. Composting Process

The aerated static pile composting involves decomposition of organic waste for over a month without any physical activity in the pile. For aeration, perforated pipes are used, and the waste piles can be kept in covered, open, windrow, or semi-covered form. This process is critically dependent on rate of aeration which produces temperature difference in the pile vertically [8]. In aerobic composting, the decomposition happens in presence of air at specific temperature and pH range as a result of which the micro-organisms convert the organic waste into a bio-fertilizer loaded with nutrients and optimization of the aeration rate can help with the odour problem [8]. Households usually don't prefer anaerobic composting due to methane production which leads to a foul odour and also contributes towards greenhouse gas emissions. On the other hand, vermicomposting and aerobic composting seems to be welcomed by households considering the least amount of technology and money involved. But they too have their challenges.

There is also a technique known as co-composting in which the augmentation of composting is done with the help of a mixture of two different waste [8]. It provides a best solution for food waste processing as food waste and waste substrates (like wooden chips, rice bran, rice husks, chopped hay, sawdust, wheat straw, and other similar organic waste) can be combined together to maintain favorable ratio of carbon & nitrogen, moisture, void spaces, and nitrogen content [8]. Even the lower pH of food waste can be managed by addition of sodium acetate in waste mixture [8]. Co-composting activities can use feedstocks, like poultry litter, pig manure, etc. as well [8].

Another novel composting technique is with the help of arthropods. Arthropods are invertebrate species of animals with an exoskeleton, paired jointed appendages, and a segmented body. In this composting method, an essential arthropod species is enticed at various decomposition stages and all these arthropods complete their life cycle during the process of composting [8]. These species are helpful for boosting the development of consentient species, and arthropods like black soldier fly larvae and millipedes have been used for composting of a variety of biodegradable waste [8].

There are various challenges during composting process. First barrier comes in the form of confused minds of beginners who have just started composting. For composting household waste, public motivation is seemed to be low for using barrels and separating the waste at source [9]. The public also seemed to be confused over what to separate along with cultural stigma attached with touching waste [9]. The size of the plots available for composting pits also restricts the composting activities. The best way to ensure efficiency in composting activities lies in separating the household waste at the source of generation, i.e., segregating the organic waste at home itself instead of doing it later at a landfill where, by the time the segregation starts, majority of the waste has gone into uncontrolled decomposition state which can do more harm to the segregator. This calls for cooperation between households, waste collector and the composting organization if the composting is being done at a large facility [9]. The waste collection fee charged from residents also make them concerned about the usage of the money and the income generated from the sale of the compost [9]. It has been observed that raising motivation through environmental cause or economic incentive is also very difficult to achieve when it comes to composting household waste [9]. Since the composters do not reap higher profits from composting plants as compared to other businesses, dumping of waste has become highly unregulated in countries with low-income due to low motivation from municipalities as well [9]. Due to lack of necessary capital (like buying or renting land) and unawareness about the technology, process or potential markets, the urban poor have also shown least interest in the composting activities [9]. Biodegradable waste, that decomposes slowly or needs shredding using machinery, often requires money, time and equipment and this also pose as a challenge for composting at regional levels [9]. High short-term costs associated with switching from industrial fertilizers to bio-fertilizers produced through composting also acts as a barrier for farmers [9]. Another major challenge occurs when the composting plants target the employment creation for the poor but the improvement in labour conditions is not guaranteed [9]. For example, workers may not get equal respect in society even if they work at composting plant or facility due to the stigma attached with touching waste. Increased waste means need for more land for composting as composting cannot happen in a day, but the waste generation occurs without any stop. Shortage of land space for community level composting also is an issue in the process. It is also a challenge to decide the effect certain type of compost can have on the soil or plants it is utilized for and this also forms a dilemma and hesitation in people's mind for using compost. Community level composting calls for proper management of compost bins to ensure hygienic conditions. And since composting is not the only thing on people's mind, various composting initiatives start but are not supervised or managed properly and this leads to more environmental hazard near the compost pile. Imagine if the temperature of compost pile doesn't reach to certain degrees and instead of killing the pathogens naturally, it starts to become a breeding ground for infections.

