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WASTE MANAGEMENT IN INDIA

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Abstract:

The quantity of waste production is raising daily due to industrial activities, economic development, and population growth. In India, rapid urbanization and growing population have led to a significant increase in waste generation, posing severe environmental and health concerns. Moreover, improper disposal and the accumulation of hazardous waste pose serious environmental and health risks. This paper examines the current state of waste management in India, highlighting the challenges and opportunities for improvement. This research paper also explores the best solutions, such as implementing effective waste segregation and recycling practices, leveraging technology for efficient waste management, and promoting public-private partnerships for infrastructure development. By addressing these issues with integrated approaches, waste management can evolve from a burden to an opportunity for environmental protection, economic growth, and social well-being. Effective waste management strategies are essential for the country's environmental sustainability and public health.

Keywords: waste management, urbanization, environmental sustainability, public health.

1. Introduction:

Waste management means the processes of managing waste from cradle to grave. And this process includes the collection, transportation, disposal/recycling and monitoring of waste materials produced as a result of human activity. Waste management includes all types of waste, such as household, industrial and hazardous. It can also be solid, liquid or gas, each of which have their own methods of management and disposal.

The whole object of the topic is to reduce the amount of waste that goes into landfill and its effects. Related operations in that line include waste recycling, composting, and converting to useful energy. It has many objectives, such as reducing pollution and conserving resources to

achieve sustainability by properly handling waste materials.

Effective waste management involves strategies to reduce waste generation, reuse materials, and recycle products, ensuring that as much waste as possible is diverted from landfills. With the growing concerns over pollution, climate change, and resource depletion, waste management has become an essential aspect of sustainability, encouraging communities and industries to adopt eco-friendly practices and technologies.

2. Statement of problem:

Waste management remains one of the most critical environmental challenges faced by urban areas worldwide. With rapid population growth, urbanization, and industrialization, the

volume of waste generated has significantly increased, outpacing the capacity of existing waste management systems. Addressing waste management requires innovative, sustainable solutions that can reduce waste generation, enhance recycling efforts, and promote responsible waste disposal practices to safeguard public health and the environment. This research is focused on the following questions:

- 1) What are the primary challenges facing waste management systems in India?
- 2) What role does population growth play in the increasing volume of waste in India?
- 3) How effective are current waste segregation practices in Indian households and commercial establishments?
- 4) What are the technological innovations being implemented in waste management in India, and how effective are they?
- 5) Whether any scheme is launched by government of India to reduce wastes?

3. Review of literature:

In their study, **Kumar and Jha (2008)** discuss the technological and economic challenges associated with recycling, particularly focusing on municipal solid waste (MSW) management. They found that a significant barrier to effective recycling is the contamination of recyclable materials, which diminishes the quality and economic viability of recycled products.

McDougall et al. (2001) defined sustainable waste management as an approach that minimizes environmental impact while ensuring that economic and social factors are balanced. They emphasized the importance of using life cycle assessment (LCA) tools to evaluate the sustainability of different waste management options.

Onwughara (2010), in this research article, different waste management hierarchy of waste management options and environmental impact of options are described. The research article also explains the environmental impact of waste management with special reference to health and social effects. The researcher has

suggested legislation of Extended Producer Responsibility where remanufacturing and reuse is available to insure sound management practice in developing country Nigeria.

Teresa (2010), this research paper focuses on analysis of the solid waste management practices of waste generators. The researcher has observed that, the waste generators do not practice waste segregation, dumping of the waste is not done properly; waste generators dump the waste in the open drainage, in rivers or on the street. The respondents do not recycle the waste because of lack of facilities and lack of support from the local civic authorities. Lack of financial resources, lack in decision making are the major problems of the civic authorities. The researcher suggests that the local government units should formulate a long-term and comprehensive solid waste management program that would encourage and motivate the public to encourage their cooperation and participation.

Rodic (2010), this research paper is based on the observations made of the present situation of solid waste management of twenty cities. The researcher notes that, solid waste management is a challenge in many cities as it can pose public health and environmental risks, precipitate into political crisis, display strong leadership and commitment to sustainable practices and equity of citizens.

Kinnaman (1999), this research article gives a broad overview of recent trends in solid waste and recycling, related public policy issues. The explains that economists have developed an effective model for recycling of solid waste because of the awareness of public towards the effective solid waste management has been increased in United States and Europe. Economists have also used different kinds of data to estimate the factors that contribute to the generation of residential solid waste and recycling.

