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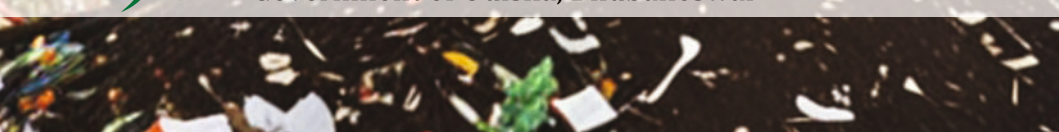
Waste MANAGEMENT

CENTRE FOR ENVIRONMENTAL STUDIES
Forest, Environment & Climate Change Department
Government of Odisha, Bhubaneswar



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PREFACE

Waste management has become one of the most pressing global challenges of our time. As urban populations expand, addressing this issue requires a multidimensional approach that integrates scientific advancements, effective policies, and community participation.

This book provides a comprehensive overview of waste management, covering various aspects such as solid waste disposal, recycling, hazardous waste treatment, and sustainable practices. It explores the impact of improper waste handling on ecosystems and human health while highlighting successful waste management strategies implemented worldwide. Special emphasis is given to e-waste management strategies. Under the guidance of Dr. Sasanka Lenka, this resource has evolved into a comprehensive and scientifically robust tool, thanks to his meticulous attention to detail and expert knowledge.

Centre for Environmental Studies (CES), we champion sustainable practices and environmental stewardship. Together, let's reduce waste, recycle wisely, and adopt eco-friendly solutions for a cleaner, healthier planet - now and for future generations.

I would like to thank Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India for giving opportunity to compile this book under Environment Education Programme (EEP).

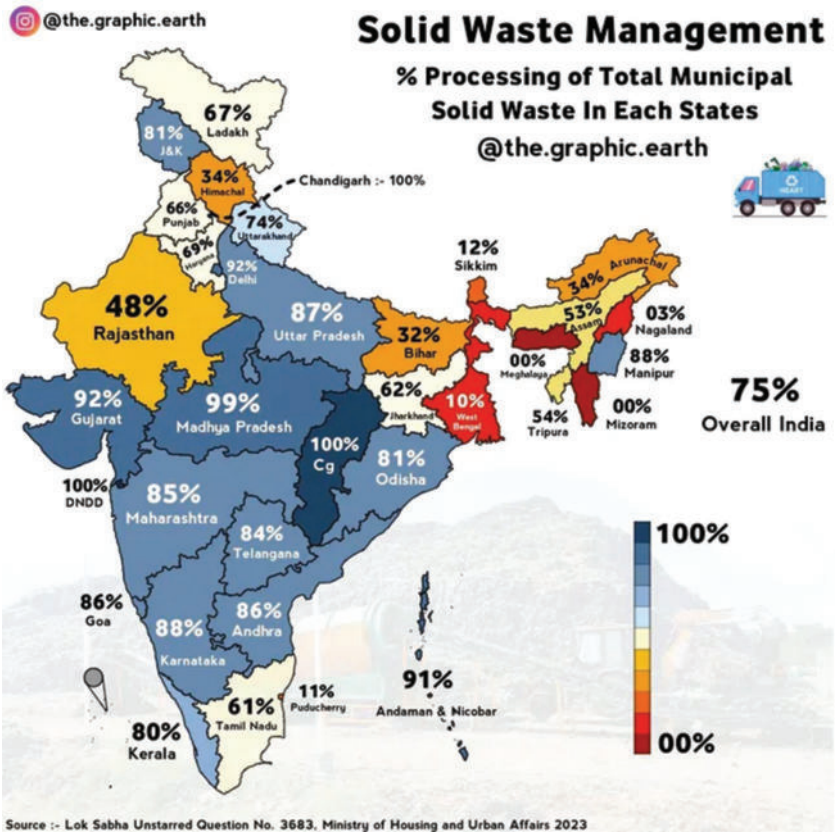
(Dr. K. Murugesan)

CONTENT

WASTE MANAGEMENT

1.0 INTRODUCTION

Waste management is the process of handling waste from its creation to its disposal. It includes collecting, transporting, processing, and disposing of waste. The goal of waste management is to reduce the amount of waste that goes to landfills. In other words, we can say that it is a process of collecting, transporting, and disposing of waste. It also involves monitoring and regulating the waste management process. The primary goal of pre-incident waste management planning is to prepare a community to effectively manage waste, debris and materials generated by a homeland security incident, including reducing the potential amount of waste generated at the outset. The main objective of the Division is to promote the safe management and use of hazardous substances, including hazardous chemicals and hazardous wastes, to avoid damage to health and the environment.



Solid waste management in India

Waste management is a term that refers to all of the various actions taken and plans created to manage waste, from composting or recycling existing waste to minimizing the production of waste in the first place. Because we currently produce so much waste-plastic waste alone comes to 400 million tons annually managing it all is a complex process, and different countries and regions have created different answers to the challenge. Even some states and counties have come up with their own systems on this front. Waste management is essential for every business to reduce its environmental impact,

meet regulatory requirements, and contribute to a sustainable future. "Waste management" is a term used to refer to all of the ways that waste is dealt with throughout its lifecycle, from recycling or composting existing waste to minimizing its production in the first place. India's status is shown in the figure.

The Ministry of Environment, Forest and Climate Change notified the Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness and Response) (CAEPPR) Rules, 1996 for ensuring chemical safety in the Country. These rules delineate the criteria for the identification of Major Accident Hazard (MAH) units. As per the rules, Central Crisis Groups, State Crisis Groups, District Crisis Groups, and Local Crisis Groups at the Central, State, District and Local levels are required to be set up for the management of accidents due to the handling of hazardous chemicals listed in the rules.

The increasing volume and complexity of waste associated with the modern economy are posing a serious risk to ecosystems and human health. Every year, an estimated 11.2 billion tonnes of solid waste is collected worldwide, and the decay of the organic proportion of solid waste is contributing about 5 per cent of global greenhouse gas emissions. Of all the waste streams, waste from electrical and electronic equipment containing new and complex hazardous substances presents the fastest-growing challenge in both developed and developing countries.

Poor waste management, from non-existing collection systems to ineffective disposal, causes air pollution and water and soil contamination. Open and unsanitary landfills contribute

to the contamination of drinking water and can cause infection and transmit diseases. The dispersal of debris pollutes ecosystems, and dangerous substances from electronic waste or industrial garbage strain the health of urban dwellers and the environment. The solution, in the first place, is the minimisation of waste. Where waste cannot be avoided, recovery of materials and energy from waste and remanufacturing and recycling waste into usable products should be the second option. Recycling leads to substantial resource savings. For example, for every tonne of paper recycled, 17 trees and 50 per cent of water can be saved. The UNEP International Environmental Technology Centre (IETC) in Japan supports the implementation of integrated solid waste management systems. Its work also focuses on the proper treatment of special wastes (electronics, agricultural biomass, plastics) in developing countries. IETC aims to optimize the management of solid waste by involving all stakeholders in the process through pilot projects at the local level.

As per the Annual Report of the Central Pollution Control Board for the year 2021-22, the average quantity of solid waste generated in India is 1,70,338 TPD, of which 91,512 TPD is treated. India processed more than 75 percent of the total waste generated in the country in the financial year 2023. Nevertheless, as India's recycling rates for different types of waste hardly surpass 30 percent, landfilling is oftentimes the number one approach. As of 2023, the status of solid waste management in India is marked by significant challenges, including a large amount of uncollected waste, inadequate processing facilities, poor waste segregation practices, and a lack of proper infrastructure, despite government initiatives

like the Swachh Bharat Mission; only a fraction of generated waste is effectively collected and treated, with a considerable portion still ending up in open dumps or landfills. India generates about 0.1kg, 0.3-0.4, and 0.5 kg per capita per day in small, medium and large cities and towns (Meena et al., 2023), and with rising per capita income, it is estimated that the waste generation per capita will increase in comparison to other south-east Asian countries like Indonesia (0.7).

