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PORTABLE BIO COMPOSTER BIN FOR THE MANAGEMENT OF HOUSEHOLD WASTE

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ABSTRACT:

Waste is any substance that is discarded after primary use or is worthless, defective, and of no use. Food waste represents the largest fraction of the municipal solid waste generated and its management is associated with suboptimal performance in environmental, health, and social dimension. It includes the action to reduce waste through material efficiency, waste reduction, and the recovery reusing of discarded material. Composting is one such effective manner that can be followed in the house for waste management. No nuisance or danger to public health and safety is to be caused by waste and effluent disposal system. Among these, a Portable bio composter bin provided by the Kerala government followed by aerobic digestion coupled with effective nutrient and energy recovery is, according to the findings, the preferred option to improve the sustainability of the current system in all dimensions considered. The nutrient analysis of the compost is carried out to check the stability and quality. Results showed that moisture content is slightly above the permissible limit whereas the pH, total nitrogen, phosphorus, and potassium came under the optimum limits. The results also suggested that the composting of waste using potable bio bin composter was feasible and its applicability is continuous. This technique also fulfilled the objective of producing quality compost, which was suitable for agricultural use.

KEYWORDS:

WASTE, HOUSEHOLD WASTE MANAGEMENT, COMPOSTING, ENVIRONMENT, PORTABLE BIO COMPOSTER BIN, NUTRIENT ANALYSIS.

INTRODUCTION

Waste management in rural and remote areas poses major challenges for governments of developing countries. The waste management budgets of local municipalities are limited and even more so in rural and remote areas (Jouhara et al., 2017). Municipalities in such areas usually face obstacles with the collection of waste. They also lack proper equipment, infrastructure, and treatment centers and experience difficulties accessing treatment centers elsewhere. These obstacles contribute to other problems, such as littering and illegal dumping. Waste refers to anything that the owner does not want anymore and wants to discard or dispose of, whether it can be reused, recycled, recovered, or not. Municipal Solid Waste (MSW) includes predominantly household waste (domestic waste), as well as some commercial waste. Household waste is generated through household activities, such as cooking, sweeping, cleaning, fuel burning, repairs, and gardening. It also includes used products or materials, such as old clothing, old furnishing, retired appliances, glass, paper, metal packaging, and old books and newspapers (Jouhara et al., 2017).

Municipal waste management is positively influenced by the proper handling of waste at the household level. Proper waste handling includes re-use, recycling, and composting practices and can only be achieved if households separate and sort their waste. However, separation-at- source programs in rural communities are usually non-existent due to a lack of facilities. Waste management is, therefore, not only the responsibility of the municipality but also that of households. The key starting point to enhance the 'reduce, reuse and recycle approach' is to analyzed waste management practices of households (Pamnani et al., 2014).

WASTE

Waste is an unavoidable by-product of most human activity. Waste (or wastes) are unwanted or unusable materials. Waste is any substance that is discarded after primary use or is worthless, defective, and of no use. Excess waste deposited over the open area is shown in Fig.1. A waste product may become a by-product, joint product, or resource through an invention that raises a waste product's value above zero Economic development and rising living standards in the Asian and Pacific Region have led to increases in the quantity and complexity of generated waste, whilst industrial diversification and the

provision of expanded health-care facilities have added substantial quantities of industrial hazardous waste and biomedical waste into the waste stream with potentially severe environmental and human health consequences (Jouhara et al., 2017); (Ugwu et al., 2021).

FIG. 1 EXAMPLE OF EXCESS WASTE DEPOSITED OVER THE OPEN AREA (UGWU ET AL., 2021)

SOURCES OF WASTE

A clear appreciation of the quantities and characteristics of the waste being generated is a key component in the development of robust and cost-effective solid waste management strategies (Rahman et al., 2020). The developed countries generate much higher quantities of waste per capita compared to the developing countries of the region. However, in certain circumstances, the management of even small quantities of waste is a significant challenge.

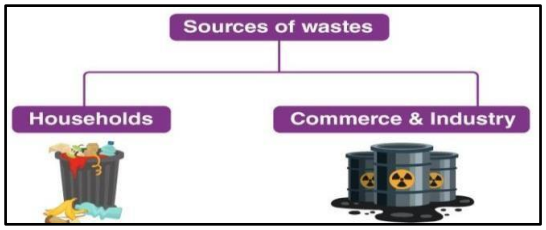

FIG.2 CLASSIFICATION OF THE WASTE GENERATED BASED ON SOURCE (TONINI ET AL., 2020)

Sources of waste can be broadly classified into four types: Industrial, Commercial, Domestic, and Agricultural and Fig.2 show the classification of the waste generated based on the source.