V Ramakrishna (2012), the research paper focuses on the process of energy recovery from municipal solid waste generated in New Delhi.

Municipal solid waste can be used as fuel for which different components of wastes are observed. Energy can be recovered from municipal solid waste in the form of biogas and usage as a fuel. The researcher concludes that continuous recovery of energy from the city's municipal solid waste through biogas needs a lot of planning with respect to the design, construction, operation and maintenance of landfills. The researcher suggests that Electric Power Generation process can be fired by MSW as fuel in the boiler steam-turbine system.

4. Objectives of the study:

- 1) To review the effectiveness of existing government policies and regulations related to waste management,
- 2) To identify and analyze the major challenges faced in waste management
- 3) To assess the level of public awareness regarding waste segregation and management
- 4) To analyze the trends in waste generation in urban and rural areas of India
- 5) To compare India's waste management practices with global best practices

5. Research methodology:

This research is based on doctrinal research methodology involves analysing and interpreting the text which are already in existence. The data collected for this research is mostly on secondary sources and the sources are journals, newspapers, articles, case analysis, etc. This includes both quantitative and qualitative research process.

6. Significance of the study:

- 1) The study can provide insights into how improving waste management practices can help reduce land, water, and air pollution, thereby contributing to a cleaner and healthier environment
- 2) By analyzing waste management systems, the study can help identify methods to reduce health risks associated with poor sanitation and waste handling.
- 3) This can support the successful implementation of initiatives like the

Swachh Bharat Mission and improve overall governance in waste management

- 4) The study's findings can suggest ways to reduce emissions and mitigate climate change, aligning with India's climate action goals.

7. Limitation of the study:

- 1) One of the significant limitations could be the lack of accurate and comprehensive data on waste generation, collection, and disposal practices, particularly in rural areas. This may result in challenges in drawing definitive conclusions or generalizing findings
- 2) The study may face limitations due to the inconsistency in the implementation of waste management policies across different states and municipalities. In some areas, local governments may not have the necessary resources or political will to enforce regulations effectively.
- 3) Conducting a comprehensive study on waste management may require significant financial and human resources, which may be difficult to obtain, especially when the focus is on practical solutions for resource-poor regions or economically disadvantaged areas.
- 4) The adoption of advanced waste management technologies (e.g., waste-to-energy, automated sorting) may be limited by high costs, lack of technical expertise, or infrastructure deficits in certain regions, affecting the feasibility of scaling up such technologies nationwide.
- 5) Waste management policies often face delays or changes due to political factors or administrative inefficiencies, making it difficult to carry out a study with stable, long-term governmental support or commitment.

8. Body of the research:

8.1 Population density:

Population plays a significant role in the increasing volume of waste because as the population grows, so does the demand for

goods, services, and consumption. More people lead to:

More people typically consume more resources, which results in more packaging, food waste, and electronic waste, among other types of waste. As populations concentrate in urban areas, waste generation increases due to dense living conditions and more industrial activities. Growing populations often drive construction, infrastructure development, and industrial expansion, generating large amounts of construction and demolition waste. As the population grows, there is an increased strain on natural resources, leading to more waste through overconsumption and inefficient resource use. In summary, a larger population intensifies waste generation due to higher levels of consumption, industrialization, and urban development.

8.2 Technological developments

India has been increasingly focusing on technological innovations for waste management to address its growing urbanization and waste challenges. Some of the key technological innovations being implemented include:

- 1) **Smart Waste Bins and IoT (Internet of Things):** Cities like Surat and Indore are using smart waste bins equipped with sensors to monitor the fill levels. This technology enables more efficient collection schedules, reducing unnecessary trips by waste collection vehicles and optimizing the overall waste management process.
- 2) **Robotics and AI for Waste Sorting:** AI-powered robots are being introduced in some waste management facilities to automate the sorting of recyclable materials from mixed waste. Robotics systems can help improve sorting efficiency and reduce labor costs.
- 3) **Circular Economy Models:** Indian cities are increasingly adopting circular economy principles, focusing on reducing waste by reusing and recycling materials. New business models and platforms are being

developed to promote upcycling and reuse of materials in various industries.

- 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 centres 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 centres 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.

8.3 Policies Rules and Act governing Waste management:

Waste management in India falls under the purview of the Centre with the Ministry of Environment, Forests and Climate Change being the nodal ministry. The National Environment Policy, 2006 has laid emphasis on disposal, recycling and treating waste. It is the primary legislatures to protect the environment and regulation of waste. Major legislations include the following.