Waste generation in urban areas of India will be 0.7 kg per person per day in 2025, approximately four to six times higher than in 1999. According to the Ministry of Environment, Forest and Climate Change, India currently generates 62 million tons of waste (both recyclable and nonrecyclable) every year, with an average annual growth rate of 4%. Solid waste, plastic waste and E-waste are the principal waste materials. The generation of municipal solid waste is expected to rise to 165 million tonnes by 2030 due to changing consumption patterns and rapid economic growth.

2.0 PRESENT STATUS OF WASTE MANAGEMENT

Waste management is a bigger challenge for India due to inadequate collection, transportation, treatment, and disposal of waste. The details are as follows:

Waste Generation

- India generates a large amount of solid waste, including hazardous waste, plastic waste, e-waste, and biomedical waste
- Urban areas contribute significantly to waste generation

Waste Collection

- Waste collection efficiency is high, but a large amount of waste remains unaccounted
- Sorting recyclable materials is a problem, with many valuable materials ending up in landfills

Waste Treatment

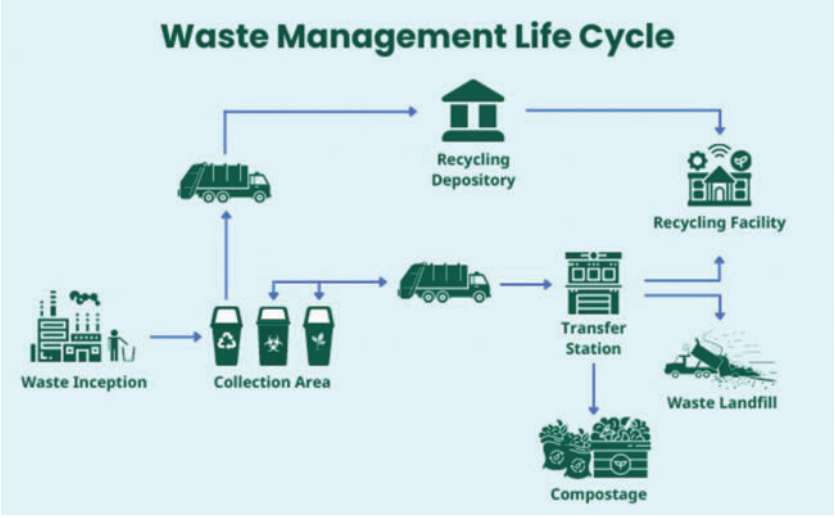
- Only a portion of collected waste is treated
- Landfilling is the most common method of waste disposal
- Other methods of waste treatment include incineration and composting

Waste Management Issues

- Lack of land resources for waste processing plants
- Limited waste separation at source
- Shortage of trained workers
- Low public awareness about proper disposal
- Illegal dumping due to limited land for disposal

Waste Management Initiatives

- The Ministry of Environment, Forest and Climate Change has notified waste management rules
- Some cities have made segregation of municipal waste mandatory at the generator level
- The government has a GIS-based National Hazardous Waste Information System



Waste management cycle

The life cycle time or the scope considered is from Gate to Grave, which includes the transportation of waste to treatment facilities (MRF, composting, AD) and later final disposal of residues at the landfill. According to available data, Haryana and Karnataka are considered to be the top states in India for overall waste management, particularly in wastewater treatment and reuse, with significant progress in their comprehensive action plans for managing wastewater; however, the effectiveness of waste management can vary significantly within each state, depending on city-level initiatives.

3.0 IMPORTANCE OF WASTE MANAGEMENT

Waste management is important because it protects the environment, public health, and the economy. As long as we are producing waste, it will need to be managed. And we produce a lot of it. Over 2 billion metric tons of MSW are

generated globally every year, a figure that's expected to grow by about 70% by 2050. Municipal solid waste generation is predicted to grow from 2.1 billion tonnes in 2023 to 3.8 billion tonnes by 2050. In 2020, the global direct cost of waste management was an estimated USD 252 billion. When factoring in the hidden costs of pollution, poor health and climate change from poor waste disposal practices, the cost rises to USD 361 billion. Without urgent action on waste management, by 2050, this global annual cost could almost double to a staggering USD 640.3 billion. Waste must be managed. But how we manage the waste matters, too – when it's managed properly, it can do a lot of great things for the environment. We'll explain some of these benefits below.

Environmental Protection

Proper waste management helps prevent pollution of air, water, and soil. It reduces the release of harmful substances into the environment, minimizing negative impacts on ecosystems, wildlife, and human health.

Resource Conservation

It involves recycling and reusing materials, reducing the need for new raw materials. This conserves natural resources and energy, leading to more sustainable production processes.

Energy Savings

Many waste management practices, such as recycling and waste-to-energy technologies, generate renewable energy or recover energy from waste. This reduces the reliance on fossil fuels and helps combat climate change.

Reduction of Greenhouse Gas Emissions

Proper waste management, including recycling and composting, reduces methane emissions from landfills and the need for energy-intensive production of new materials, thereby mitigating climate change.

Health and Safety

It can lead to disease transmission, water contamination, and air pollution. It minimizes health risks for communities and workers in the waste industry.

Aesthetic Improvement

Proper waste disposal and cleanliness contribute to visually appealing surroundings, enhancing the quality of life for residents and attracting tourism.

Economic Benefits

It creates job opportunities in recycling, waste collection, processing, and related industries. It also reduces the costs of waste clean-up, disposal, and environmental remediation.

Compliance with Regulations

Many countries and regions have strict regulations for waste management to protect the environment and public health. Proper waste management ensures compliance with these regulations, avoiding legal and financial penalties.

Sustainable Development

Integrating waste management into sustainable development goals ensures the well-being of current and future generations by preserving resources and minimizing the environmental footprint.

Promotion of Circular Economy

It contributes to the transition to a circular economy, where resources are used efficiently, products are designed for durability and recyclability, and waste is minimized.

4.0 KEY POINTS ABOUT WASTE IN INDIA

- **High waste generation:** India generates a large amount of municipal solid waste daily, with a considerable portion going untreated.
- **Plastic pollution leader:** India is considered the top producer of plastic waste globally, contributing significantly to environmental concerns.
- **Unprocessed waste:** A significant percentage of waste remains unprocessed and ends up in landfills.
- **E-waste concerns:** The surge in electronic waste generation is also a major issue, with a large portion not being properly recycled.

Challenges in waste collection and treatment:

Inadequate infrastructure for waste collection and treatment remains a major hurdle in many areas.

5.0 SOME POSITIVE DEVELOPMENTS

Positive developments in waste management include: increased focus on recycling and reuse, advancements in composting technologies, implementation of smart waste collection systems, growing awareness of the circular economy model, improved waste segregation practices, and the development of innovative technologies to convert waste into

energy sources, all contributing to reduced environmental impact, resource conservation, and economic benefits.