MUNICIPAL SOLID WASTE

The wastes, collected from the residential houses, markets, streets, and other places mostly in the urban areas, and disposed of by municipal bodies are called municipal solid wastes (MSW). In general, the urban solid wastes are called refuse. The Municipal solid wastes are a mixture of paper, plastic, clothes, metals, glass, organic matter, etc. generated from households, commercial establishments, and markets (Warunasinghe & Yapa, 2016). The proportions of different constituents vary from season to season and place to place depending on the lifestyle, food habits, standard of living, and the extent of commercial and industrial activities in the area. Municipal solid wastes are collected locally and the amount collected depends upon the size and consumption of the population.

INDUSTRIAL WASTES

Industrial wastes are released from chemical plants, paint industries, cement factories, power plants, metallurgical plants, mining operations, textile industries, food processing industries petroleum industries, and thermal power plants. These industries produce different types of waste products. Industrial solid wastes can be classified into two groups (Amasuomo & Baird, 2016).

NON-HAZARDOUS WASTES

These wastes are produced from food processing plants, cotton mills, paper mills, sugar mills, and textile industries.

HAZARDOUS WASTES

Hazardous wastes are generated by nearly every industry. Metals, chemicals, drugs, lather, pulp, electroplating, dye, rubber are some important examples. Liquid Industrial waste that runs into a stream from a factory can kill the aquatic fauna, and also cause health problems for humans. There might have various industrial products which have hazardous waste and it is shown in Table 1.

TABLE 1 INDUSTRIAL PRODUCTS AND HAZARDOUS WASTE

Products	Hazardous Wastes
Medicines	Organic solvents and residues, heavy metals (mercury and zinc)
Paints	Heavy metals, pigments, solvents, organic residues
Leather	Heavy metals, organic solvents

AGRICULTURAL WASTES

Agricultural areas produce plants and animal wastes. Excess use of fertilizer, pesticides, and other chemicals used in agriculture and the wastes formed from these causes land and water pollution. They also contaminate the soil. Among pesticides, chlorinated hydrocarbons, DDT, BHC, endrin, dieldrin, lindane, parathion, malathion, and endosulfan are important which are absorbed by the soil and contaminate crops grown in the soil (Nelles et al., 2016).

COMMERCIAL WASTES

With the advancement of modem cities, industries, and automobiles, huge amounts of wastes are generated daily. These include markets, roads, buildings, hotels, commercial complexes, hostels, auto workshops, printing press, etc. Hospitals, nursing homes, and medical institutes also release tremendous amounts of wastes that are hazardous and are much toxic (Rahman et al., 2020). Many chemicals and disposable items are also produced from

these units. These wastes are dumped in inhabited areas which pose much danger to human health and life and cause several types of infectious diseases. Apart from wastes, generated from the above sources, there are certain wastes produced from mining activities and radioactive substances that cause much damage to the society and environment.

TYPES OF WASTE

Biodegradable and Non- Biodegradable Waste and Its Difference

A lot of wastes on a daily routine and throw them away or discard them. These substances include kitchen waste like vegetables and fruit peels, empty cartons, used tea leaves, and so many expendable items like juices, plastic bags, paper, old clothes, old footwear, etc. Many of these materials like paper,

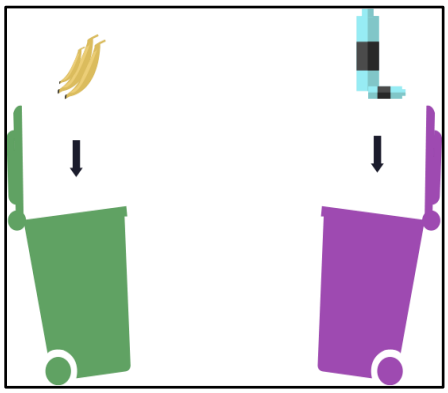

FIG.3 BIODEGRADABLE AND NON BIODEGRADABLE WASTES (DUBEY ET AL., 2020)

vegetable, and fruit peels can be easily broken down by the action of bacteria or other decomposers. Such substances which can be easily broken down by the action of bacteria are named biodegradable substances. Other substances or materials like plastics, metallic cans, and pesticides that cannot be broken down easily by biological processes are named non-biodegradable substances (Tonini etal., 2020). There are tons of waste materials that are degradable and non-degradable. Therefore, classification and proper disposal of wastes are necessary. Waste materials can be categorized as biodegradable and non- biodegradable as shown in Fig. 3. Risk and threats associated with waste disposals can be easily evaded by the knowledge on forms of wastes.

BIODEGRADABLE WASTE

A biodegradable material or substance can be defined as a material that can be decomposed easily by bacteria or any other natural organisms and not being part of pollution. Biodegradable wastes are the waste materials that are and can be easily degraded by natural factors like microbes (example; bacteria, fungi, and a few others), abiotic components like temperature, UV, oxygen, etc. few examples of such wastes are kitchen wastes, food materials, and other natural wastes. Microorganisms and other abiotic elements work together to break down complex substances into simple organic matters which finally suspend and disappear into the soil. The whole process is natural which can be fast or slow. So, the environmental issues and risks caused by biodegradable wastes are very low (Slorach et al., 2020).

