

AN OVERVIEW ON WASTE DISPOSAL MODELS

Abstract

This abstract presents a comprehensive overview on waste disposal models in India, addressing various types of waste, their decomposition rates, health implications of waste generation, and the imperative need for effective waste management strategies.

It examines the relationship between urban home gardening and waste management, exploring models available for managing kitchen waste at the household level. Additionally, it delves into specific cities in India implementing household waste disposal programs and the emerging trend of bio decomposer starter cultures for kitchen waste.

Furthermore, the abstract sheds light on agricultural and industrial waste disposal models in India and discusses existing community-based waste disposal models, emphasizing the principles and benefits associated with them. It highlights the emerging Extended Producer Responsibility (EPR) model and Zero Waste model, identifying cities in India implementing these approaches.

Moreover, it examines the integration of waste management models in India, detailing cities adopting an integrated approach and following the Waste Hierarchy Model for effective waste management. Finally, it emphasizes the principles and benefits of community-based waste disposal models, offering a comprehensive view of waste management strategies and implementations in India.

Keywords: Waste disposal, Population, Urbanization, Solid waste

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In 2016 the world generated approximately 2.01 billion tons of solid waste according to the World Bank reports, among the waste high income countries generated majority of the waste. By 2050 this amount is expected to increase approximately 3.40 billion tons, due to the growth of the world population and urbanization.

In addition to solid waste, the world also generates significant amounts of liquid and hazardous waste, as well as electronic and other types of waste.

According to the world bank reports in 2016 among the Asian countries i.e in East Asia and the Pacific Asia generated approximately 0.66 billion tons of solid waste, where as in South Asia it was 0.57 billion tons. This amounts to approximately one-third of the total solid waste generated worldwide.

In 2016 in India the solid waste generated was estimated to be around 62 million tons per year according to the Central Pollution Control Board (CPCB), This amount is expected to increase to approximately 165 million tons per year by 2030, as the population and urbanization in India continue to grow.

To improve the waste management practices the Government of India has implemented several programs and policies those are Swachh Bharat Abhiyan, the National Solid Waste Management Policy, and the Plastic Waste Management Rules. These initiatives aimed to promote reduction, reuse and recycling of waste to enhance the capacity of local communities and governments to manage waste effectively.

It is important to note that the generation of waste has significant environmental and public health impacts, including soil and water pollution, greenhouse gas emissions, and the spread of diseases. Effective waste management practices, including reducing, reusing, and recycling waste, can help to mitigate these impacts and promote a more sustainable and healthy environment.

The Waste Generated at Household Level is Divided in to Two Types

- Organic waste
- Inorganic waste

After certain period of time the organic waste starts decomposing.

I. DECOMPOSITION

Decomposition is the process by which organic matter breaks down into simpler, stable compounds through the action of bacteria, fungi, and other microorganisms. Decomposition occurs naturally over time, and the rate of decomposition varies based on the type of waste and environmental conditions, such as temperature, moisture, and presence of oxygen.

The Following are Some Common Types of Waste and Their Decomposition Times

- 1. Food Waste:** Food waste, including fruits, vegetables, and meat, can decompose within a few days to a few weeks in a compost pile, but can take much longer in a landfill where conditions are not optimal for decomposition.
- 2. Paper:** Paper products, such as newspapers, cardboard, and paper bags, can take a few weeks to several months to decompose in a compost pile, and several years to decades in a landfill.
- 3. Yard Waste:** Yard waste, including leaves, grass clippings, and branches, can decompose within a few months to a year in a compost pile, and several years to decades in a landfill.
- 4. Plastic:** Plastic products can take hundreds of years to decompose in a landfill, and may never fully decompose in the environment.
- 5. Glass:** Glass is a non-biodegradable material and does not decompose, but can be recycled and made into new glass products.

It is important to note that decomposition rates can be affected by a variety of factors, including the type of waste, environmental conditions, and the presence of other waste materials that can either promote or hinder decomposition. By using effective waste management practices i.e reducing, reusing, and recycling can help to reduce the amount of waste which ends up in landfills, where the decomposition rates are much slower.