- A. **Plastic Waste Management Amendment Rules, 2021** Proposes a ban on the manufacture, import, stocking, distribution, sale and use of specific single-use plastic

from July 1, 2022. These include plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, and thermocol (extended polystyrene) for decoration.

In order to stop littering due to light weight plastic carry bags, with effect from 30th September, 2021, the thickness of plastic carry bags has been increased from fifty microns to seventy five microns and to one hundred and twenty microns with effect from the 31st December, 2022. This will also allow reuse of plastic carry due to increase in thickness.

B. Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2019

Solid plastic waste has been prohibited from import into the country including in Special economic Zones and by Export Oriented Units. Exporters of silk waste have now been given exemption from requiring permission from the ministry of Environment, Forest and Climate Change.

Electrical and electronic assemblies and components manufactured in and exported from India, If found defective can now be imported back into the country, within a year of export, without obtaining permission from the Ministry of Environment, Forest and Climate Change.

C. E-waste (Management) Amendment Rules, 2018

Collection targets under the provision of Extended Producer Responsibility (EPR) in the Rules have been revised and targets have been introduced for new producers who have started their sales operations recently. The phase-wise collection targets for e-waste in weight shall be 10% of the quantity of waste generation as indicated in the EPR Plan during 2017-18, with a 10% increase every year until 2023.

After 2023 onwards, the target has been made 70% of the quantity of waste generation as indicated in the EPR Plan. Producer Responsibility Organizations (PROs) shall apply to CPCB for registration to undertake activities prescribed in the Rules.

Under the Reduction of Hazardous Substances (RoHS) provisions, cost for sampling and testing shall be borne by the government for conducting the RoHS test. If the product does not comply with RoHS provisions, then the cost of the test will be borne by the Producers.

D. Bio-Medical Waste Management (Amendment) Rules, 2018

Bio-medical waste generators including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, health care facilities, and clinical establishments will have to phase out chlorinated plastic bags (excluding blood bags) and gloves by March 27, 2019.

All healthcare facilities shall make available the annual report on its website within a period of two years from the date of publication of the Bio-Medical Waste Management (Amendment) Rules, 2018.

Operators of common bio-medical waste treatment and disposal facilities shall establish bar coding and global positioning system for handling of bio-medical waste in accordance with guidelines issued by the Central Pollution Control Board.

E. Solid Waste Management (SWM) Rules, 2016

Source segregation of waste has been mandated to channelize the waste to wealth by recovery, reuse and recycle responsibilities of generators have been introduced to segregate waste in to three streams (wet, dry and domestic hazardous) and handover segregated wastes to authorized rag-pickers or waste collectors or local bodies.

Generator will have to pay "User Fee" to waste collector and for "Spot Fine" for littering and non-segregation All hotels and restaurants to segregate biodegradable waste and set up or follow a system of collection to ensure that such food waste is utilized for composting/bio methanation.

8.4 Initiatives taken by government:

Swachh Bharat Mission: The aim of the mission is to accelerate the efforts to achieve universal sanitation coverage and to put focus on sanitation. The programme includes elimination of open defecation, conversion of unsanitary toilets to pour flush toilets, eradication of manual scavenging, municipal solid waste management and bringing about a behavioural change in people regarding healthy sanitation practices. The Union Cabinet has recently approved the Phase II of the Swachh Bharat Mission – Grameen till 2024-25, which will focus on Open Defecation Free Plus (ODF Plus), which includes ODF sustainability and solid and liquid waste management.

Swachh Survekshan: Ministry of Housing and Urban Affairs Swachh Survekshan is an annual survey of cleanliness, hygiene and sanitation in cities and towns across India. The Survey, being undertaken since 2016, covers different components of sanitation. Related aspects that include segregation of waste at source and processing of waste. In the 2019 Survey, Indore was adjudged as India's cleanest city for the third consecutive year, while Bhopal was named as the 'Cleanest Capital of India'. The Swachh Survekshan 2020 covers over 4370 cities.

Atal Mission for Rejuvenation and Urban Transformation: Ministry of Housing and Urban Affairs

The Mission focuses on development of basic urban infrastructure in sewerage and septage management in the Mission cities with the expected outcome of Substantial improvement in coverage and treatment capacities of sewerage. Substantial coverage of sewerage and septage management is the priority sectors under the Mission. At the inception of AMRUT, the sewerage coverage was 31%. By the end of the Mission, it aims to cover 62% Households.