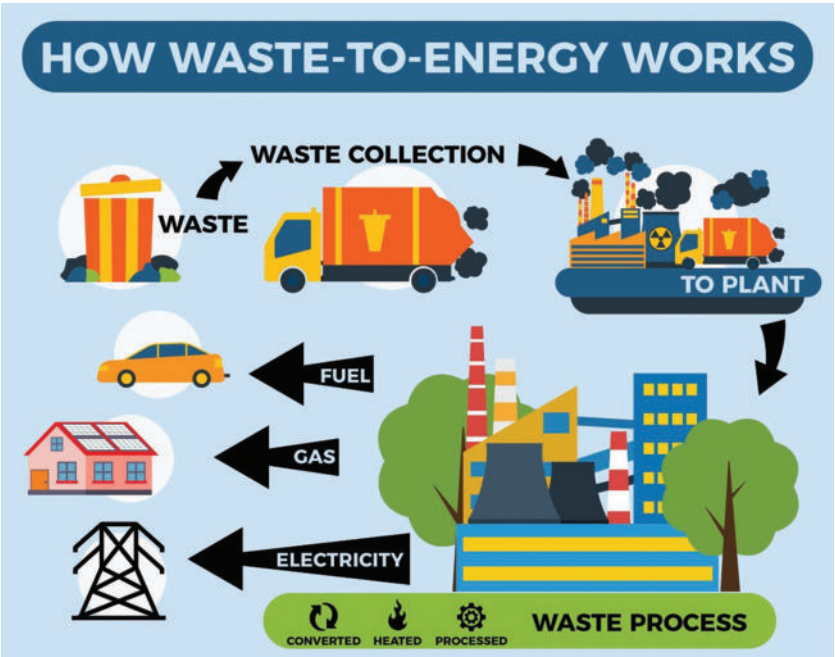
- **Government initiatives:** The Swachh Bharat Mission aims to improve sanitation and waste management practices across India.
- **Increased awareness:** Public awareness campaigns are promoting waste segregation and responsible disposal.
- **Growing recycling efforts:** Some progress is being made in recycling certain waste streams, including e-waste.
- **Increased Recycling and Reuse:** More communities are implementing robust recycling programs, encouraging residents to separate waste and promoting initiatives to reuse materials, minimizing landfill waste.
- **Advanced Composting Technologies:** Developments in composting methods allow for the efficient processing of organic waste, producing valuable compost for soil improvement.
- **Smart Waste Collection Systems:** Utilizing technology like sensors and data analytics to optimize waste collection routes, improving efficiency and reducing unnecessary truck trips.
- **Circular Economy Approach:** The growing adoption of the circular economy model, where waste is viewed as a resource to be reused and recycled back into the production cycle.

- **Waste Segregation Practices:** Emphasis on proper waste segregation at the source, allowing for better recycling and treatment of different waste types.
- **Waste-to-Energy Technologies:** Development and implementation of technologies that convert waste into energy sources like electricity or heat, reducing reliance on fossil fuels.
- **Community Engagement:** Increased public awareness campaigns and educational programs to promote responsible waste management practices.
- **E-Waste Recycling Initiatives:** There is a growing focus on responsible recycling of electronic waste, minimizing the release of hazardous materials.

6.0 AREAS NEEDING IMPROVEMENT

Key areas need to be improved in waste management include: inadequate infrastructure for collection and treatment, lack of public awareness and participation in waste segregation, inefficient recycling systems, improper handling of hazardous waste, limited funding for waste management initiatives, inconsistent policy implementation, and a need to prioritize waste reduction strategies like composting and reuse.

- **Improved waste collection systems:** Better waste collection infrastructure and efficient collection practices are crucial.
- **Waste processing facilities:** Develop more robust waste processing facilities to treat a larger portion of generated waste.



- **Enforcement of regulations:** Stricter enforcement of waste management rules and regulations to curb improper disposal.
- **Public participation:** Encouraging active citizen participation in waste segregation and responsible disposal.
- **Infrastructure Deficiencies:** Many areas lack sufficient waste collection bins, vehicles, and treatment facilities, leading to open dumping and environmental contamination.
- **Public Awareness and Participation:** A significant gap exists in educating the public about proper waste segregation and disposal practices, leading to improper waste management at the household level.

- **Recycling Inefficiency:** Most waste management systems lack robust recycling programs with efficient sorting and processing capabilities, resulting in low recycling rates.
- **Hazardous Waste Management:** Improper handling and disposal of hazardous waste poses serious health and environmental risks.
- **Financial Constraints:** Many local bodies struggle with limited funding to invest in advanced waste management technologies and infrastructure.
- **Policy Implementation Gaps:** While waste management policies may exist, their effective implementation often falls short due to regulatory challenges and enforcement issues.
- **Focus on Waste Reduction:** Greater emphasis on reducing waste generation through practices like composting, reusable packaging, and mindful consumption is needed.

7.0 TYPES OF WASTE MANAGEMENT

Waste disposal refers to the removing, discarding, recycling, or destroying of unwanted materials. Waste management is associated with waste disposal, it is useful for maintaining a clean environment. The "five Rs" are an ordered list of the actions that should ideally be taken before recycling: refuse, reduce, reuse, repurpose, and then recycle. By treating recycling almost as a last resort, the five Rs help to minimize waste and ensure that nothing is disposed of unless it truly can't serve any other purpose first. Here's a closer look at what each of these "Rs" actually means:

- **Refuse:** Refusing waste means not acquiring it in the first place, so by default, it's the best way to minimize your output. For example, if you're running a small business, you could tell your vendors that you won't buy products with unnecessary packaging.
- **Reduce:** The next best thing you can do is reduce the amount of waste that you generate. For example, if you can't refuse to print a document, you can reduce the resulting waste by printing it on double-sided paper.
- **Reuse:** Single-use plastics do major harm to the environment: at least 14 million tons of plastic end up in the ocean every year. By replacing these types of items with reusable counterparts – like metal cutlery, for example-you can play a role in reducing that damage.
- **Repurpose:** If an item can't be reused, you might be able to find a different purpose for it instead. Some people call this upcycling, and it's a fun chance to get creative with what you already have!

- **Recycle:** And last comes recycling. If you've gone through the first four Rs and can't find a way to make use of the item, then this is finally your best option.

The 7 R's linked with waste management are Refuse, Repurpose, Reduce, Reuse, Rot, Recycle & Rethink. Waste management is the collection, processing, treatment and recycling of waste (human waste, animal waste, farm waste and industrial waste). The process of waste management is constituted of a range of tasks which include storage, transport, treatment and disposal of waste; monitoring, supervision and regulation of the development, processing, transit, treatment and disposal for better health of our environment.

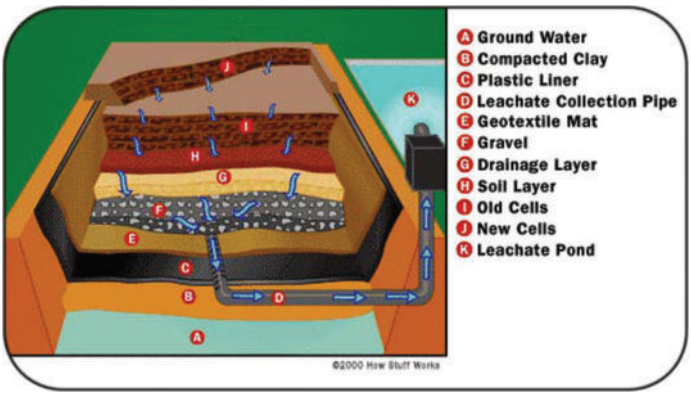
Wastes are of different types & much of the waste generated today is non-biodegradable waste. This is due to globalization & industrialization. The dumps have harmful substances in the waste, which releases toxic fumes & smoke. Therefore, the disposal of different types of waste should be done in the right manner. For instance, burning all kinds of wastes may lead to the release of toxic fumes & harm bodies. Dumping waste into rivers & filling land depressions without proper administration should not be done. Waste, including plastics, batteries, sanitary & oil products, should be properly disposed of. Segregation of waste should be done in homes as well as commercially. Segregating biodegradable waste, non-biodegradable & toxic products should be followed.