II. WASTE GENERATION EFFECT ON HEALTH

Waste generation can have a important impact on human health, both directly and indirectly. Some of the ways in which waste generation can affect health include:

- **Contamination of Food and Water Sources:** Improperly managed waste can contaminate food and water sources, leading to the spread of diseases such as cholera, dysentery, and other waterborne illnesses.
- **Air Pollution:** Waste burning, especially in open dumping sites, releases harmful chemicals and particulate matter into the air, can be inhaled and lead to respiratory problems, such as asthma and bronchitis.
- **Vector-Borne Diseases:** Improperly managed waste can provide breeding grounds for pests such as mosquitoes and rats, which can spread diseases such as malaria, dengue fever, and leptospirosis.
- **Soil Pollution:** The waste which is not managed properly can contaminates soil and groundwater, which is leading to the spreading of harmful chemicals and pollutants and can be taken by the crops and will be entered in the food chain, affecting human health.

- **Chemical Exposure:** Improper disposal of hazardous waste, such as batteries and electronic waste, can lead to the release of toxic chemicals into the environment, which can harm human health if they are inhaled, ingested, or come into contact with skin.

1. Need of Waste Management In India: Waste management is critical in India for several reasons:

- **Environmental Protection:** India is facing a growing waste problem, with increasing amounts of waste generated by its rapidly growing population and urbanization. Improper waste management can cause impact on the environment, including air and water pollution, soil contamination, and the spread of diseases. Effective waste management is essential to protecting the environment and promoting sustainable development.
- **Public Health:** Improper waste management can also have serious impacts on public health, by contaminating food and water sources, spreading diseases, and exposing communities to harmful chemicals and pollutants. By implementing effective waste management practices, the risk of exposure to harmful substances and diseases can be reduced, promoting better public health outcomes.
- **Conservation of Resources:** Proper waste management can help to conserve valuable resources, such as water and energy, by reducing the need for new resources and minimizing the waste impact on the environment. Recycling and composting, can help to reduce the amount of waste that ends up in landfills, conserving resources and reducing greenhouse gas emissions.
- **Economic Benefits:** Waste management can also have significant economic benefits, including the creation of new jobs, the promotion of local industries, and the reduction of the cost of waste disposal. By implementing effective waste management practices, communities can realize these benefits, while also contributing to a cleaner and more sustainable environment.

In conclusion, effective waste management is essential in India to address the growing waste problem, protect the environment and public health, conserve resources, and promote economic development. By working together, communities, governments, and businesses can take action to reduce waste, promote recycling and composting, and implement sustainable waste management practices to provide a clean and healthier future for all.

2. Home Gardening in the Urban Areas Related to Waste Management: Home gardening in urban areas can play a role in waste management by promoting reuse and recycling of organic waste to reduce the amount of waste generated. Some of the ways in which home gardening can contribute to waste management include:

- **Composting:** Home gardening provides an opportunity for residents for making compost by using food scraps and yard waste which can be used as a fertilizer for their plants. It helps in reducing organic waste which ends up in landfills and helps to conserve the resources by reducing the need of chemical fertilizers.

- **Reduce Food Waste:** By growing their own food, residents can reduce their food waste by only growing what they need and using the produce when it is fresh and at its peak. This can also help to promote healthy eating habits and improve food security by providing access to fresh, locally-grown produce.
- **Green Space Creation:** Home gardening contributes to the creation of green space in urban areas, which can help to experience variety of benefits, including improved air and water quality, increased biodiversity, and a reduction in the urban heat island effect.
- **Education:** Home gardening can also provide an opportunity for residents to learn about waste management, composting, and sustainable living practices, which can help to raise awareness and encourage greater participation in waste management programs.

By promoting home gardening in urban areas, communities can help to reduce waste, conserve resources, and promote sustainable living practices. By working together, the communities, governments, and businesses can help to create a pure, healthier, and sustainable future for all.

3. Models Available to Manage Kitchen Waste: There are several models available for managing kitchen waste, including:

- **Composting:** Composting process involves breaking down of organic waste in to small pieces, such as food scraps, into a nutrient-rich soil amendment that can be used in gardening and agriculture. Composting can be done at home, in community gardens, or on a larger scale at industrial composting facilities.
- **Anaerobic Digestion:** Anaerobic digestion involves organic waste breaking down takes place in the absence of oxygen, which produces biogas, a renewable energy source, and a nutrient-rich fertilizer. This model is typically used on a larger scale, at commercial and industrial facilities.
- **Incineration:** Incineration involves burning the waste at high temperatures, reduces its volume and transforming it into ash and gases. Incineration is a widely used waste management method for managing solid waste, but it can be expensive and may have negative environmental impacts, such as air pollution and greenhouse gas emissions.
- **Landfilling:** Landfilling involves burying waste in a designated landfill site. This method is often used as a last resort for managing waste, as it can be expensive and may have negative environmental impacts, including air and water pollution, and the creation of methane, a potent greenhouse gas.
- **Recycling:** Recycling involves collecting and processing waste materials, such as paper, glass, and plastic, it can be reused as raw materials in the production of new products. This model helps to conserve resources, reduce waste, and promote sustainability.