So, the question arises what can be done to mitigate these challenges? For beginning, waste segregation is required at household levels and easy composting activities should be initiated at community levels and decentralization of waste management is required. When the waste generation is not centralized, the waste treatment can also not be successful through centralization. A lot of interventions are necessary for increasing composting of waste. Some of them include policies for waste segregation, bulk waste producers and responsibility distribution based on amount of waste generated individually. There is also a need to charge waste collection fee based on family incomes as it is observed that the increase in income leads to rise in consumption and consequentially increase in waste generation. Incentivizing the poor or low-income groups for composting is also a great step towards increasing motivation. Educational awareness campaigns for behavioral changes through schools is also a good approach.

5. SPECIAL INTERVIEW

A telephonic interview was conducted by author of this paper in the year 2021 with the purpose of sharing citizen's experience of composting process to link the scientific community and the citizens to start a dialogue needed to emphasize community-level composting. Refer Figure 8 & Figure 9 for the details of the interview.

Excerpts from the Interview

Q1. When did you start composting?
 A1. I started composting three years ago.

Q2. What motivated you to start composting?
 A2. I have always been inclined to gardening since my childhood, but never tried it. Three years ago, I saw this advertisement about a course on home-waste composting being organized near my home and I enrolled for it. After learning the method, I started composting at home. To be able to provide nutrition to soil and plants through my kitchen waste motivated me to do this.

Q3. How often do you make compost? How much time does it take to make compost?
 A3. I make compost three times a year. The total process takes 4 months from collecting waste to formation of compost. It takes 1 month for collection of waste and 3 months for compost formation.

Q4. How much compost are you able to make?
 A4. I use earthen pot as compost bin and can make 5-6kg of compost using the pot of 10L capacity.

Q5. What type of waste do you use?
 A5. I use all type of food waste generated in the kitchen including peels of vegetables, fruits, tea leaves. I do not use cooked food, or peels of onions and garlic.

Q6. What's the process like? What do you do for the odour generated in the process of composting?
 A6. I take an earthen pot to use as compost bin. I put my kitchen waste everyday into the pot along with cocopeat. The quantity of cocopeat used is half the quantity of kitchen waste. It takes one month for the pot to be completely full of waste and cocopeat. While collecting waste, I keep stirring the mixture so that it doesn't form a block that cannot be stirred later on. After collection is over in a month, I keep the pot covered with a sieve or cloth on the roof in ventilated area to avoid the smell coming inside house. In about 3 more months, the compost is completely ready to be used in the garden.

Q7. What do you use this compost for?
 A7. I use this compost as natural fertilizer for my plants. I also use this fertilizer while conducting plantation drives in my community.

Q8. What challenges did you face in the beginning? Did you get support from family or neighbors?
 A8. There were a few challenges that I faced. Firstly, in the beginning, the compost used to become a thick block and it was difficult to stir it. But then I started stirring the mixture every time while putting the waste in the pot and then it became easier to stir. There's also a lot of odor that comes from the pot while decomposition is in progress. So, I couldn't keep it outside or inside the house. I chose a place on the terrace which is open and ventilated. As far as my family is concerned, they didn't actively support me, but they didn't stop me either. Now, they even recommend me when people have doubts about composting. They also respect my passion. I have also inspired my neighbours and some of them have even started growing their own vegetables using the compost in their backyards and terrace. In the beginning, neighbours used to criticize it as it is a lot of hard work but now, they are all supportive and eager to learn more.

Q9. How much does it cost you?
 A9. Honestly, it doesn't cost a dime to make compost at home. Everything from pot, waste, wooden stirrer can be used without buying it. Earthen pot and plantation pots are the only thing that cost money and that too is less than 500 INR.

Q10. How does your gardener feel about it?
 A10. Earlier he used to feel threatened as it posed a threat to his job. But when I gave him the plants, I grew using the compost and seeds, he was happy. He also is elated that I am managing my own household waste.

Q11. Have you tried collaborating with your gardener by giving him the extra compost left with you?
 A11. No, I haven't till now. But I like this idea. I usually have large amount of compost and not able to use all of it. So, I use it to plant seeds and give those plants as gifts to people around me. But this sounds like a great initiative. Next time, when I see him, I will ask his thoughts about this.