Methods of Waste Disposal

Garbage accumulation has never been much of a concern in the past, but due to globalization and industrialization, there is a need for a more efficient waste disposal method. The current waste disposal methods include the following:

7.1 Landfill

In the landfill process, the waste type is of non-reusable & non-recyclable substances, which are spread in a thin layer in specific low-lying lands or areas. Then these areas are dug deep & here, waste is disposed of inside, after which a layer of soil is used to cover it back. Such an area is not suitable for activities like construction of buildings. Instead, they can be used for building parks or playgrounds. The landfill is one of the most widely adopted waste disposal methods. However, once this process is complete, the area is declared unfit for the construction of buildings for the next 20 years. Instead, it can only be used as a playground or a park.



7.2 Incineration

Incineration is the process of controlled combustion of garbage to reduce it to incombustible matter, such as ash and waste gas. The exhaust gases from this process may be toxic,

hence, it is treated before being released into the environment. This process reduces the volume of waste by 90 percent and is considered one of the most hygienic methods of waste disposal. In some cases, the heat generated is used to produce electricity. However, some consider this process not quite environmentally friendly due to the generation of greenhouse gases such as carbon dioxide and carbon monoxide.

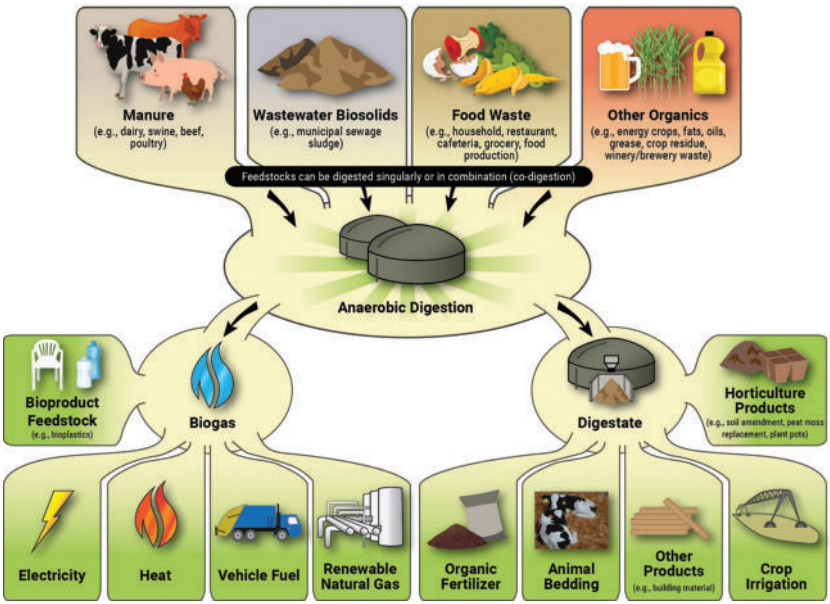
7.3 Waste Compaction

Waste compaction means shredding the waste into smaller pieces, pushing it to mix properly & then placing it in

such a way to fill voids. This leads to reduced amount & waste size which leads to less pollution in the environment. The waste materials, such as cans and plastic bottles, are compacted into blocks and sent for recycling. This process prevents the oxidation of metals and reduces airspace need, thus making transportation and positioning easy.

7.4 Biogas Generation

Biodegradable waste, such as food items, animal waste, or organic industrial waste from food packaging industries, is sent to biodegradation plants. In bio-degradation plants, they are converted to biogas by degradation with the help of bacteria, fungi, or other microbes. Here, the organic matter serves as food for the micro-organisms. The degradation can happen aerobically (with oxygen) or anaerobically (without oxygen). Biogas is generated as a result of this process, which is used as fuel, and the residue is used as manure.



7. 5 Composting

All organic materials decompose with time. Food scraps, yard waste, etc., make up one of the major organic wastes we throw out every day. The process of composting starts with these organic wastes being buried under layers of soil and then left to decay under the action of microorganisms such as bacteria and fungi. This results in the formation of nutrient-rich manure. Also, this process ensures that the nutrients are replenished in the soil. Besides enriching the soil, composting also increases the water retention capacity. In agriculture, it is the best alternative to chemical fertilizers.

7.6 Vermicomposting

Vermicomposting is the process of using worms for the degradation of organic matter into nutrient-rich manure. Worms consume and digest organic matter. The by-products

of digestion, which are excreted by the worms, make the soil nutrient-rich, thus enhancing the growth of bacteria and fungi. It is also far more effective than traditional composting.

8.0 FARM WASTE MANAGEMENT

Agricultural waste in India, totalling around 620 million tonnes annually, presents a major environmental and economic challenge. The improper disposal of crop residues, especially through practices like burning, leads to severe air pollution, soil degradation, and greenhouse gas emissions. Currently, farm waste management in India is characterized by a large volume of agricultural waste generated, with only a small portion being utilized effectively, leading to significant environmental concerns like burning of crop residue, while efforts are being made to promote sustainable practices like composting, bioenergy production, and government initiatives to encourage better waste management, but challenges remain due to inadequate infrastructure, lack of awareness among

farmers, and economic constraints; overall, the situation is improving but still requires substantial progress to achieve efficient and comprehensive farm waste management.

Key points about Farm Waste Management

- **Large waste generation:** India produces over 620 million tonnes of agricultural waste annually, with a significant portion being crop residue.
- **Burning practices:** A major issue is the burning of crop residue, particularly in regions like Punjab and Haryana, which contributes to air pollution.
- **Underutilization of waste:** Only a small percentage of agricultural waste is currently utilized for purposes like animal feed or energy production.

- **Government initiatives:** The government has launched programs to promote sustainable waste management, including subsidies for machinery to manage crop residue and initiatives to convert waste into bioenergy.

Positive Developments

- **Growing awareness:** Increasing awareness about the environmental impacts of burning crop residue is pushing farmers towards alternative methods.
- **Technological advancements:** Technologies like composting, anaerobic digestion, and biofuel production are gaining traction in the utilisation of agricultural waste.
- **Farmer engagement:** Some farmers are adopting practices like mulching and crop residue retention in the soil.

Major Challenges

- **Infrastructure limitations:** Lack of adequate collection and processing infrastructure hinders efficient waste management.
- **Economic constraints:** Farmers may lack the financial resources to invest in new technologies for waste management.
- **Knowledge gaps:** Many farmers may not have sufficient knowledge about sustainable waste management practices.

Overall, while there are positive developments in farm waste management in India, significant efforts are still needed

to address the challenges and achieve a more comprehensive and sustainable approach to utilizing agricultural waste effectively.

9.0 BENEFITS OF WASTE MANAGEMENT

Collection, transportation & disposal of garbage, sewage & other waste products is called **Waste Management.** Waste management has many benefits, including environmental protection, resource conservation, and cost savings. This involves treating solid & liquid waste. The following are the benefits of waste management:

9.1 Environmental Protection

- **Reduces pollution**: Waste management reduces the amount of waste that ends up in landfills or pollutes the environment.
- **Protects ecosystems**: Waste management prevents the harmful effects of waste accumulation on ecosystems.
- **Mitigates climate change**: Waste management helps mitigate climate change.

9.2 Resource Conservation

- **Conserves natural resources**: Waste management helps conserve natural resources by recycling materials like paper, glass, plastic, and metals.
- **Reduces energy consumption**: Recycling conserves energy.

9.3 Cost Savings

- **Reduced disposal fees**: Waste management can lead to cost savings for businesses through reduced disposal fees.