The most appropriate waste management model for kitchen waste will depend on a variety of factors, including the type and amount of waste generated, the availability of infrastructure, and local regulations and policies. By considering these factors and working together, communities, governments, and businesses can develop effective and sustainable waste management programs that promote a cleaner and healthier future for all.

4. Household Level Waste Disposal Models

- **The 3R's Model (Reduce, Reuse, and Recycle):** This model emphasizes the importance of reducing waste generation, reusing items as much as possible, and recycling materials that cannot be reused.
- **The Linear Model:** This model follows a linear process of extracting raw materials, manufacturing products, using them, and then disposing of them. It emphasizes the need to reduce waste generation and promote recycling.
- **The Circular Model:** This model promotes a closed-loop system where materials are reused, recycled, or repurposed, and waste is minimized. It emphasizes the importance of designing products with end-of-life considerations in mind.
- **The Zero Waste Models:** This model aims to eliminate waste generation altogether by reducing consumption, reusing items, and recycling materials. It emphasizes the importance of redesigning products and systems to minimize waste.
- **The Pay-As-You-Throw Model:** This model charges households for the amount of waste they generate. It incentivizes households to reduce waste generation and recycle more.
- **Door-to-Door Collection Model:** This model involves waste collectors going door-to-door to collect household waste. The collected waste is then transported to the nearest waste segregation center.
- **Community Bins Model:** Community bins are large bins placed in designated areas within the neighborhood. Households bring their waste to the bins, and waste collectors come to collect the waste from the bins and transport it to the segregation center.
- **Self-Managed Model:** In some areas, households manage their waste disposal by composting organic waste in their own backyards and disposing of non-biodegradable waste in public bins.
- **Formal Waste Collection Model:** In larger cities, there are formal waste collection systems managed by the city authorities. Households place their waste in designated public bins, and waste collectors collect the waste and transport it to the segregation center.

- These models can be used to guide households in their waste disposal practices, and municipalities and governments can also use them to design policies and programs to promote sustainable waste management practices.

5. Cities Implementing Household Waste Disposal In India: In India, several cities have implemented household waste disposal systems to manage the growing amount of waste generated by households. Here are some examples:

- **Indore:** Indore is known for its innovative waste management practices and has been recognized as India's cleanest city for four consecutive years. The city has implemented a door-to-door waste collection system, where waste collectors separate the waste into organic and inorganic categories at the source. The organic waste is then processed into compost, and the inorganic waste is recycled.
- **Bangalore:** Bangalore has implemented a decentralized waste management system, where waste is collected and processed at the ward-level. The city has set up dry waste collection centers and composting facilities in every ward to manage the waste generated by households.
- **Surat:** Surat has implemented a waste-to-energy system, where waste is incinerated to generate electricity. It has setup a waste-to-energy plant, which processes 1000 tons of waste every day.
- **Pune:** Pune has implemented a source-segregation-based waste management system, where households are required to segregate their waste into wet and dry categories. The city has set up waste processing facilities, which convert the wet waste into compost and the dry waste into recyclable material.
- **Chennai:** Chennai has implemented a waste segregation program, where households are required to segregate their waste into three categories - biodegradable, non-biodegradable, and sanitary waste. The city has set up composting facilities and recycling plants to manage the waste generated by households.

These cities are setting an example for other cities in India and around the world on how effective waste management practices can be implemented to promote sustainability and reduce the impact of waste on the environment.

III. BIO DECOMPOSER STARTER CULTURE

A biodecomposer starter culture is a mixture of microorganisms, typically bacteria and fungi, that are specifically selected to promote the decomposition of organic matter. These cultures are often used in composting, waste management, and other applications where the breakdown of organic material is desired.

The microorganisms in a biodecomposer starter culture work together to break down the complex organic compounds found in plant matter, food waste, and other organic materials. They break down these compounds into simpler compounds that can be used by plants as nutrients or recycled back into the ecosystem.

The specific microorganisms in a biodecomposer starter culture can vary depending on the intended application. For example, a culture designed for composting food waste might include bacteria that are particularly good at breaking down carbohydrates, while a culture designed for breaking down cellulose-rich materials like straw might include fungi that are specialized for that task.