Figure 9. Telephonic Interview Part-B

6. SUGGESTED COMPOSTING METHOD AT COMMUNITY LEVEL

Figure 10 shows a sample area of a residential complex with a government building and district park on its side, all situated in the west district of Delhi, capital of India. This is just taken as a sample area to put forward an idea for composting at community level and using the compost for the benefit of the surroundings. Figure 11 depicts the steps that can be taken to implement this idea. The idea is to utilize the roofs of the apartments to install compost bins and every house in the residential complex contribute their biodegradable kitchen waste generated every day to these roof bins. Then the process of composting can take place with residents taking turns for flipping the waste every once a while till the compost bin is full and cannot accommodate any more waste. Then the organic mixture is left to decompose till the final compost is ready with frequent turning of waste in bin for proper aeration. Then final compost can then be used with the help of local gardeners to provide soil nutrients to areas with existing trees and plants. It can also be used for soil amendment in the adjoining district park and as biofertilizer for growing new plants to increase the green patch in the region. This, of course, cannot happen without proper education, community proactiveness, coordination between gardeners and residents and needs to be supervised by any person who has been doing composting or a person who is a compost expert.

Telephonic Interview with Mrs. Anita (composting at home)

Highlights of compost and its use for plantation

Interviewee
 Mrs. Anita is a woman passionate about composting, living in Delhi, the capital of India. She is 53 years old yoga teacher. She has been composting her kitchen waste for 3 years and started learning about it when she was 50 years old. She is inspiring people around her to convert their kitchen waste into nutrition for soil and plants.

Interviewer
 Pamika Gupta is a Master's student studying Environment and Natural Resources at University of Iceland.

Personal Interview Details
 Date: 23-Nov-2021
 Duration: 30 Minutes
 Mode: Over phone call

"Everybody should make compost at home. It's fun and helps reduce the management of solid waste at landfills."
 ~ Mrs. Anita