- **Elimination of landfill fines**: Waste management can help businesses avoid landfill fines.
- **Decreased demand for raw materials**: Waste management can help businesses reduce their demand for raw materials.

9.4 Other Benefits

- **Job creation**: The recycling industry also generates jobs. Thus, we see that by managing waste, we are making a difference to society & our world. Even though we cannot completely get rid of garbage, we can adopt eco-friendly practices of reducing & reusing waste. This way, we serve as an example for the people around us, who, in turn, are now motivated to embrace a sustainable approach.
- **Safer and more sustainable living conditions**: Waste management ensures safer and more sustainable living conditions.

10.0 COLOUR CODE FOR WASTE DISPOSAL

Waste Disposal Colour Code:

Colour coding at the source itself helps in separating the waste for waste disposal. It helps in decreasing the hazards & handling & disposal costs. As waste harms the health & well-being of the environment, appropriate waste management is essential for maintaining hygiene, aesthetics, cleanliness & pollution control. The colour codes for waste disposal vary from country to country. It may also be different for plastics, recyclables, metals, glassware, radioactive items, etc. They need to be separated as per the recycling needs

1. **Yellow** is considered to be clinically highly infectious, which is meant for pathogens. Incineration is the waste disposal method for this. Bodily fluids or medicinal fluids that infect PPE kits & garments are under this category.
2. **Orange** is used for hazardous & non-hazardous waste which comes out of patients having infectious diseases. Medical waste & anatomical waste should not be mixed with this waste.
3. **Black and Yellow** waste can neither be recycled, incinerated, or deep landfilled. Any waste that is not in

contact with bodily fluids can be disposed of in this bag or container.

4. **Purple** waste stream is meant for hazardous waste that has been polluted by chemotherapy-related pharmaceuticals & certain medicines having cytotoxic or cytostatic properties.
5. **Red** represents the anatomical waste stream, which includes all body parts that must be disposed of & is most usually associated with surgical treatments. This has both hazardous & non-hazardous waste. This needs to be incinerated.
6. **White** is meant for containers that are used for sharps & puncture-proof bags.
7. **Blue** is used for non-hazardous solid waste that includes regular pills, medication & pharmaceuticals.

The colour codes for biomedical waste disposal & waste disposal are not the same.

11.0 WASTE DISPOSAL SERVICES BY COMPANY

Waste Disposal Services: Waste management is one of the biggest problems India faces. A lot of waste is generated every day & it is not effectively managed. This impacts the environment & human health. Many waste management companies can handle all our waste disposal needs. Some of the waste management companies in India that provide e-waste, paper waste & solid waste management services are:

Company Name	Services	Head Office
Attero	E-waste management	Noida, Uttar Pradesh
Synergy Waste Management Pvt. Ltd.	Biomedical waste management	New Delhi
Eco-Wise Waste Management Pvt. Ltd.	All waste management	Noida, Uttar Pradesh
Saahas Zero Waste	End-to-end waste management	Bangalore, Karnataka
NEPRA-Let's Recycle	Dry waste management	Ahmedabad, Gujarat
Greenobin Recycling Pvt. Ltd.	Paper waste management	Gurgaon, Haryana
Sampurn(e)arth Environment Solutions Pvt. Ltd.	Solid waste management	Mumbai, Maharashtra
Namo e Waste Management Ltd.	E-waste management	Faridabad, Haryana
Shivalik Solid Waste Management Ltd	Solid waste management	Nalagarh, HP
Antony Waste Handling Cell Ltd.	Solid waste management	Mumbai, Maharashtra
Eco Credible Enviro Solutions Pvt. Ltd.	E-waste recycling, solid waste management & wastewater treatment	Pune, Maharashtra
ComePost	Complete waste management	Mumbai, Maharashtra

There are several waste disposal companies working in Odisha, including Mantra Udyog, Micro Composition Center, and S.K. Nayak.

Waste Disposal Companies in Odisha

- **Mantra Udyog**: A popular waste disposal service in Bhubaneshwar
- **Micro Composition Center**: A popular waste disposal service in Bhubaneshwar
- **S.K Nayak**: A waste disposal service in Bhubaneshwar
- **Hulladek Hungry for Waste**: A waste disposal company in Bhubaneshwar
- **Medicare Environmental Management Pvt. Ltd.**: A waste disposal company in Bhubaneshwar
- **Greentech Environ Management Pvt Ltd**: A waste disposal company in Bhubaneshwar
- **Igiene Cleaning Services Pvt Ltd**: A waste disposal company in Bhubaneshwar
- **A 2 Z Waste Management**: A waste disposal company in Bhubaneshwar
- **Vishras Waste Bin**: A waste disposal company in Bhubaneshwar

12.0 WASTE DISPOSAL PROJECTS

India generates more waste than it recycles. This is a grave matter of concern as it threatens our environment & sustainability. Certain projects deal with waste disposal. These are:

1. Rejuvenation of Lake

Chilika Lake was rejuvenated through a combination of measures, including desilting, opening a new mouth, and community participation. These efforts improved the lake's water quality, fish yield, and the livelihoods of local communities. The project was about desilting, beautification, creating a walking path & tree plantation.

2. Solid waste management & Construction of Sewage Treatment Plant

The Odisha Water Supply Sewerage Board (OWSSB) is constructing sewage treatment plants (SeTPs) and managing solid waste in Odisha. REC Limited along with Tata Memorial Center, Skill Council for Green Jobs (SCGJ), New Delhi, and Advanced Center for Treatment, Research & Education in Cancer (ACTREC) in Uttar Pradesh, Maharashtra & Haryana has set up mechanized sweeping, collection & transportation of Municipal Solid Waste in 14 wards of Varanasi.

3. Waste Management Program

Odisha's Solid Waste Management (SWM) program focuses on efficient waste disposal and resource recovery. The state has implemented innovative strategies to address solid waste challenges. The Government of India launched the Swachh Bharat Mission-Urban (SBM-U) on October 2, 2014. The objective of SBM-U is to scientifically process all the Municipal Solid Waste (MSW) generated in the country.

4. Clean My Village, Clean My Transport Nagar

A "Clean My Village, Clean My Transport" program in Odisha would likely focus on comprehensive cleanliness initiatives across villages, including public spaces, roads, and

transportation hubs, often involving community engagement, waste management practices, awareness campaigns, and collaborations with local authorities to improve hygiene standards in rural areas of Odisha.

5. Zero Waste Initiative

Odisha has taken several steps toward zero waste, including awareness campaigns, waste segregation, and recycling. Swachh Sathis and sanitation workers have conducted awareness campaigns in all 114 urban local bodies (ULBs). The state government and state pollution control board have organized awareness campaigns. The state pollution control board has organized plastic waste collection drives in Puri. The Bhubaneswar Municipal Corporation (BMC) has launched a pilot project to educate students about sustainable waste management practices.

6. Waste Management Program

Odisha's Solid Waste Management (SWM) program focuses on efficient waste disposal and resource recovery. The state has implemented innovative strategies to address solid waste challenges. The Odisha Urban Academy offers specialized training programs for professionals, administrators, and elected representatives. The state has a collaborative and forward-thinking approach to waste management. The state's commitment to sustainable waste management positions it at the forefront of effective and responsible solid waste management practices. Godrej Consumers Products Limited, along with Maa Kamakhya Disposable Works in Assam, has started several community waste management projects in India.

7. Sustainable Development

Odisha has made progress in sustainable waste management by using innovative approaches like door-to-door campaigns, source segregation, and battery-operated vehicles. Sustainable waste management practices adopted by the Odisha Govt are reducing single-use plastics, reducing food waste, addressing wastewater, making sustainable purchases, recycling, reusing, repurposing, and refusing.