Biodecomposer starter cultures can be purchased commercially or prepared at home using a variety of methods. They are often used in combination with other composting or waste management techniques to accelerate the breakdown of organic material and reduce the volume of waste that ends up in landfills.

- 1. Biodecomposer Starter Culture Usage in Kitchen Waste in India:** Biodecomposer starter cultures are commonly used in India for composting kitchen waste. Composting is a natural process which breaks the micro organisms in to nutrient rich soil. When kitchen waste is composted using a biodecomposer starter culture, the process is accelerated and the resulting compost is of higher quality.

To use a biodecomposer starter culture for composting kitchen waste in India, the following steps can be followed:

- **Collect Kitchen Waste:** Collect kitchen waste in a composting bin or container. This can include fruit and vegetable peels, leftover food, tea and coffee grounds, and eggshells.
- **Add Biodecomposer Starter Culture:** Add the biodecomposer starter culture to the kitchen waste. The amount of starter culture to be added depends on the specific product and manufacturer's instructions.
- **Mix and Moisten:** Mix the kitchen waste and starter culture thoroughly. The mixture should be moist, but not waterlogged.
- **Cover:** Cover the composting bin or container with a lid or cloth to keep out pests and maintain moisture.
- **Stir and Aerate:** Stir the compost regularly to aerate it and promote the growth of beneficial microorganisms.
- **Wait:** Allow the compost to break down for several weeks or months, depending on the temperature, moisture, and other conditions.
- **Harvest:** When the compost is ready, it should be dark and crumbly, with a sweet, earthy smell. It can be used as a natural fertilizer for plants, or mixed with soil to improve its quality.

Using a biodecomposer starter culture to compost kitchen waste in India is a sustainable and eco-friendly way to manage organic waste and produce nutrient-rich soil for gardening and farming.

2. Biodecomposer Starter Culture Practice in India: Biodecomposer starter culture practice is becoming increasingly popular in India as people seek sustainable alternatives for waste management and agriculture. There are several different types of biodecomposer starter cultures used in India, each with its unique composition and application. Some common biodecomposer starter culture practices in India include:

- **Jeevamrut:** It is a biodecomposer starter culture made up of from cow dung, cow urine, jaggery, gram flour, and water. It is used as a soil conditioner and biofertilizer in organic farming.
- **Bokashi:** Bokashi is a biodecomposer starter culture originating from Japan. It is made up of by a fermenting bran with a mixture of beneficial microorganisms, which including lactic acid bacteria, yeast, and phototrophic bacteria. It is commonly used for composting kitchen waste.
- **EM (Effective Microorganisms):** EM is a biodecomposer starter culture made up of from a mixture of beneficial microorganisms, which is including lactic acid bacteria, yeast, and phototrophic bacteria. It is used for waste management, particularly for composting and cleaning.
- **Bio-Enzymes:** Bio-enzymes are biodecomposer starter cultures made from a mixture of fruits, sugar, and water. They are used for cleaning, odor control, and waste management.

Biodecomposer starter culture practice in India is often associated with organic farming and sustainable agriculture. Farmers and gardeners use biodecomposer starter cultures to improve soil health, increase microbial activity, and enhance plant growth. Biodecomposer starter cultures are also used for waste management, particularly for composting kitchen waste, animal manure, and agricultural residue.

3. Agricultural Waste Disposal Models: Agricultural waste disposal is an important issue as it has significant environmental impacts and can pose health risks. There are several agricultural waste disposal models that are commonly used, including:

- **Burning:** The traditional method of agricultural waste disposal is burning, which involves setting fire to the agricultural waste in the field. However, this method is now widely discouraged due to its negative environmental impacts and the risk of starting wildfires.
- **Composting:** Composting involves the decomposition of organic waste, which is prepared with agricultural waste, into a nutrient-rich soil amendment. Composting can be done on-site or at a central facility.
- **Land Filling:** Land filling involves the disposal of agricultural waste in a designated landfill. This method is commonly used for non-organic agricultural waste such as plastic mulch films and packaging materials.

- **Animal Feed:** In some cases, agricultural waste such as crop residues and by-products can be used as animal feed. This can reduce the amount of waste which needs to be disposed of while providing a source of nutrients for livestock.
- **Biogas Production:** Agricultural waste can also be used to produce biogas through anaerobic digestion. This process involves breaking down organic matter in the absence of oxygen to produce methane, which can be used as a renewable energy source.

In recent years, there has been increasing awareness of the importance of sustainable agricultural waste management, and efforts have been made to promote environmentally friendly methods such as composting and biogas production. Governments and non-governmental organizations are also providing support and incentives to encourage farmers to adopt sustainable waste management practices.