But the giant dumping of waste can increase some threats to life sooner or later. To prevent this, some people practice known as composting. In composting, the biodegradable wastes are dumped into a big pit and covered for some time. During this the action of microbes, they will decompose and will be used as compost for cultivation purpose. This will reduce the quantity of waste at landfills.

NON-BIODEGRADABLE

A Non-Biodegradable material can be defined as a type of material that cannot be broken down by natural organisms and serve as a source of pollution. Unlike biodegradable wastes, non-biodegradable wastes cannot be easily taken care of. Non- biodegradable wastes are those which cannot be decomposed or degraded by natural agents. They remain on earth for thousands of years without any degradation or decomposition. Therefore, the threat caused by them is also more dangerous. An example is a plastic which is usually used in almost every area. To give these plastics a long-lasting outcome, better quality plastics are being used. This made them more temperature resilient and tougher even after the use. The difference between the biodegradable and non- biodegradable material is shown in Table 2. Other cases are cans, metals, and chemicals for agricultural and industrial uses(Slorach et al., 2020).

TABLE 2 DIFFERENCE BETWEEN BIODEGRADABLE AND NON-BIODEGRADABLE WASTE

Sl.No	Biodegradable waste	Non-Biodegradable waste
1	The degradation process in Biodegradable waste is fast	The degradation process in Non- Biodegradable waste is slower than in biodegradable
2	Biodegradable waste is decomposed and degraded by microbes or microorganism	Non-Biodegradable waste cannot be decomposed by microbes or naturally
3	Biodegradable waste is not collected but is used up in a short time	Non-Biodegradable waste is often collected
4	Biodegradable waste has become	Most of the Non-Biodegradable waste can never enter biogeochemical cycles, very slow and more harmful for the earth
5	Biodegradable waste used to generate energy as compost and biogas	Non-Biodegradable waste can be separated and recycled but the process is very costly

WASTE MANAGEMENT

Waste management (or waste disposal) includes the processes and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment, and disposal of waste, together with monitoring and regulation of the waste management process and waste- related laws, technologies, economic mechanisms (Safari et al., 2018). Waste can be solid, liquid, or gaseous and each type has different methods of disposal and management. Waste management deals with all types of waste, including industrial, biological, household, municipal, organic, biomedical, radioactive wastes. In some cases, waste can pose a threat to human health. Health issues are associated throughout the entire process of waste management (Kim et al., 2016).

Health issues can also arise indirectly or directly. Directly, through the handling of solid waste, and indirectly through the consumption of water, soil, and food. Waste is produced by human activity, for example, the extraction and processing of raw materials. Waste management is intended to reduce the adverse effects of waste on human health, the planetary resources, and aesthetics.

NEED FOR WASTE MANAGEMENT

Planning the waste management and recycling for all of the rubbish produced in this country is an enormous task that involves both logistical planning and scientific knowledge and understanding to balance the impact on the environment and the cost-effectiveness of the process. Waste management and recycling companies are also feeling extra pressure to perform their role in the greenest ways possible. Waste collection and rubbish disposal play an extremely important role in the global cleanliness and sustainability drive, with people's health and the conservation of resources being the responsibility of every government (Vigneswaran et al., 2016). To ease the pressure on government agencies, numerous privately-managed organizations also play a part in these waste management and recycling programs. In many cities, it means that local government agencies have been left with the responsibility of overseeing the work done by these privately-held organizations.

FIG.4 WASTE COLLECTION TRUCK THAT IS EFFICIENTLY USED TO CONTROL THE WASTE DISPOSAL

Waste collection companies also sort the garbage into recyclable columns, as recycling the products that leave our homes is of utmost importance. Fig. 1.4 represents the Waste collection truck that is efficiently used to control waste disposal. Recycling not only helps in conserving our natural resources but also reduces the cost of production of many products. Products such as glass, oil, plastic, paper can all be recycled which will ultimately put less pressure on the natural resources used to manufacture these products.

DIFFERENT WASTE MANAGEMENT SYSTEMS

"Waste management or Waste disposal is all the activities and actions required to manage waste from its inception to its final disposal. This includes amongst other things, collection, transport, treatment, and disposal of waste together with monitoring and regulation. It also encompasses the legal and regulatory framework that relates to waste management encompassing guidance on recycling etc."(Burgess, 2013). Those groups include source reduction and reuse, animal feeding, recycling, composting, fermentation, landfills, incineration, and land application. Among which composting is the most major technique that can be followed over the household.