9. Challenges:

1) **Unclear regulations** Unclear regulations are another significant challenge for the

recycling industry. This can include inconsistencies in policies and practices of managing waste across states or countries. As a result, various waste management companies operating in multiple jurisdictions may become perplexed. To address this challenge, simple, clear, and consistent regulations are required. This could include standardizing definitions of recyclable and compostable materials, as well as developing national or international policies for managing waste.

2) **Lack of technological advances** This means the absence of efficient, cost-effective technologies to manage and dispose of waste in a sustainable manner. However, the current technologies used in the waste management industry are inadequate, leading to inefficiencies in the collection and processing of waste. For example, the process of sorting and separating recyclables is done manually and is labor-intensive. As a result, the process becomes costly and even leads to potential health and safety hazards for workers. Hence, automated sorting and separation technologies can help to reduce manual efforts and overcome these challenges.

3) **Financial constraints** Insufficient funding for waste management programs is another significant issue. Many communities, particularly those in developing countries, lack the necessary funding to engage in waste management infrastructure or programs. This may result in insufficient waste management services. For example, insufficient funding may prevent communities from accessing appropriate collection and disposal services, resulting in litter and unlawful dumping. Additionally, a lack of financing may lead to improper treatment of hazardous waste, which poses major threats to the environment and the health of humans.

4) **Segregation of Waste** The biggest problem in the country is the lack of awareness among people regarding sorting the

segregation of household waste Unlike in western nations where they have different dusthens for organic and non-organic waste, in India, we have poorly maintained dusthins at every nook and corner. Hence it becomes very difficult for the municipality to segregate the waste at the the destination. Bangladesh is an exceptional example of segregating waste and managing the fertility of sod by then turning waste to manure (Iftekhhar Enayetullah & Maqsood Sinha, 2015).

- 5) **Lack of Political Will and Burdened Municipalities** Till now the government of India does not have an adequate national policy for waste management and this absence led to serious health and environmental problem across India.
- 6) **Lack of Availability of Data** Very few researchers have ventured into this field and India has no time series data or panel data in connection with solid or liquid waste. So it is of very difficult to the waste management. Hence it analyzes the economy becomes difficult for private entities to enter into the market without prior assessment of future prospects. It becomes very difficult to understand the relationship between cost and benefits of the waste management policies. This inaccessibility of the area and the unavailability of the data is one of the major problems faced by waste planners in the country.

10. Suggestions:

Following are various suggestions that evolve from this study to improve the existing MSWM practices in India:

- 1) The community should pay to augment inadequate resources for MSWM of municipal bodies. Community participation in SWM is the key to sustain a project related to management of solid waste. Till date no such tax has been levied for SWM.
- 2) The people should be educated to realize the importance of source segregation at generation point as biodegradables, inert

and recyclable material for proper waste management.

- 3) Viable decentralized composting plants should be installed to reduce the load on ULBs for collection and transportation of MSW, which subsequently culminates in reduction of the pressure exerted on the landfills.
- 4) In most parts of India, sweeper and rag-pickers are still considered inferior class of citizens despite several laws in place to bring dignity to their profession. To change people's views and perspective, awareness regarding this important service to community should be initiated and manpower engaged in such activities should be named as Green brigade/Crew, and so on.
- 5) Characterization of waste at collection and also at disposal point should be made and be available in public domain. Government should take initiative to encourage Universities, Technical Institution to take up waste management in its curriculum. Assistance of academic institutions should be solicited in characterization of waste in their vicinity.

11. Conclusion:

In conclusion, waste management is a critical aspect of maintaining environmental health, promoting sustainability, and improving quality of life. Proper waste management involves reducing, reusing, and recycling materials to prevent pollution, conserve resources, and minimize the environmental footprint of human activities. However, challenges persist, including limited infrastructure, lack of public awareness, inadequate recycling systems, and the growing amount of waste due to increasing consumption. Addressing these challenges requires collaborative efforts from governments, industries, and individuals, alongside innovation in waste treatment technologies and public education campaigns. By overcoming these barriers, we can build a more sustainable future with reduced waste and a cleaner environment. All these above said suggestions are given in

relation to India and will be effective only when we individually feel the responsibility of making environment clean. As general public, we can not do much in policy and regulations formulation, adoption of newer technologies related to recycling and other waste management options but we can play a very important role in this process if we can adopt only few tips. Here are a few tips to achieve goal. India faces challenges related to waste policy, waste technology selection and the availability of appropriately trained people in the waste management sector. Until these fundamental requirements are met, India will continue to suffer from poor waste management and the associated impacts on public health and the environment.

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