4. Industrial Waste Disposal Models in India: In India, several industrial waste disposal models are implemented to effectively manage industrial waste and promote sustainable practices. Here are some examples:

- **Common Effluent Treatment Plant (CETP):** This model involves the construction of a centralized effluent treatment plant, where industries can discharge their wastewater for treatment. The treated water is then reused or safely discharged into the environment. The CETP model is widely implemented in India to manage industrial wastewater effectively and prevent pollution of water bodies.
- **Material Recovery and Waste-to-Energy:** This model involves recovering the useful materials from the waste generated by industries and then using the remaining waste to generate energy. The waste is sorted and separated into different categories, and the recyclable materials are sent for recycling. The non-recyclable waste is then used to generate energy through incineration or gasification. This model is gaining popularity in India, especially for the disposal of hazardous waste.
- **Hazardous Waste Management:** This model involves the collection, treatment, and disposal of hazardous waste generated by industries. Hazardous waste requires special attention for handling and disposal methods to prevent environmental pollution and public health risks. Based on the regulations and guidelines set by the authorities the hazardous waste is collected, treated, and disposed.
- **Bioremediation:** This model involves using microorganisms to degrade or remove pollutants from industrial waste. The bioremediation process can be implemented in situ or ex situ and is a cost-effective and environmentally friendly way to manage industrial waste. The bioremediation model is widely implemented in India for the treatment of contaminated soil and water.
- **Zero Waste Models:** This model aims to reduce the amount of waste generated by industries to zero. It involves the implementation of several strategies, such as reducing waste at the source, reusing materials, recycling, and composting. This model also promotes sustainable production practices to minimize waste generation.

The zero waste model is gaining popularity in India, especially in the textile and leather industries.

IV. DIFFERENT EXISTING COMMUNITY MODELS AVAILABLE IN DISPOSING THE WASTE

1. Extended Producer Responsibility (EPR) Model : Extended Producer Responsibility (EPR) Model history and how it is implementing and where it is implementing The Extended Producer Responsibility (EPR) Model is a waste management strategy that aims to shift the responsibility for the management of waste from local governments to the producers of the products that generate the waste. The EPR model was first introduced in the late 1980s and early 1990s, and it has since become a widely used approach to waste management in many countries around the world.

The history of the EPR model can be traced back to the late 1980s, when the concept was first introduced in Europe as a way to address growing concerns about the environmental impact of waste. The idea behind the EPR model is to make the producers of products responsible for the entire life cycle of the products they produce, including the management of the waste generated when the products are no longer in use.

Today, the EPR model is widely recognized as an effective way to reduce waste and promote recycling, and it is used in many countries around the world, including Europe, North America, and Asia. The model is typically implemented by national or local governments, and it involves the creation of product-specific regulations that require producers to take responsibility for the end-of-life management of their products.

The implementation of the EPR model can vary from place to place, depending on local regulations and resources. However, the basic principle of the model remains the same - producers are required to take responsibility for the management of the waste generated by their products, in order to reduce waste and promote recycling.

Overall, the EPR model is considered a proven and effective approach to waste management, and it is widely used in many countries around the world. However, it is important to note that the implementation of the EPR model requires careful planning and enforcement to be effective, and it is often challenging to implement in practice.

- **The Cities Implementing EPR Model in India:** The implementation of the Extended Producer Responsibility (EPR) model in India has been uneven across cities, and there is no comprehensive list of cities that have implemented the model. However, some cities have taken steps to promote the EPR model and improve waste management, including:
 - **Bengaluru:** In 2016, the government of Bengaluru launched an EPR program to promote the responsible disposal of electronic waste, including televisions, computers, and mobile phones. The program has been successful in reducing e-waste and promoting sustainability.

- **Mumbai:** The government of Mumbai has implemented several programs to promote the EPR model and improve waste management, including a program to promote the responsible disposal of e-waste.
- **New Delhi:** The government of New Delhi has implemented a pilot project to test the viability of the EPR model, but the results have not been widely reported.

2. Zero Waste Models in India: The Zero Waste model has gained traction in India in recent years, but its implementation has been uneven across the country. Some cities and communities have implemented Zero Waste programs and initiatives, while others have been slow to adopt the model.

One of the challenges in implementing the Zero Waste model in India is the lack of infrastructure for waste collection and disposal, which makes it difficult to reduce waste and ensure that all waste is reused, recycled, or composted. The government has introduced several laws and policies to promote the responsible disposal of waste, but the enforcement of these laws has been weak, and the implementation of these policies has been challenging.