COMPOSTING

Composting is an easy and natural bio- degradation process that takes the organic wastes remains of plants and garden and kitchen waste and turns it into nutrient-rich food for your plants. Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose them. The process, however, has its downsides. Some people have found it to be slow, while others have observed that it takes a lot of space (Rahman et al., 2020).

MUNICIPAL SOLID WASTE MANAGEMENT IN INDIA

Municipal solid waste management (MSWM) involves various activities associated with the generation, storage, collection, segregation, transfer and transport, processing, and disposal of solid waste in an environmentally compatible manner, adopting the principles of economy, aesthetics, and energy and conservation (Pamnani, 2014).

ROLE OF GOVERNMENT AND PRIVATE AGENCIES IN MANAGING WASTE

According to the Indian Constitution, the responsibility for solid waste management is under the purview of the state government and the urban local bodies (ULBs). MSWM is governed by the Municipal Solid Waste Management and Handling Rules, 2016. The rules designate ULBs as solely responsible to manage solid waste in their area and direct that ULBS be responsible for the management of municipal solid waste within their territorial area and be responsible for the implementation of the provisions of these rules, and any infrastructure development for collection, storage, segregation, transportation, processing and disposal of municipal solid wastes (Pamnani, 2014). However, GoI, state governments, and various institutions in the country, including the Planning Commission and the National Institute of Urban Affairs, have brought the requisite

knowledge and advocacy to deal with this subject. Currently, waste management is one of the pressing issues that GoI is dealing with under its flagship programs such as the Smart City Mission and the Swachh Bharat Mission (Safari et al., 2018).

TYPES OF COMPOSTING

Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting is an organized method of producing manure by making use of this natural phenomenon. Composting can be carried out in two ways:

» Aerobic (in presence of oxygen)

» Anaerobic (in absence of oxygen)

AEROBIC COMPOSTING

Aerobic microorganisms oxidize organic compounds to carbon dioxide, nitrite, and nitrate. Carbon from organic compounds is used as a source of energy while nitrogen is recycled. Due to the exothermic reaction, the temperature of the mass rises. Aerobic composting takes place when you use above-ground containers, a freestanding pile, or a simple basket with perforations. As long as the air is available, aerobic decomposition takes place much faster than the anaerobic method, meaning you do not have to wait long for the compost to form (Dubey et al., 2020). However, if during the process supply of oxygen gets limited, the process may slow down. Usually, the bacteria that break down the food also release a lot of heat. This heat kills off most of the pathogens present and makes composting safe. Ideally, the composting process is free of any foul odor. Adding brown parts such as twigs, fallen dry leaves, coffee or coconut fiber like moisture-absorbing materials can help. A well-made compost pile has a very pleasing, earthly aroma.

ANAEROBIC COMPOSTING

Anaerobic decomposition takes place in conditions of lack of oxygen supply, primarily in underground pits. During the process, anaerobic micro-organisms break down the organic compounds through a process of reduction. A very small amount of energy is released during the process and the temperature of composting mass does not rise much. The gases generated are mainly methane and carbon dioxide. An anaerobic process is a reduction process and the final product is subjected to some minor oxidation when applied to land. In this type of composting, just need to dig a hole and prepare an organic mix to fill it. Seal the hole with a layer of soil and the process begins. Typically, anaerobic digestion takes longer than the aerobic digestion process. Compost is the final product of a composting process that has fertilizer value and is safe to be used as manure.

The compost obtained can be checked for its quality before use. The following parameter needs to check:

» pH

» Moisture content

» C/N ratio

» Nitrogen

» Potassium

» Phosphorus

METHODS OF COMPOSTING

Composting means breaking down organic material. There are three kinds:

aerobic, anaerobic, and vermicomposting. Each has its pros and cons. Households, farms, restaurants, schools, offices, and places of business produce compostable materials. For example, food scraps, grass clippings, leaves, animal manure, and coffee grounds are all compostable. Composting is useful for making inexpensive fertilizer for lawns, gardens, and farms. Here is a run-down of each type composting Methods

Traditional backyard composting is typically achieved by:

- Direct Composting (in-ground composting)
- Tumbler Composting (A form of hot composting)
- Worm Farm Composting (Vermicomposting)
- EMO Composting (Bacteria composting)
- Combination Composting (Compot Composting)
- Commercial Composting
- Mechanical Composting
- Elements are generally required in most systems to produce compost.

OPEN AIR COMPOSTING

Open Air Composting is traditionally a pile of green and brown matter in the backyard. More often than not it is a bay constructed of anything that gets hands-on that is cheap and easy to put together. Or it might have a couple of bins upturned sitting on the ground like the Gedye bin that can buy in a shop (Slorach et al., 2020).

DIRECT COMPOSTING

Direct Compost is simply digging a hole or trench in the ground and burying your scraps. It is also probably the oldest and most effective method of composting, but like all other methods of composting it too has its limitations.

