

## Changed Paradigm of Municipal Solid Waste Management: Recycling and By-Products to Attain Zero Waste

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### Abstract

The gap is narrowing between urban and rural areas as a result of rapid urbanisation, the "use and throw" tendencies of the present generation, especially in the developed world, and the equally rapid communication between the two. A larger proportion of urban solid trash—including plastics and a variety of packaging materials like Styrofoam, bubble wrap, and others—contains non-biodegradable components, in contrast to the biodegradable components found in rural solid waste. Nonetheless, the mentality towards solid waste and its handling is universal across rural and urban regions. "Garbage out of sight" refers to the universally accepted practice of concealing waste. Municipal corporations and councils, which are the urban local bodies in India, are in charge of public health management.

The paper's findings are derived from previously published papers on waste management as well as suggestions made by planners, non-governmental organisations (NGOs), consultants, and government accountability bodies. Finding ways to better manage trash for the benefit of society is the primary goal of this study, which focuses on waste management programmes in India. The formal sector's involvement in waste management in our country is a significant one, and this article aims to explore that. It is possible to build upon this work, since it is novel.

**Keywords:** Management, recycling, waste disposal, waste management, welfare

### Introduction

People have been progressively moving away from nature ever since civilization began, and this trend has culminated in the current dramatic shift in human society's way of life. What a community throws out and how much of it are direct indicators of this transformation. The general public views as trash or waste everything that is unsightly or deemed useless. No matter how large or little a dwelling is, garbage will inevitably accumulate. With good management, we can dispose of the waste, put it to good use again, and even make money from it. In their pursuit of rapid economic development, Indian cities are quickly competing with global economies, but they have not been able to adequately manage the massive amounts of waste they produce. Nonetheless, according to scientific consensus, trash does not exist. Scientific conversion or treatment of nearly all solid waste components can yield some useful byproducts. So, solid waste might be defined as "Organic or inorganic waste materials produced out of domestic or business activities, that have lost their worth in the perspective of the first owner but which may be of tremendous use to somebody else." As stated by Robinson in 1986. India is home to almost 5,000 towns and 593 districts. With almost 1 billion people in the country (as of the 2001 census), over 27.8 percent call an urban area home. Assuming current trends continue, the urban population is expected to reach 33.4% by 2026. With a growing population and GDP, India is seeing a steady growth in the amount of garbage produced by its urban centres. From six million tonnes in 1947 to forty-eight million tonnes in 1997—a growth rate of 4.25 percent—and an anticipated increase to three hundred million tonnes in 2047—all from urban areas in India (CPCB, 1998).

Both urban and rural areas of the country generate more solid waste as a result of the population boom and people's improved lifestyles. In India, as in every other industry, there is a clear divide between rural and urban solid waste.

Management of public health operations in India is carried out by the urban local bodies, commonly referred to as municipal corporations/councils. Solid waste management was formerly neglected, but is now receiving the attention it deserves as a result of rising governmental and public awareness and the opportunities presented by expanding economies. Government, non-governmental organisations (NGOs), business companies, and the general people have all ramped up their efforts in recent decades. Still, land filling remains the most popular choice for managing solid waste in the US and many other nations, including India.

In light of the developing world's increasing exposure to the developed world's trash producing activities, it is widely recognised that current waste management policies cannot be sustained over the long run. The more modern techniques advocated and widely used in the industrialised world are gradually replacing the older, more traditional ways of packing and transporting goods. Consequently, there is a sea change happening in trash management to provide more eco-friendly alternatives. Recent developments in garbage management are the focus of this article. It zeroes in on the present methods used by India in its waste management programmes. The federal government, individual states, and trade associations in the United States are all recognised for their efforts in this area. The goal of this study is to learn about different programmes in both nations and identify areas where waste management could be improved.