Figure 8. Telephonic Interview Part-A

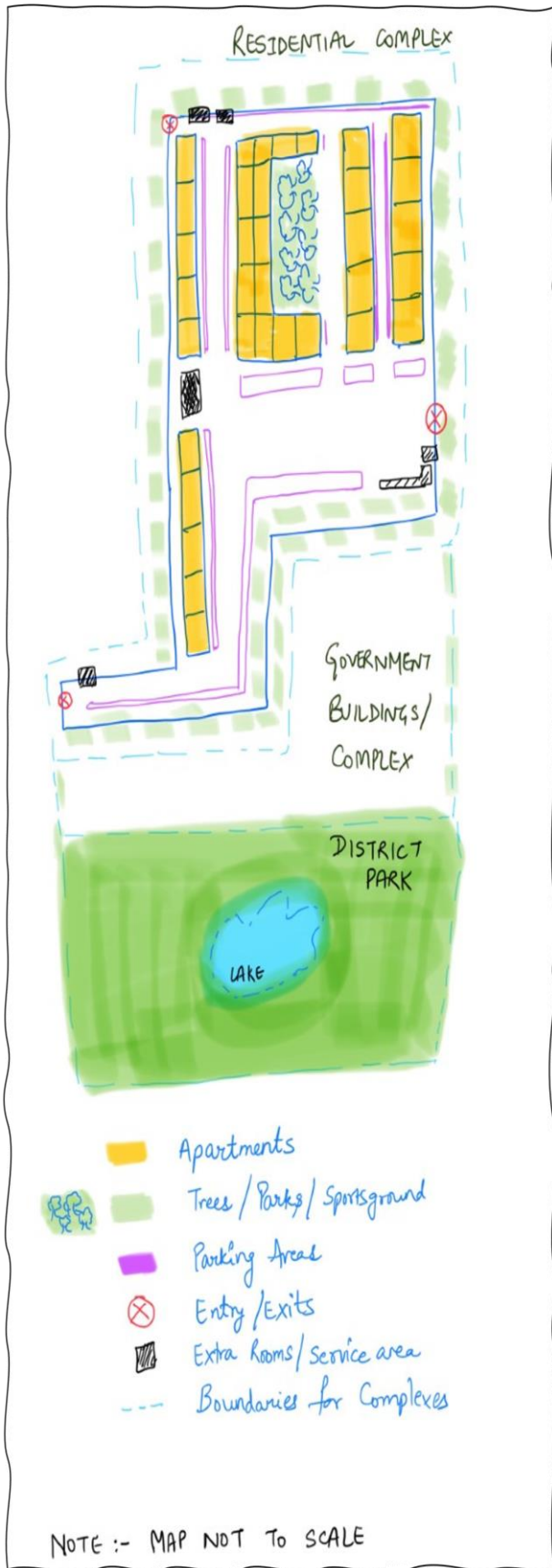


Figure 10. Community Map for suggested idea

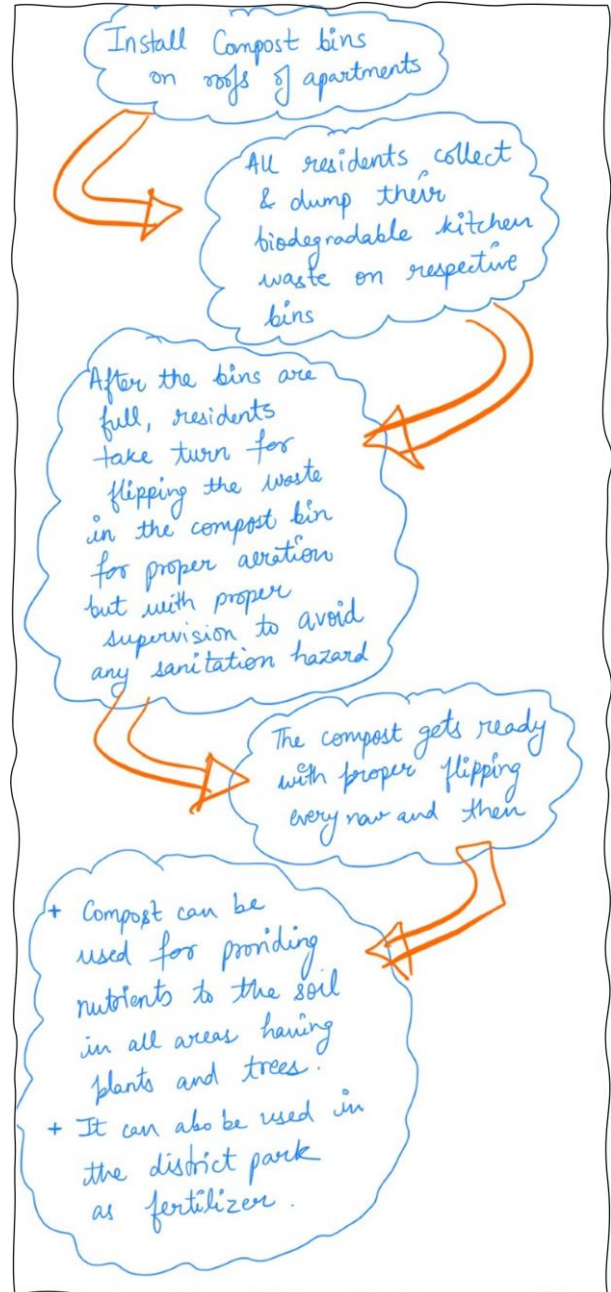


Figure 11. Community composting steps

7. DISCUSSION & CONCLUSION

Composting has been practiced since ages and being a biological decomposition process, it has its advantages and limitations. Considering the data collected by World Bank on waste generation, composition, disposal, and treatment, it is clear that organic waste forms a major portion of the waste and composting organic waste seems to be a good bet for solving the crisis of increasing piles of waste in landfills. It becomes clear that every individual can follow composting methods that require minimum cost, time and technological investments and still contribute towards waste management by dealing with waste at the source. Local solutions and initiatives can help better as compared to a centralized approach and composting activities can be modified based on the region. This also makes people aware of their consumption habits and helps in bringing behavioral changes. Incentivizing composting initiatives can also motivate

communities to cooperate and start composting. Citizen engagement and participation is key in composting and should be kept in mind while making policies. Composting, even with its list of challenges, has the potential to kill two birds with one stone: the problem of waste management and greenhouse emissions from the open dumps or landfills.

8. ACKNOWLEDGMENTS

The author is grateful to the professors and administration at University of Iceland for providing the opportunity, resources, support, and invaluable insights. The author expresses gratitude to Mrs. Anita for agreeing to be interviewed. The author is also thankful to family, friends and colleagues for the continuous motivation.

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