TUMBLER COMPOSTING

Tumbler Composting comes in many shapes and sizes of single to double units that may purchase commercially from the local hardware store. For many people, this is a great system if it is relatively strong and keen to turn it every day or every few days. For others, it is hard work especially if they are getting on in years. But it can get some mechanized ones that make turning easier **(**Dehghani et al., 2018). Often need two of these systems so it can let one sit for a few months to fully decompose before you empty it.

WORM FARM COMPOSTING

Worm Farm Composting for many is the most common and preferred choice of composting because of their capabilities to grow worms, produce compost and compost tea and keep rats out of your compost. Local Worm Types: South Australia Red Worms (Lumbricus rubellus) and Tiger

worms (Eisenia fetida) under ideal conditions are said to rapidly reproduce 8 to 1500 worms. The Tropics use Pontoscolex corethrunus or Pheretima group, commonly found in gardens, Fishing worms are not good for composting (Vigneswaran et al., 2016).

EMO COMPOSTING

EMO Composting or Effective Microorganisms is a system generally used for indoor composting but can be used by anyone who likes this method of composting. The most common product using EMO's is the Bokashi but other indoor systems can use it plus there are some systems that use a carbon filter in the lid as well to filter odors. Generally speaking, it needs two of these, so while one is sitting the other is being filled. It can collect juice to use in the garden. But they cannot put everything from your kitchen in the Bokashi System. It can buy the EMO online through many sites selling the Bokashi System. It can use the EMOs in other systems if it desires to aid the composting process.

COMBINATION COMPOSTING

Combination Composting or Compot Composting is a combination method of open- air composting, direct composting, vermicomposting, and EMO composting. All the elements of composting are used and will suit most household circumstances. For some people, it too has its challenges (Slorach et al., 2020). It can compost 'ALL' your kitchen waste and not just 'some of it. So ultimately have over 50% less waste each week to put in the council bin. Just Fill…Forget…Refill…when ready and give it a good cleanout once a year. It is faster and requires less work than most other composters (Kim et al., 2016).

COMMERCIAL COMPOSTING

Commercial Composting is different from backyard composting and uses different materials. sawdust, pine bark, sand plus ferrous sulfate, and maybe some sulfate of ammonia all mixed. It is usually turned in every 3 to 4 days and is generally ready in 6 weeks for bagging. There is not much nutrient value in a cheap commercial compost (Slorach et al., 2020). But there are small independent commercial compost companies that produce a better-quality product, then the large commercial compost companies. They are however more expensive. Some producers such as McLeod's Agriculture are certified organic as well. The old saying "you get what you pay for" certainly applies to commercial compost.

The cheaper commercial compost is a good filler for raised garden beds or to backfill Compost in clay or sandy soil. Or, it can be used to mix with composted soil to fill a pot plant perhaps.

MECHANICAL COMPOSTING

Mechanical Composting is an efficient method of composting that uses electricity to create the heat required and rotation of the contents required to produce semi-composted waste literally within a 24 hour period. This system suits restaurants, hotels, motels, hospitals from many people (Jouhara et al., 2017).

SIGNIFICANCE OF THE PROJECT

The growing amount of waste produced in modern society has a huge impact on the environment. Many of the materials disposed of in the general waste bin can last in the environment anywhere from hundreds to thousands of years (JR Richards & NetWaste, 2017). The existence of this waste in the natural environment can cause significant impacts on plants, animals, and Pollution. If a landfill site is not properly sealed, a toxic pollutant known as leachate can escape into the surrounding groundwater causing environmental problems for plants and animals living downstream. Leachate is a liquid pollutant caused by waste breaking down that contains high levels of heavy metals, chemical compounds, pesticides, and solvents that filter down into the bottom of a landfill site (Jouhara et al., 2017).Many modern landfills created today have a sealed barrier to prevent liquid pollution from entering groundwater, however, the growing level of waste generation can increase the risk of leachate pollution. Around 80% plastic litter found in the ocean has traveled there from inland waterways (Slorach et al., 2020). Municipal waste management systems for domestic use could eliminate or significantly reduce the stage of waste collection and transportation. It is necessary to reduce the waste from the home itself. So efficient techniques such as composting can considerably reduce the biodegradable waste from the house itself.

OBJECTIVES OF THE PROJECT

The objectives of this project are as follows:

- To study the effectiveness of the portable bio composter bin
- Preparation of compost from vegetable waste through portable bio bin composter
- To study the nutrient analysis of the compost obtained from the vegetable waste
- To reduce the household waste by converting it into compost

2. METHODS AND METHODOLOGY

STUDY OF PORTABLE BIO COMPOSTER BIN

A natural process of conversion of organic solid wastes which are bio-degradable, into manure using composting agents like bacteria/microorganisms or composting in other words is an eco-friendly and organic method of manure making. Portable Composter Bins are easy-to-use 3 bin composters that take up minimal space to give out organic manure from your kitchen waste without producing any foul smell. The portable bio composter bin is shown in Fig.5. The holes on the sides permit ample ventilation during the process (Biddinika et al., 2017). The composter bin is made of durable and quality material designed to last longer. The bottom lid will act as an ant trap upon pouring sufficient water.