### Separation of Waste Products

There are several distinct categories of garbage, the most common of which are:

- (i) household garbage
- (ii) Industrial by products
- (iii) Sludge from oil refineries
- (iv) Electronic garbage
- (v) The waste product from building projects
- (vi) garbage from farms
- (vii) Waste from food processing
- (viii) Biomedical waste
- (ix) Radiation waste
- (x) Meat scraps, etc.

Additional categorization of these waste kinds is possible according to the various forms of waste.

- (i) Solid trash, which includes things like food scraps, food preparation utensils, and general home garbage.
- (i) Computers, televisions, music systems, and other discarded electronic gadgets are known as E-waste.
- (ii) Liquid waste, which includes water from many sources such as manufacturers, distilleries, tanneries, and thermal power plants
- (iii) Bottles, bucket, plastic waste- plastic bags etc.
- (iv) Metal debris, which includes things like discarded metal sheets and bits.
- (v) Spent nuclear fuel and other by products of nuclear power plants

Additional categorization of these waste kinds is possible into two groups:

- A. Biodegradable (wet) waste and
- B. Non-biodegradable (dry) trash.

This biodegradable wet waste consists of the following:

- Food scraps from the kitchen, including both cooked and uncooked ingredients (eggshells, bones, etc.)
- Debris from flowers and fruits, such as juice peels and houseplants
- Yard and garden clippings, which include dry, green leaves
- Sanitary scraps
- Produce and green waste from markets selling vegetables and fruits
- Food and drink vendor scraps, etc.

What is included in the dry waste (non-biodegradable) category are:

- (i) A wide variety of plastics and papers
- (ii) Materials such as cardboard and containers
- (iii) Except for containers with potentially dangerous contents, containers of all types
- (iv) A wide variety of containers
- (v) A wide variety of glasses
- (vi) All types of metals
- (vii) Rubber, rags
- (viii) Dust and sweeping the house
- (ix) Debris
- (x) Triple-packs, tetra packs, pouches, sachets, and foils: rinsed
- (xi) Electronic waste from office and colony locations, including used cassettes, diskettes, cartridges, and components.
- (xii) Used things, such as apparel, furniture, and appliances

### **Domestic and Industrial Hazardous Waste**

Another sort of trash that can come out of homes is known as "Domestic Hazardous Waste," which is similar to the ones listed above. Things like spent aerosol cans, batteries, and cleaning solutions for the kitchen and drains, as well as automobile batteries and care products, cosmetics, chemical pesticides and insecticides, light bulbs (including CFLs, tube lights, and light bulbs), paint, oil, and lubricant, and their empty containers are all part of this category.

The Environmental Protection Agency (EPA) mandates that all solid trash, including hazardous waste, must first satisfy the legal definition.

There are three types of hazardous waste that are recognised by the EPA:

- The first category are source-specific wastes,
- The second category is nonspecific wastes, and
- The third, commercial chemical products.

For the most part, "hazardous waste" refers to trash that could do damage to people or the environment. The four states of matter—liquid, solid, gas, and sludge—are all potential forms of hazardous waste. Commercially produced items that are no longer needed, such as used cleaning agents or insecticides, or wasteful production processes can be considered these (EPA Wastes Website, 2010).

"Non Hazardous waste" is another definition. American federal agencies, state governments, and private sector organisations all use different terminology when describing what constitutes hazardous and non-hazardous trash. Wasting Defence Department (DOD) dollars or consuming DOD property due to inadequate procedures, systems, controls, or decisions is what the DOD and EPA mean when they talk about waste. Also, "abuse is the manner in which resources or

programmes are managed that causes or perpetuates waste and it includes incorrect procedures not including prosecutable fraud" (EPA Wastes Website, 2010). The following items are considered solid non hazardous waste according to the EPA: "any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including liquid, solid, semi-solid, or contained gaseous material resulting from industrial, agricultural, commercial, mining, and community activities" (EPA Wastes Website, 2010). Monetarily generated trash might also be considered non-hazardous.