8. Recycle & Reuse Programme

Odisha's waste management program includes recycling, reuse, and awareness campaigns to reduce plastic waste. Plastic waste recycling: 11 units have been registered under extended producer responsibility guidelines. Twenty units have been registered under extended producer responsibility guidelines.

9. Bio-Degradable Films Development Program

Biodegradable films have been developed in Odisha using guar gum, taro starch, and yam starch. These films are an alternative to petroleum-based plastics and can be used for packaging and agriculture. Cost-eûectiveness & increased shelf life of the products are generating demand for ûexible plastic packaging.

10. Waste Management Programmes

Godrej Properties Limited, along with Feedback Foundation Charitable, is planning the Neighbourhood Waste Management Programme and has started an integrated, decentralised solid waste management project in Konark, Odisha. This project follows a 'No Open Waste' or NOW approach & is likely to divert approximately 95% of the collected

waste from landfill or dumping sites through segregation at the source & a well-established value-chain consisting of collection staff, waste aggregators & recyclers.

12.0 WASTE DISPOSAL IN HOSPITALS

Hospital waste is also called medical waste or clinical waste. Clinical waste is waste that poses a risk of contamination or infection. Apart from hospitals, dental surgeries, doctors' surgeries, research laboratories, funeral parlours, veterinary clinics, blood banks & nursing homes also produce waste. Hospital waste is categorised in two different ways: hazardous or non-hazardous. These are:

- **Infectious waste** that has been contaminated with bodily fluids such as blood, infectious cultures from laboratories & waste from patients who have infections.
- **Anatomical waste**, also called pathological waste, is any waste that contains body tissues.
- **Offensive/hygiene waste** is likely to cause an 'offence' to the senses & is unpleasant because of smell. It includes things like sanitary protection, nappies & incontinence pads.
- **Sharps** is anything sharp like needles, syringes, scalpels & blades. Sharp waste is also separated into subcategories depending on the risk it poses.
- **Chemical waste** can be both hazardous & non-hazardous depending on its properties. Most chemical waste in hospitals is hazardous. Example: Reagents & solvents used in laboratory work, X-ray fixers & developers. It also includes cleaning, sterilising agents & batteries.

- **Pharmaceutical waste** is related to medication & drug waste, which is largely considered non-hazardous except for cytotoxic & cytostatic medications. Hospitals dispose of medicines that have expired or been unused into open containers or packaging. Prescribed medications, unused medications, or medication that belonged to someone who has died or who no longer uses it is also pharmaceutical waste.

- **Cytotoxic & cytostatic waste** is always considered hazardous regardless of whether it has come into contact with a person. This is hazardous because of its 'genotoxic properties', waste which may be mutagenic (capable of causing a genetic mutation), carcinogenic (cancer-causing), teratogenic (causing damage to an embryo or foetus), or hazardous for reproduction.

Hazards Associated with Hospital Waste

Hospital waste has potentially harmful microorganisms that can infect healthcare workers, patients & the general

public. Drug-resistant microorganisms can spread from a hospital to other places, this makes them hard to treat. Some of the hazards associated with hospital waste include:

- Sharp causes injuries
- Exposure to toxic products like cytotoxic substances & drugs, directly or through environment during handling or disposing of such waste.
- Disinfection protocols & waste treatment cause burns.
- Incineration & the particulate matter released in emissions cause air pollution.
- Radiation burns from radioactive substances.
- Injuries due to waste disposal, including burns when operating incinerators.

Managing Hospital Waste

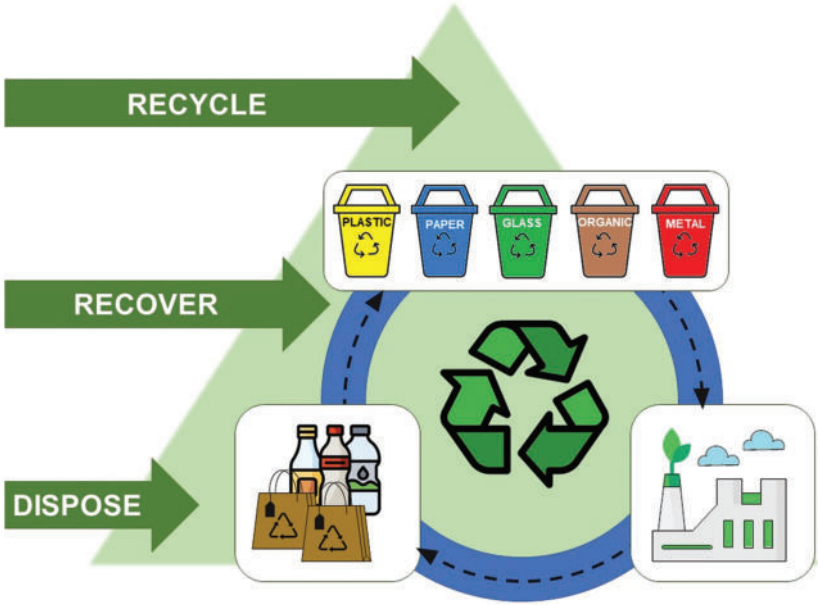
To improve hospital waste management, organisations should promote practices that reduce the amount of waste that is generated & ensure waste is segregated properly. Some of the ways through which hospital waste can be managed are:

- **Alternatives to incineration**- These methods include microwaving, autoclaving, chemical treatments & steaming treatments.
- **Hospitals need to create a system** so that waste can be disposed of correctly. A hierarchy needs to be made for those responsible at each step in the process of clinical waste disposal.

- **Training-** The ones handling healthcare waste must also be aware of the hazards & risks that come with their job. This training also applies to volunteers, hospital café workers & cleaners, consultants & managers.
- **Environmentally friendly practices**- Hospital waste is largely non-recyclable. However, even recyclable waste is often thrown away with municipal waste. Hospital leaders should look into potential waste management options that are more sustainable & reduce environmental hazards.

13.0 WASTE DISPOSAL AND RECYCLING

Solid waste can also be treated by reclaiming the raw materials within the waste stream & then reusing them to make new products. Recycling reduces the amount of waste that must be burnt or buried. It also takes some pressure off of the environment by reducing the need for new resources, such



as paper and metals. Most recycled products fall within 4 groups: metal, plastic, paper & glass.

- **Metal** is in most aluminium & steel cans. It is 100 percent recyclable; it can be completely reused over & over again to make new cans.
- **Plastic is** made from the solid materials, or resins, left over after oil (a fossil fuel) has been refined to make gasoline.
- **Paper:** Most paper products can only be recycled a few times as recycled paper is not as strong or sturdy as virgin materials. By doing this, the cutting of trees is prevented.
- **Glass** is one of the easiest materials that can be recycled & reused as it can be melted down over & over again.

14.0 DIFFERENCE BETWEEN INFORMAL AND FORMAL WASTE MANAGEMENT

Formal waste management

Formal waste management refers to both public service providers and private companies that handle waste from the time it is discarded (for example, when a household leaves its waste out on collection night) to the time it is "managed" – whether that be in a landfill, a recovery facility, and so on.

Formal waste management organizations are registered, regulated bodies that comply with the laws and rules created to govern the sector in their region.

Informal waste management

Informal waste management, on the other hand, refers to individuals, such as waste pickers, who work for often unregistered organizations that aren't fully compliant with their region's regulations.

These workers are often at a disadvantage – if their employers aren't doing things by the book, then it can mean they're not receiving state-mandated minimum wages or the proper occupational health standards for hazardous working conditions.