FIG. 5 THE FIGURE SHOWS A TYPICAL PORTABLE BIO BIN COMPOSTER

PORTABLE BIO BIN COMPOSTER PROVIDED BY KERALA GOVERNMENT

The city corporation's decision to vest the ownership of kitchen bins handed out to households with itself has come in handy in the wake of a new order from the state government which says that corporations should do away with waste-management schemes which entail the free or subsidized distribution of facilities and equipment (Ghosh, 2016). The order says that while formulating schemes for waste management using plan funds for 2020-21, corporations shall not include projects in which they distribute equipment either in a subsidized or free-of-cost manner. The exemption is given only to beneficiaries from the BPL category (Jayaprakash et al., 2018). The corporation which had made use of subsidies to propagate biogas plants and pipe-compost units had found itself in a fix when it was pointed out that subsidies had been used up and hence could not be used for kitchen bins. Besides, it was required to get a revised sanction from the coordination committee. It was at this juncture that the project secretariat of the city corporation dealing with sanitation and waste management pitched the idea of owning kitchen bins being distributed to individual households. Kitchen bins are considered the corporation's property and are given for free to residents on the condition that it is returned whenever the resident leaves the city permanently (Jayaprakash et al., 2018). Till now, 15,383 kitchen bins have been installed in households and 50,000 more are to be installed in a phased manner.

SITE THE LOCATION FOR THE COMPOST BIN

Select a dry, shady spot where the compost pile or bin can be placed. Add brown and green materials as they are collected, making sure larger pieces are chopped or shredded. Moisten dry materials as they are added. Once your compost pile is established, mix grass clippings and green waste into the pile and bury fruit and vegetable waste under 10 inches of compost material. Fig.6 shows the minimum space consumed by the portable bio bin composter. Optional: Cover top of compost with a tarp to keep it moist.

FIG. 6 THE MINIMUM SPACE CONSUMED BY THE PORTABLE BIO BIN COMPOSTER

STEPS IN COMPOST BIN

a. COLLECTION OF ORGANIC WASTE

Manage a bucket with having a lid to collect the organic waste. Collect the home organic waste and cut them into small pieces (1 to 2-inch pieces) and put them in the bucket. Fig. 7 shown is the portable Bio bin composter with specified holes for proper aeration. Transfer the chopped waste to the bin and remain closed to the bucket all the time. Thereafter, go on collecting wastes in the same bin.

FIG. 7 IMAGE SHOWN IS THE PORTABLE BIO BIN COMPOSTER WITH SPECIFIED HOLES FOR PROPER AERATION

b. TRANSFERRING THE WASTE IN THE BIN

Put the collected waste in the bin once a day either in the morning or in the evening. Fig.8 represents the collected vegetable waste and which is further transferred to the portable compost bin. Check the waste materials that whether the wastes are cut into pieces or not and if some are left unchopped, do pieces and pour them in the bin. Put a layer of inoculum at the bottom of the bucket.

FIG.8 IMAGE REPRESENTS THE COLLECTED VEGETABLE WASTE AND WHICH IS FURTHER TRANSFERRED TO THE PORTABLE COMPOST BIN

c. SURFACE LEVELLING INSIDE THE BIN

After putting the waste inside the bin, the surface of the waste heap should be leveled by a small shovel so that it could not be heaped in a place or corner. This will result in uniform distribution of air, moisture, and inoculums in the waste. Separate your kitchen waste (vegetable, fruit, small amount of wasted food) and add it daily in the bucket/bin. The leveled surface of the waste is shown in Fig. 9.

FIG. 9 THE FIGURE SHOWS THE LEVELED SURFACE OF THE WASTE WITH INOCULUM

d. SPRAYING OR MIXING OF INOCULUMS

Spray approximately one tea glass of EM (active liquid) or some Bokashi powder or available surface soil (topsoil) or compost over the waste. The lid of the bin has to be immediately closed and should be remained closed. If the compost production rate has reduced due to poor decomposition, then spray the EM once or twice a week for better decomposition. The large pieces of undecomposed waste can be reused as inoculums by mixing over waste or putting back in the bin which was un sieved during sieving compost for sale or own use.

e. FREQUENT ADDITION OF WASTE MATERIALS

Have a regular practice of putting waste in the bin and if the wastes are too moist or waste includes only fresh vegetables it will be better to wither them in shade and pour in the bin.

f. TIME TAKEN FOR COMPOST DECOMPOSITION

In general, compost is prepared within three months but it can be prepared in two months if good inoculums could be used. Compost, Bokashi, and EM are good inoculum for composting. Fig. 10 shows the organic manure prepared from vegetable waste.