In response to the public's zero-tolerance policy on fraud, waste, and abuse, the United States President issued Executive Order No. 9, Reducing Improper Payments and Eliminating Waste in Federal Programmes, in 2009, with the goal of eradicating these problems from key federal government programmes. Government and public participation in a complete framework that is open, participatory, and collaborative is the foundation of this executive order. Processing vs. Supervision Disposal of garbage is something that most individuals do regularly. Regardless matter where you live, waste disposal is quickly becoming an enormous issue. The problem persists even after people have hidden their trash; in fact, it becomes worse and worse until no one can do anything about it. This practice's well-known repercussions include health dangers, soil, water, air, and food contamination, unattractive surroundings, and the loss of valuable resources that could have been recovered from solid waste. Focusing on proper waste management is vital. Global and national concerns about waste management have grown in recent years.

Complex waste management systems are a hallmark of increasingly sophisticated human communities. Research into viable solutions to this issue is ongoing, but it is becoming more clear that relying solely on technology advancements without human involvement will not be sustainable and would only serve to further complicate things. The most effective method for managing solid waste is a system that systematically recycles all of its components after correct segregation. The well-known term for the systematic approach to managing the many steps involved in the disposal of solid waste—including collection, transportation, processing, and treatment—is solid waste management (SWM) (Robinson, 1986). From its humble origins as simple dumping, it has evolved into a complex system that offers a variety of possibilities, such as re-use, recycling, incineration with energy recovery, superior landfill engineering and design, and various alternative technologies. The World Resource Foundation (1996) and McDougall et al. (2001) state that the waste management system should be socially acceptable, economically viable, and ecologically sound for a specific area. This not only keeps the aforementioned outcomes at bay, but it also provides financial or economic benefits in some way.

## Basic Principles of Solid Waste Management

### 1. The Four R's: Refuse, Reduce, Reuse and Recycle

- a. Refuse: Avoid purchasing unnecessary items.
- b. Reduce: Lower your trash output. A more simple way of life is required. Reducing waste should be a priority.
- c. Reuse: Get the most out of anything by reusing it. Use other articles as a springboard for new ideas.
- d. Recycle – Make something new out of the recyclable trash, such manure or something else entirely. Keep recyclables and offer them to people who collect trash or rags (Kabadiwallahs).

### 2) Segregation at source:

Put separate containers for solid trash that is organic (biodegradable) and solid garbage that is inorganic (non-biodegradable). The whole recycling process using the least amount of time and money.

**3) Distinct for various solid waste types:**

It is necessary to use methods that are appropriate for the specific waste type, such as For instance, a method that works well with garbage from regular markets might not be the best fit for meat processing facilities.

**4) Treatment as close to the source as practicable:**

As much decentralisation as possible should be achieved in the treatment of solid waste. The best place to treat trash is at the source, which means every house.

**Waste Management System in India – Useability and Marketability**

The waste management industry is segmented into four submarkets:

- [i] Municipal Waste
- [ii] Industrial Waste
- [iii] Biomedical Waste
- [iv] Electronic Waste

Depending on the kind of waste, each of these four categories is subject to a unique set of regulations. The steps involved in waste management in India include from producing trash to storing it, collecting it, transporting it, recycling it, treating it, and finally disposing of it. Along with the public health department, municipal corporations in India play a crucial role in garbage management in every city. The management of municipal solid waste (MSW) is one of the many responsibilities of the Municipal Corporation. Purification of public spaces, prevention of epidemics, and detection of food fraud all fall within the purview of the public health department.

**Disposal of Waste in India**

In most cities, people dispose of their solid garbage by throwing it directly into the streets or placing it in plastic bags. Then, road sweepers come and collect it, making piles. A hand-cart trolley carries the refuse to adjacent open landfills or bins, while a tractor trolley takes it directly to the outskirts of towns. Wheelbarrows are used to gather trash from street cleaning, which is then deposited in bins either along the roadside or at an open dumping area with regular home garbage. Various equipment, such as tractors and bull carts, are used by municipal workers to transport garbage from collection stations, which are open dumping spaces or bins, to disposal sites.