This poor treatment impacts a lot of people – in fact, approximately 15 million people around the world are involved in informal waste recycling, mainly for plastics, metals, glass, and paper. Informal waste management can sometimes negatively impact the environment because it lacks the required technology for proper waste segregation – for example, between recyclable and non-recyclable materials.

It has also been found that informal waste management exacerbates air, soil, and water pollution due to the improper management of secondary pollutants that are formed by chemical reactions.

15.0 WASTE MANAGEMENT SERVICES

The different services used to manage waste will depend on plenty of factors, including the type and amount of waste produced. There are plenty of ways to get started handling waste more efficiently:

- **Audit:** To create an effective waste management plan, businesses can conduct an audit to figure out the type, quantity, and frequency of the waste they produce
- **Plan:** Using the information from such an audit, the business can have a formal waste management service draw up a plan for disposing of its waste. This will usually include a cost estimate
- **Equipment:** Depending on the plan, businesses may receive equipment from the waste management company. This could be as simple as designated recycling bins
- **Collection:** Waste managers collect the waste as needed
- **Tracking:** By organizing their waste management efforts, businesses can track their progress against predetermined goals

16.0 CHALLENGES FACED IN WASTE MANAGEMENT

India faces challenges in managing waste. The informal sector plays a significant role in extracting value from waste, but many challenges remain.

- **Rapid urbanization:** Urban areas with 377 million people generate about 62 million tons of solid waste every year. However, only 43 million tons are collected, and the rest ends up untreated or in landfills.

- **E-waste** is also a growing concern, with projections showing a substantial increase in e-waste generation.
- **There is a lack of adequate garbage collection infrastructure,** with only 21 million garbage collectors compared to China's 700 million.
- **Sorting recyclable materials** is also a problem, as only about 30% of waste is properly sorted, leading valuable materials like aluminium and plastics to end up in landfills instead of being recycled.

17.0 SOLUTIONS TO WASTE MANAGEMENT

- **Scientific studies and planning:** It means understanding the type of waste, the costs involved, and the best locations for disposal facilities.
- **India needs to invest in innovative technologies** and develop a better recycling infrastructure.
- **Improve waste collection:** India has more frequent services, uses machines to collect waste, and coordinates the timing of collection with waste generation.
- **Combining informal and formal waste collection sectors:** This will help with segregation and collection. Other ways to improve include decentralized waste management, where local communities take care of waste treatment, and promoting recycling by implementing supportive policies and regulations.
- **Treating organic waste** through composting and bio-methanation can reduce the amount going to landfills.
- **Converting existing dumps into sanitary landfills:** This requires proper funding and expertise.

- **Integrating technology** like RFID-enabled monitoring and GPS tracking can also help in efficient waste management.
- **Waste-to-energy methods** like bio methanation can convert organic waste into fuel, which is beneficial.
- **The concept of common waste treatment facilities** is being promoted, involving public-private partnerships. The country needs to ensure proper treatment facilities for biomedical and hazardous waste.
- **Strictly implementing waste management rules,** especially the "Polluter Pays Principle," is crucial to penalize those who don't comply.

Public awareness: India needs to educate people through community organizations and self-help groups about separating waste, recycling, and composting to make the process more effective and sustainable.

18.0 FUTURE STRATEGIES FOR WASTE MANAGEMENT

The future of waste management lies in continuous innovation and advancements. With the increasing adoption of sustainable practices and emerging technologies, waste management is evolving towards a more circular and resource-efficient model. Advancements in waste sorting and recycling technologies, along with the integration of renewable energy sources, hold promise for a sustainable waste management future. The future of waste management is moving towards a more circular model that's more resource-efficient and sustainable. This will involve innovation, new technologies, and sustainable practices.

Waste Management Innovations

- **Waste sorting and recycling**: The new technologies can sort and recycle waste more efficiently.
- **Renewable energy**: Integrating renewable energy sources into waste management can help reduce emissions.
- **Waste-to-energy**: Waste-to-energy technology can improve efficiency and reduce emissions.

Waste Management Principles

- **Reduce, reuse, recycle**: The "3Rs rule" is a key principle of waste management.
- **Extended producer responsibility**: This adds the environmental costs of a product to its market price.
- **Zero waste**: This involves redesigning the resource extraction, consumption, and disposal cycles so that no resources are wasted.

E-waste management in India

India's e-waste recycling industry has growth potential, but stakeholders need to invest in sustainable practices to realize it. The future of e-waste recycling in India is bright, with emerging trends and innovations that can transform the industry. However, to fully realize the potential of these innovations, stakeholders must embrace innovation and invest in sustainable e-waste management practices.

The exponential growth of electronic devices and technology has led to an increase in electronic waste, creating a pressing need for sustainable e-waste management and

recycling. Emerging trends and innovations in e-waste recycling in India are addressing these challenges with new technologies and processes that make it possible to recover valuable materials from electronic waste while minimizing the environmental impact.

E-Waste Recycling in India and Its Potential for Growth

India is one of the largest producers of electronic waste, with around 2 million tons generated annually. However, only a small fraction of this e-waste is properly recycled. The current state of e-waste recycling in India is hindered by inadequate infrastructure, lack of awareness, and limited government support. However, the potential for growth in the e-waste recycling industry is immense, with increasing public awareness and government initiatives promoting sustainable waste management practices.

Innovative E-Waste Recycling Technologies and Processes

Innovative e-waste recycling technologies and processes are transforming the industry, making it possible to recover valuable materials while minimizing environmental impact. For example, some companies are using advanced robotics and

AI technologies to sort and dismantle electronic waste, while others are using chemical processes to recover rare earth metals from discarded electronics. Additionally, some companies are using blockchain technology to track the entire e-waste recycling process and ensure transparency.

19.0 SMART WASTE TECHNOLOGIES FOR THE FUTURE OF WASTE MANAGEMENT

Several innovative companies are working on exciting new waste management systems and technologies that are specifically designed to build a more sustainable waste management industry. These technologies come in a variety of different forms and address several different issues affecting the waste management industry. One thing they all have in common is a desire to reduce pollution, streamline the waste collection system and protect our environment.

Many of the new technologies making waves in the world of solid waste management are aimed at businesses. This is because companies generally produce more waste than individual households. Helping businesses make sustainable waste management easier and more cost-effective will encourage more to recycle. With an estimated 75 percent of all the waste we produce thought to be recycled, this could have a real impact on pollution, landfill levels and climate change.

Around the world, businesses and waste management companies are already integrating smart automation and technology into their processes. Here are eight of the most exciting emerging technologies for 2024.

1. Smart Waste Bins

When left to their own devices, people don't always bother to sort their waste into the proper waste or recycling bins. To help reduce improper recycling sorting, Polish company Bin-e designed a smart waste bin that uses artificial intelligence-based object recognition to automatically sort recyclables into separate compartments. After sorting, the machine compresses the waste and monitors how full each bin is.

Smart waste bins take human error out of the initial sorting process, making material processing faster and easier for recycling facilities. This can lower waste management costs by as much as 80% and drastically improve employee efficiency.