In addition, the cultural attitudes towards waste and the environment need to change in India, and there needs to be a greater public awareness and understanding of the benefits of the Zero Waste model.

Despite these challenges, there have been some successes in implementing the Zero Waste model in India. For example, the city of Mysuru has been recognized as one of the cleanest cities in India, with a well-developed waste management system and a strong focus on reducing waste and promoting sustainability.

Overall, the Zero Waste model has the potential to significantly improve waste management and reduce environmental impact in India, but it will require the support and cooperation of the government, communities, and businesses to be successful.

- **The Cities Implementing Zero Waste Model in India:** In India, there are several cities that have implemented the Zero Waste model to some extent. Some of the cities that have been recognized for their efforts to reduce waste and promote sustainability include:
 - **Mysuru, Karnataka:** Mysuru is one of the cleanest cities in India, with a well-developed waste management system which includes door-to-door waste collection and segregation, composting, and recycling.
 - **Alappuzha, Kerala:** Alappuzha is known for its innovative waste management practices, which include door-to-door waste collection, composting, and recycling. The city has also implemented a number of programs to promote public awareness about waste reduction and sustainability.

- **Pune, Maharashtra:** Pune has been recognized for its efforts to reduce waste and promote sustainability, with a focus on door-to-door waste collection, segregation, composting, and recycling.
- **Udaipur, Rajasthan:** Udaipur is known for its efforts to reduce waste and promote sustainability, including door-to-door waste collection, segregation, and composting.
- **Bengaluru, Karnataka:** Bengaluru is one of the largest cities in India, and it has made significant efforts to reduce waste and promote sustainability, including door-to-door waste collection, segregation, composting, and recycling.

These cities serve as examples of what can be achieved with a commitment to the Zero Waste model, but it will require continued effort and support from the government, communities, and businesses to make this model a reality across the country.

3. **Integrating Waste Management Model in India:** In India, the Integrating Waste Management Model has been gaining traction in recent years, as cities and communities look for more sustainable and efficient ways to manage their waste. The model has been adopted in a number of cities across India, and has shown promising results in terms of reducing waste, conserving resources, and protecting the environment.

Integrating Waste Management Model implementation in India involves the following steps:

- **Waste Segregation:** The first step is to promote the segregation of waste at the source, into biodegradable and non-biodegradable waste, so that it can be managed more effectively.
- **Collection and Transportation:** The second step is to ensure the efficient collection and transportation of waste from households, businesses, and other sources, to the appropriate waste management facilities.
- **Treatment and Disposal:** The third step is to ensure the appropriate treatment and disposal of waste, through methods such as composting, recycling, and landfilling.
- **Public Education and Awareness:** The fourth step is to raise public awareness and educate communities about the importance of waste reduction, reuse, recycling, and composting, and how they can be involved in the process.

The Cities Implementing Integrating Waste Management Model in India: There are many cities in India that have implemented or are in the process of implementing the Integrating Waste Management Model, including:

- **Mumbai:** Mumbai has been working towards integrating its waste management system and has made significant progress in terms of segregation and collection of waste, as well as in promoting public education and awareness.

- **Bangalore:** Bangalore has implemented a comprehensive waste management system, which includes door-to-door collection, waste segregation, and composting, and has been recognized for its efforts in promoting sustainability and reducing waste.
- **New Delhi:** New Delhi has implemented a number of initiatives to promote the segregation and composting of waste, as well as to reduce the amount of waste being sent to landfills.
- **Pune:** Pune has been actively promoting the segregation and composting of waste, and has implemented a number of initiatives to raise public awareness and encourage community involvement in waste management.
- **Hyderabad:** Hyderabad has implemented a number of initiatives to promote waste segregation and composting, to improve the collection and transportation of waste, with the goal of reducing the amount of waste sent to landfills.

These are some of the cities in India that are implementing the Integrating Waste Management Model, and many more cities and communities are following their lead in promoting sustainable waste management practices.

4. **Waste Hierarchy Model History:** The Waste Hierarchy Model, also known as the "Waste Management Hierarchy," is a concept that was first introduced in the 1970s to promote sustainable waste management practices. The model was developed by the European Union (EU) and is now widely recognized and used globally.

The Waste Hierarchy Model provides a framework for decision-making in the management of waste, by prioritizing the most environmentally-sound waste management options and strategies.