On occasion, employees will manually load the MSW into trucks after collecting it in baskets from designated locations. On a daily basis, garbage collectors/dumper placers typically make four trips, tractors make two or three journeys, and bull carts make just one or two trips to the final disposal location.

Recycling centres in many cities facilitate recycling and reusing materials. Repurposing trash into something new is what recycling is all about. Recycling and reusing items is deeply ingrained in Indian culture, thanks to both modern economic trends and long-established

customs. Because many recyclables come from nearby towns and villages, several Indian cities have transformed into recycling epicentres. Main materials processed by recycling companies include metals, glass, plastic, and paper. Recycling technologies are either not available or pose

risks for a lot of products. Sometimes recycling just doesn't make financial sense. A large portion of the unofficial industry involved in managing solid waste is recycling. There are organised and unorganised parts to the waste recycling process.

### **Programmes for the Control of Waste in India**

Municipalities, state governments, and the federal government in India have all recently put a lot of emphasis on solid waste management. In the realm of solid waste management, several alliances and partnerships are discovered in Indian cities. Cooperation between these groups can take the form of public-private, community-public, or private-private partnerships. Identifying the different players in the waste management business is the first step in determining the state of current alliances in the subject area. The following categories best describe these players: and rural areas. Main materials processed by recycling companies include metals, glass, plastic, and paper. Recycling technologies are either not available or pose risks for a lot of products. Sometimes recycling just doesn't make financial sense. A large portion of the unofficial industry involved in managing solid waste is recycling. There are organised and unorganised parts to the waste recycling process.

- The public sector, which includes municipal governments and their respective agencies;
- Companies big and small that are registered in the private-formal sector that engage in collection, transportation, treatment, disposal, and recycling make up this sector.
- The private-informal sector, which includes non-registered small-scale businesses, waste-pickers, dump-pickers, dealers, and itinerant waste buyers and sellers; and
- Non-governmental organisations (NGOs), representatives of the community, etc.

These parties form alliances to carry out a range of solid waste management-related tasks. These collaborations can take the following forms:

- (i) Local authorities and commercial companies form a public-private partnership.
- (ii) Local government and non-governmental organisations (NGOs); etc.
- (iii) The business sector, which includes waste pickers, nomadic waste purchasers, waste dealers and traders, wholesalers, and recycling companies both big and small; and
- (iv) The public sector, corporate sector, and community members (including local governments, businesses, and other non-governmental organisations).

There are still health and environmental risks associated with the linear system of waste management, which involves collecting trash and then disposing of it. There will most certainly be a huge garbage disposal crisis in India's urban areas in the near future. Up until recently, trash has been perceived as a cleaning and disposal issue. However, when we examine the present and the future more closely, we see that trash requires a comprehensive approach that takes into account both its health implications and its ties to natural resources. Instead of contributing to pollution, waste has the ability to become riches through composting and recycling, which might have far-reaching effects on both the environment and the lives of the urban poor. Waste management is going to become more challenging to manage in the near future due to rising urban migration and high population density unless a new way of looking at it is developed. We must overlook the dangers of private sector involvement in waste management, despite the fact that it is desperately needed. There is a chance that the private

sector may not be completely transparent, that businesses may fail and disrupt public services, or that stakeholders won't work together very well.