FIG.10 THE ORGANIC MANURE PREPARED FROM VEGETABLE WASTE IS SHOWN.

STUDY OF CHEMICAL PARAMETERS

MOISTURE CONTENT

Moisture is a critical factor in establishing stable conditions conducive for composting because the microbes need moisture for survival and growth. Moisture tends to occupy the free airspace between the decomposing particles (Vijayalakshmi, 2020). Hence, when the moisture content is very high, anaerobic conditions set in. Biological activity will slow if the compost heap starts to dry and will virtually cease if it dries out as most of the desirable compost creatures become dormant or die. The determination of moisture content is easy as a weight of 5g of the prepared material in a clean weighed Petri dish and heat it in an oven for 5 hours at 65◦± 1 ℃ to constant weight. Later on, cool it in a desiccator as in Fig. 11 and weigh and identify the loss in weight as moisture content (Peña et al., 2020). The in-home composting moisture content of between 40% - 60% is normally recommended. Within the optimum in this range, a thin water film will cover the particles of the material being composted but will not fill the air spaces (pores) between and around the particles (Jones, 1982). If there is insufficient moisture (<30%) bacterial activity is inhibited and this can be a problem during hot dry periods, On the other hand too much moisture (>70%) results in slow decomposition, odor production in anaerobic pockets, and nutrient leaching.

FIG. 11 THE COMPOST PLACED OVER A PETRI DISH TO CHECK THE MOISTURE CONTENT

DETERMINATION OF pH

When compost is done and ready for use, it has a pH of between 6-8. As it decays, the compost pH changes, meaning that at any point in the process the range will vary. The majority of plants thrive at a neutral pH of

around 7, but some like it more acidic or alkaline. To test the pH of the sample, transfer 25g of the manure sample to a 100 ml beaker and add 50 ml of water and the collection of the sample to be checked is shown in Fig. 12. It can be kept for suspension over a rotary shaker for 2 hours and then filter through the Whatsman No.1 or equivalent filter paper under vacuum using a Buchner funnel and the pH value of filtrate can be recorded by pH meter.

FIG. 12 THE TESTS CARRIED OUT TO DETERMINE THE PH OF THE MANURE IS SHOWN IN THE FIGURE

ESTIMATION OF PHOSPHORUS

A common and traditional practice has utilized manure as an organic fertilizer or soil improver due to its contribution to organic matter and nutrients, mainly nitrogen and phosphorus. The laboratory treatment of the compost for the estimation of phosphorus content is shown in Fig. 13. P content in compost is quantified as total P, but within this total, neither the quantities nor the available P species is entirely clear. Compost application in intensive cropping system soils often exceeds P uptake owing to an accumulation of P species which are unavailable or not readily available. It has been determined that high levels of total P in soil amended with compost increased fixed-form P with Fe, Al, and Ca.

FIG. 13 THE LABORATORY TREATMENT OF THE COMPOST FOR THE ESTIMATION OF PHOSPHORUS CONTENT

ESTIMATION OF POTASSIUM

Potassium in finished compost is much more available for plant uptake than nitrogen and phosphorus since potassium is not incorporated into organic matter. However, much of the potassium can be leached from the compost since it is water- soluble. In one study, potassium levels were reduced by 25% when compost finished undercover was left uncovered in the open over winter. The estimation of potassium is carried out by flame photometer instrument which is shown in Fig. 14.

FIG. 14 THE FLAME PHOTOMETER USED TO DETERMINE THE POTASSIUM CONTENT

ESTIMATION OF TOTAL NITROGEN

Total nitrogen includes organic, ammonium, and nitrate nitrogen. The normal range for total nitrogen in finished composts is 0.5 to 2.5 on a dry basis. Ammonium levels decrease as the maturity of the compost increases.

Ammonium levels may be high during the initial stages of the composting process but will decrease as maturity increases. Organic nitrogen is determined by subtracting the ammonium and the nitrate-nitrogen (an optional test) from the total nitrogen. However, since nitrate- nitrogen levels are generally very low, total nitrogen minus ammonium nitrogen will give a good estimate of organic nitrogen in most composts.

3. RESULT AND DISCUSSION

MOISTURE CONTENT

The air spaces allow air and water to circulate through the organic material. At the lower end of this moisture range, between 40-45%, the compost heap will be able to absorb additional moisture, as greens and food waste is added, while providing an allowance for a limited amount of rain to add extra moisture to the heap. The moisture content obtained is 67.98% which is a little bit more than the normal permissible limit. The in-home composting moisture content of between 40% - 60% is normally recommended. Within the optimum in this range, a thin water film will cover the particles of the material being composted but will not fill the air spaces (pores) between and around the particles. If there is insufficient moisture (<30%) bacterial activity is inhibited and this can be a problem during hot dry periods, On the other hand too much moisture (>65%) results in slow decomposition, odor production in anaerobic pockets, and nutrient leaching as shown in table 3 (Jouhara et al., 2017).