- **Cities implementing Waste Hierarchy Model in India:** Many cities in India have implemented the Waste Hierarchy Model in their waste management policies and practices. Some examples of cities that have integrated the model include:
 - Bengaluru
 - New Delhi
 - Mumbai
 - Pune
 - Hyderabad
 - Jaipur
 - Ahmadabad
 - Chennai
 - Kolkata
 - Surat

These cities have implemented various programs and initiatives to improve waste management practices, such as waste segregation and collection, recycling and composting, and the use of renewable energy from waste, in line with the principles of the Waste Hierarchy Model. The implementation of the model has led to

improvements in waste management practices, and has reduced the environmental impact of waste in these cities. However, there is still room for improvement, and many cities in India continue to work towards fully integrating the Waste Hierarchy Model into their waste management practices.

- 5. Circular Economy Model in waste disposing in India:** In India, the implementation of circular economy models in waste management is still in its early stages, with significant room for improvement. Although there has been some progress in recent years, such as the implementation of waste segregation and recycling programs in several cities, the country still faces significant challenges in managing its waste effectively.

One of the main challenges in India is the lack of infrastructure for waste management, which leads to widespread littering, open dumping, and the release of hazardous pollutants into the environment. In addition, there is a lack of awareness and understanding among stakeholders, including consumers, businesses, and local governments, about the importance of waste reduction and recycling.

Despite these challenges, there are several initiatives underway to promote the circular economy in waste management in India. For example, the government has launched several programs to promote waste segregation and recycling, and there is a growing interest in product-as-a-service models and closed-loop supply chains. In addition, there is a growing network of social entrepreneurs and non-governmental organizations working to promote sustainable waste management practices in India.

Overall, the implementation of circular economy models in waste management in India is still in its early stages, and there is a need for further investment, research, and collaboration to address the challenges and fully realize the potential benefits of this approach.

- 6. Circular Economy Model in Waste Disposing in Different Cities in India:** The Circular Economy Model is a concept that aims to keep resources in use for as long as possible, extract the maximum value from them before recovering and regenerating them. In the context of waste disposal, this means reducing the amount of waste generated, reusing materials whenever possible, and recycling waste into new products.

In India, there are several cities that have implemented the Circular Economy Model in their waste management systems, including:

- **Bengaluru:** Bengaluru has set up a number of waste management initiatives that focus on reducing, reusing, and recycling waste. The city has implemented a door-to-door waste collection system, which ensures that waste is segregated at source and processed accordingly.
- **Pune:** Pune has implemented a decentralized waste management system that involves the local community in waste collection and segregation. The city has also set up a number of recycling facilities that process waste into compost and other usable products.

- **Ahmadabad:** Ahmadabad has set up a number of composting units and recycling facilities that are aimed at reducing the amount of waste that is sent to landfills. The city has also implemented a door-to-door waste collection system, which helps in segregating waste at source.

These are just a few examples of cities in India that are implementing the Circular Economy Model in their waste management systems. The adoption of this model can help reduce the amount of waste generated, increase the rate of waste recycling, and promote sustainability in the long term.

- 7. Public-Private Partnership (PPP) Model in Waste Management in India:** Public-Private Partnership (PPP) model in waste management in India involves collaboration between the government and private companies to manage waste in a sustainable and efficient manner. Under this model, the private sector assumes the responsibility for design, construction, operation, and maintenance of waste management facilities, while the government provides support in the form of regulatory and financial incentives. This model aims to leverage the strengths of both the public and private sectors to address the challenges of waste management in India, including inadequate infrastructure, lack of proper waste disposal methods, and increasing amounts of waste generated. The PPP model has been adopted by several cities in India and has shown promising results in improving waste management practices.

Public-Private Partnership (PPP) models have been implemented in various cities in India to address the challenges of waste management.

In cities such as Bangalore, PPP models have been used to develop waste-to-energy projects, where the waste generated in the city is converted into energy. In New Delhi, PPP models have been used to develop waste segregation and recycling facilities, promoting the efficient management of waste.

In cities such as Hyderabad, PPP models have been used to develop integrated waste management systems, including the collection, transportation, and treatment of waste. In Mumbai, PPP models have been used to develop composting and biogas facilities, promoting the sustainable management of organic waste.

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In addition to these cities, PPP models have been implemented in other cities in India, including Chennai, Kolkata, Pune, and Ahmadabad, to address the challenges of waste management. The specific details of the PPP models may vary from city to city, but the overall goal is to promote sustainable, efficient, and effective waste management practices.