2. Pello

Pello is a new technology that's been developed to help businesses reduce their environmental impact and manage their waste collection more efficiently. Pello helps companies

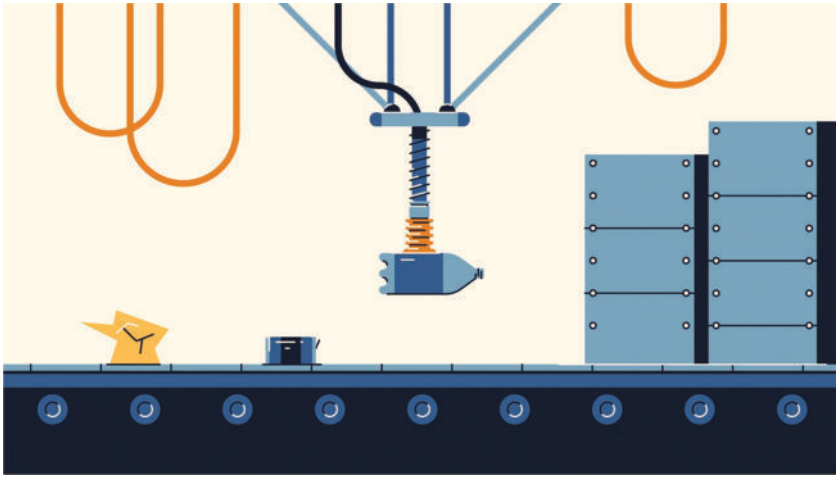
to achieve these goals in several different ways. Firstly, the Pello system monitors the fill level of your trash cans and provides real-time information on the dumpsters' contents and location. It also tells you if your container has been contaminated and sends pickup alerts when a collection is due.

Having this information at your fingertips allows you to streamline your waste management practices and take control of your business's waste disposal. It also means that garbage trucks are only sent out when necessary, something that can help to reduce greenhouse gas emissions and cut traffic.

3. Recycling Robots

Artificial Intelligence has been in the news a lot lately, and not always for the right reasons. However, one area where AI could make a real and valuable difference is in the world of recycling. AI robots can be programmed to quickly and accurately differentiate between different materials, and many recycling centers are already making use of the technology.

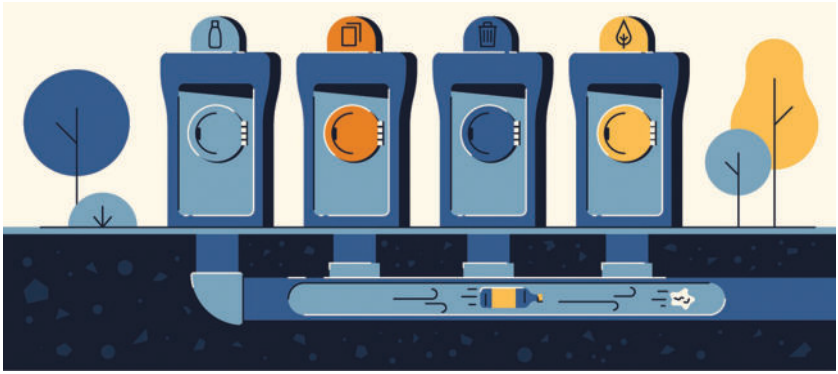
Introducing AI robotics into the process allows for more efficient waste sorting in recycling centers and helps to divert as many recyclable materials away from landfills as possible. It



also allows waste management companies to operate longer hours or even stay open 24/7, dramatically increasing the amount of waste processed.

4. Pneumatic Waste Pipes

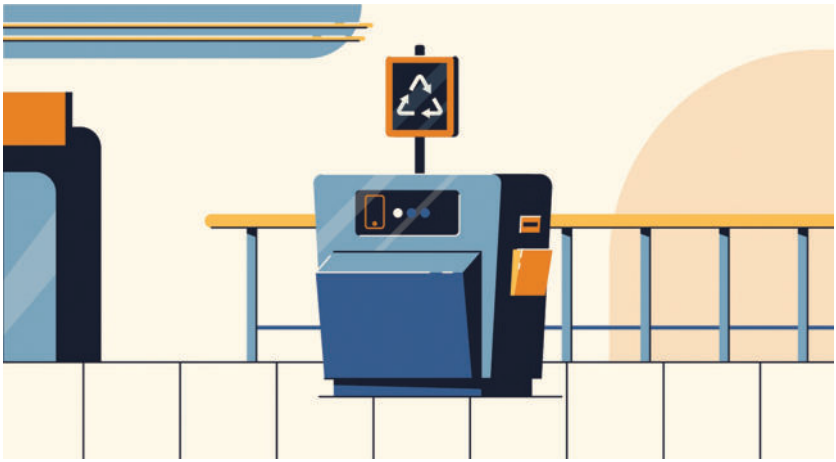
As urban areas grow and become more densely populated, traditional waste disposal and collection systems become less practical. One of the best tech solutions to this problem is the pneumatic waste pipe. Pneumatic pipes can be installed below public waste containers to transport waste straight to processing centers without the need for a trash pickup.



This system has two main benefits. The first is that it can dramatically reduce the number of garbage trucks on the roads. This can help to cut harmful emissions and minimize the number of vehicles clogging up our cities. Secondly, sending waste direct from dumpsters to waste management centers can help to avoid full containers overflowing. As well as being unsightly, overflowing dumpsters can cause an environmental health hazard and contribute to the pollution of the local area.

5. Solar-Powered Trash Compactors

The more waste a trash truck can carry, the more it can collect on each round and the fewer trips it has to make. Solar-powered trash compactors compress trash as it accumulates inside a dumpster to increase capacity. This allows these smart containers to hold up to five times more than traditional trash bins.



As well as compressing waste, solar-powered trash compactors have built-in waste level sensors. These sensors transmit data on the capacity of the bins, allowing users to schedule pickups and streamline the collection process.

6. Garbage Truck Weighing Mechanisms

Like waste level sensors, weighing mechanisms installed in garbage trucks can help predict fill levels and reduce collection trips. They do this by measuring and storing the weight of waste containers, then using the data to predict fill levels over time. Cities can use this technology to more accurately predict how often they need to send their trucks out and reduce annual collection costs.

7. E-Waste Kiosks

Electronic waste, like old computers, phones and TVs, contains a lot of harmful substances. If e-waste is improperly disposed of, these substances can leak out into the environment and pose a serious hazard to both human health and the local ecosystem. Instead of being sent to landfills, e-waste should be recycled or, even better, repaired and reused. This will help to prevent harmful chemicals from seeping into our soil and water and protect the local area.

One start-up company has taken things into their own hands by launching specialist e-waste recycling kiosks. Eco ATM kiosks allow you to dispose of your unwanted electronics safely and easily. If your phone, tablet or computer is still in good condition, they may even give you cash in exchange for the item, rewarding your efforts and helping to boost e-waste recycling rates in the process.

8. Recycling Apps

Apps have changed the way we order taxis, the way we date and the way we communicate, so why not the way we recycle? A new range of apps is now available to help individuals and businesses navigate the world of recycling. From donating your food waste to a worthy cause and giving away your

clothes to locating a nearby recycling center, these apps are a fantastic resource for those who want to keep their waste out of the landfill. Some apps also provide detailed information on exactly which materials can be recycled in your local area.

Because a lot of apps allow you to pass unwanted items on to other people, they're also a great way to develop a sustainable, circular economy. Check out your app store to find out more about the specialist apps on offer.

20.0 CONCLUSION

India, as well as Odisha, faces significant challenges in the management of waste due to its large population and the huge amount of trash it generates approximately 1.3 billion tons every year, a third of the global total. India must improve its recycling industry, as only 5% of recycled material is currently reused. Solving these problems is crucial for a sustainable future and environmental protection.

To move forward, India needs to plan for the long-term management of waste and adapt strategies to changing lifestyles. Household and institutional waste must be separated at the source to make recycling more efficient.

The goal is to minimize landfill use, but this requires active community participation. Recycling e-waste on a large scale is vital for solving the e-waste disposal problem. India must take action to solve these challenges, as it's not just an Indian problem but a global one that affects everyone.

Waste management is not just a responsibility; it's a necessity for a sustainable future. From individuals to governments, everyone has a role to play in creating cleaner, healthier environments. Let's work together to manage waste effectively and give back to the Earth.

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