TABLE 3 DIFFERENT MOISTURE CONTENT AND ITS EFFECT

Moisture content (%)	Effects
<30%	Bacterial activity is inhibited

40-60%	Normally recommended
>65%	Slow decomposition

During the main composting stage, higher moisture content, in the region of 50-55%, may be recorded. Increasing the moisture content to 55% - 60% is desirable at the start of the summer, or dry season, to allow for an increased rate of evaporation during hot and dry weather. During the maturation stage, the slightly lower moisture content is desirable, as the compost will become lighter making it easier to mix to make seed or potting compost or to use in the garden.

DETERMINATION OF pH

When compost is done and ready for use, it has a pH of between 6-8. As it decays, the compost pH changes, meaning that at any point in the process the range will vary. The majority of plants thrive at a neutral pH of around 7, but some like it more acidic or alkaline. The pH of the compost obtained is 6.34. Most finished composts will have a pH value in the range of 5.0 to 8.5 (Jouhara et al., 2017). A lower pH is preferred for certain ornamental plants while a neutral pH (pH 7) is suitable for most applications.

ESTIMATION OF PHOSPHORUS

According to the Indian standards, TP contents in the compost are usually expressed as P_2O_5 (Phosphorus Pentoxide) in terms of percentage concentration per dry weight. When evaluated with the lower limits specified in the Indian compost standards, it can be understood that the compost has nearly phosphorous (0.685%) in the sample. The low range of phosphorus depends on the type of food habit of the locals and feedstock in composting. To maximize the chemical and physical availability of the TP in feedstock, monitoring is required during the composting process. If P exceeds 0.7 percent, the compost feedstocks likely included manure. If P content is below 0.3 percent, consider supplemental P fertilizer application if a soil test indicates need. The current compost has optimum phosphorus content (Shafique et al., 2021).

ESTIMATION OF TOTAL NITROGEN

To denote, compost as having fertilizing capabilities and for it to be used in agriculture, TN content must be approximately 1%, by dry weight. However, the typical TN in compost is recommended to be ranging from 1.0 - 3.0%, dry weight. The compost with low TN levels (>1%) is better used as mulch and those over 3% are usually found to be immature and ammonical as shown in table 4 So in this reference, when Compost test results (2.8%), it can be observed that though falling within the typical range, the TN contents in the test sample was marginally higher than 1%., which is good for plant growth (Jouhara et al., 2017).

TABLE 4 TOTAL NITROGEN CONTENT AND EFFECTS

SL No.	Total nitrogen content	Effects
1	<1.0%	Used as mulch
2	1.0-3.0%	Recommended
3	>3.0%	Immature and ammonical

ESTIMATION OF POTASSIUM

Potassium is another essential macronutrient that is responsible for overall plants growth viz., for water uptakes, plant sugars synthesis, crop formulation, etc. Potassium in its available form in compost exists as K_2O (Potassium Oxide) and the amount it exists in compost depends on the feedstock and the composting process (Nelles et al., 2016). However, its concentration in the compost is not usually high as it can be easily leached from the feedstock during the composting process. From the analysis, it can be observed that the test results of compost 2.82% has a relatively higher concentration of K i.e. nearly 1.6% greater than the lower limit specified in the Indian Standards (1.2% minimum) Low levels of nutrients may indicate incomplete decomposition or low amount of nutrients in the original material (Tonini et al., 2020)

4. CONCLUSIONS

The weakest points of centralized waste management systems are the transportation of waste to large processing facilities, and the complex waste separation systems required. Garbage treatment in households offers the opportunity to eliminate the inconvenience of extended waste management systems. The most common waste management system at the domestic level is composting, which provides the opportunity of returning the nutrients contained in the biomass back to the soil. The consumer can obtain good quality fertilizer. However, it needs time and this portable bio composter bin took one month for converting the vegetable waste into compost. The compost obtained from the portable bio composter bin yielded high-quality manure. The nutrient analysis is carried out over the manure. The yielded moisture content is 67.98% which is slightly above the permissible limit, whereas the other parameters such as pH, phosphorus content, potassium content, total nitrogen content belonged within the recommended limit. The pH is about 6.34 and is satisfied as it should be between 6-8. Also, the other parameters constituents the appropriate value required for a natural bio fertilizer. That is the phosphorus content is about 0.685%, the nitrogen content is 2.8% and potassium content is 2.82%. Thus, portable bio bin composters segregate the waste and minimize the actual waste by recycling biodegradable waste to make compost.

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