8. Regional Waste Management Model: It is a comprehensive approach to managing waste in a specific region, taking into consideration the unique characteristics, needs, and resources of the region.

- **Cities implementing Regional Waste Management Model in India:** In India, there are several cities that have implemented or are in the process of implementing a Regional Waste Management Model. Here are some examples:
 - **Bangalore:** Bangalore has implemented a comprehensive waste management program that includes door-to-door collection of waste, waste segregation at source, and composting and recycling of waste.
 - **Pune:** Pune has implemented a waste management program that emphasizes waste segregation at source, door-to-door collection, and the use of composting and recycling facilities.
 - **Surat:** Surat has implemented a waste management program that includes door-to-door collection of waste, waste segregation at source, and the use of composting and recycling facilities.
 - **Indore:** Indore has implemented a waste management program that includes door-to-door collection of waste, waste segregation at source, and the use of composting and recycling facilities. The city has also established a decentralized waste management system, with waste processing and composting facilities located in different parts of the city.
 - **New Delhi:** New Delhi has implemented a waste management program that includes door-to-door collection of waste, waste segregation at source, and the use of composting and recycling facilities. The city has also established a decentralized waste management system, with waste processing and composting facilities located in different parts of the city.

9. Principles of the Community Waste Disposal Models

- **Prevention:** The first principle of the community waste disposal model is to prevent waste from being generated in the first place. This includes reducing the use of single-use products, promoting the use of reusable products, and reducing the use of toxic and harmful products.
- **Minimization:** The second principle is to minimize waste through more efficient use of resources and reducing the amount of waste generated. This includes reducing the

use of packaging, increasing the use of recycled materials, and reducing the use of hazardous materials.

- **Reuse:** The third principle is to reuse products and materials as much as possible, rather than sending them to landfill. This includes repairing and refurbishing products, as well as using reusable products such as cloth bags, containers, and water bottles.
- **Recycling:** The fourth principle is to recycle as much waste as possible, so that it can be transformed into new products and materials. This includes recycling paper, plastic, metal, glass, and other materials.
- **Composting:** The fifth principle is to compost organic waste, such as food scraps and yard waste, so that it can be transformed into nutrient-rich soil.
- **Responsible Disposal:** The final principle is to ensure that any remaining waste is disposed of responsibly, in a manner that minimizes harm to the environment and human health. This includes properly disposing of hazardous waste, and properly disposing of waste in landfills.

10. Benefits of the Community Waste Disposal Models

- **Environmental Protection:** It reduces the amount of waste that ends up in landfills, where it can release harmful chemicals into the environment and contribute to climate change. By reducing waste, these models also help to conserve natural resources and protect wildlife habitats.
- **Economic Benefits:** These models create jobs and generate economic activity in the recycling and composting industries, as well as in the production of new products made from recycled materials.
- **Public Health Benefits:** These models help to protect public health by reducing the use of toxic and hazardous materials, and by reducing the amount of waste in landfills, which can release harmful chemicals into the air and water.
- **Increased Resource Efficiency:** These community models promote the more efficient use of resources, by reducing waste and encouraging the use of reusable products and recycled materials.
- **Community Engagement:** These models encourage community involvement and engagement in waste reduction efforts, which can help to build stronger, more sustainable communities.
- **Increased Awareness:** These models raise awareness about the environmental impact of waste, and encourage individuals and communities to take action to reduce waste and promote sustainability.

V. REVIEW OF LITERATURE

Emmanouil *et al.* (2022) found in their study that 43 per cent of the respondents strongly agreed pay as you through model and 41.5 per cent respondents agreed the necessity of fines in pay as you through model. Another 48.9 per cent respondents agreed PAYT model started to implement for financial benefits and 51.9 per cent agreed PAYT implementation started for environmental benefits.

Ukkonen and Sahimaa (2021) stated in their study that due to implementation of pay as you through model in Finland they decreased the household waste by 32 per cent and increased sorting efficiency by 40 to 80 per cent.

Morlok *et al.* (2016) revealed in their study that an amount of residual waste reduced due to impact of pay as you through model from 162 kgs to 56 kgs in Germany. The average residual waste was reduced from 380 kgs to 220 kgs which is usually disposed through incineration.

VI. CONCLUSION

All these models needs to be implemented based on the infrastructure availability and feasibility of the application in our country. The Public of the country need to understand the severity of the waste disposal and its causes leading to climate change and global warming to overcome environment related problems. Proper waste management planning, usage of the starter culture and usage of portable kitchen wastage bins will help to reduce the waste and also the generated waste will be converted in to compost.

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