Many legislative initiatives have attempted to address India's urban solid waste problem, particularly in recent years, but no one has yet found a long-term solution for the country's inorganic or organic garbage. In terms of investment and creating jobs for the urban poor without skills, garbage recycling is the most economically viable choice for emerging nations. Recycling is one of the many trash diversion strategies mentioned in all laws and policy papers pertaining to urban solid waste. Because it disregards the necessary framework, the perspective is fragmented and lacks a holistic view. Important topics like the role of the industry, the need for a new paradigm to facilitate sustainable recycling, and the acceleration of trash reduction have thus far been untouched. Plastics, paper, and metals are just a few examples of the many materials that need recycling. Many modern materials, especially those used in packaging, are not recyclable with the current state-of-the-art technologies. On top of that, waste pickers and other workers face major problems with inadequate occupational safety measures. We are ignoring the social and environmental consequences of our rush for new and costly technology to address our urban waste problem in India. This is especially the case when it comes to thermal waste treatment methods like gasification, incineration, pyrolysis, or pelletization. Developing nations are becoming prospective waste sites for incinerator technology as industrialised nations phase them out due to expensive costs and stricter emission control regulations.

### **A Strategy for Efficient Waste Management**

Communities, the informal economy, official garbage collectors, and government agencies must all work together. The goal of any good solid waste management system should be to collect and transport all solid trash to an absolute minimum and eliminate the need for any human intervention whatsoever. Segregation at source has emerged as a crucial component of solid waste management. Sanitary land filling is out of the question in India due to the high cost of land and the fact that many municipalities lack suitable areas for trenching. It is crucial to study segregation at source since it necessitates ongoing sensitization efforts tailored to residents' feelings about their city. Direct mitigation of possible dangers is possible by waste segregation. In addition, since no mixing is involved, the retrieved materials will be of higher quality. Therefore, not only are the pickers less likely to contract infections, cuts, and wounds, but they can also earn more money for the goods they gather.

Adopting and transferring technologies from developed nations without tailoring them to local or regional needs would have technical implications for waste management initiatives that need careful consideration of numerous factors in order to tailor strategies to each country's unique situation. Strengthening the management sector is necessary, and it must accompany technical planning. In order to implement an effective waste management system, public involvement is important. Alterations to garbage segregation and littering practices can influence MSW management strategies. It is suggested that different arrangements for garbage collection, such as employing commercial operators, be investigated in order to boost system efficiency and achieve 100% covering all cities. It is also important to develop a system to collect money from the people. However, Indian towns in general cannot be expected to follow the model of public-private partnerships seen in industrialised nations. Certain adjustments that accommodate for local variables are necessary before this technique may be put into action. Possible government decentralised plans exist in parallel. Decentralised community funding schemes are the perfect catalyst for waste management method development. Residents will likely hold the municipality

to its word regarding garbage collection services if they pay these user fees. Reduced volume of waste sent beyond the locality is one result of their incorporation into the comprehensive waste

management strategy in all areas. Rates of trash generation and local economic standards should inform the imposition of disposal and collection costs, with the sort of waste taken into account where appropriate.

### **Conclusion**

In terms of leadership, technological know-how, and expert proficiency, there are numerous loose ends and missing pieces. For example, competent individuals with solid waste management qualifications should be deployed (not those who show up with a handkerchief to cover their nose—those real hard workers), waste handling equipment should be combined efficiently and cost-effectively, and waste should be streamlined at various stages of its journey from generation source to final disposal site, without any dumping or accumulation occurring in the middle. In order to create a waste management plan that is both effective and sustainable, it is necessary to draw out a perfect continuous route map for end-to-end encryption. Clearly, the key to efficient and effective waste management in India will be matching financial backing, discipline, and attitude change among all parties involved. Loading up low-lying areas with stinky waste is the extent of landfilling in India, which is frequently referred to as a "sanitary landfill," conveniently ignoring the required standards for that term. Ultimately, any material dumped at dumping or landfill sites continues to do significant harm on the ecosystem. To prevent the leaching of harmful digested and undigested trash into the ground underneath, most industrialised nations boast about their more scientific waste management practices at landfill sites, which include covering the dumping grounds with a vulcanised plastic sheet. For a variety of causes, the amount of solid waste is always rising. In terms of overall MSW, plastic trash accounts for a considerable amount. The goal of plastic recycling should be to increase efficiency while decreasing pollution levels; this will have a multiplicative effect on energy conservation. The employment of more modern methods for plastic recycling and reusing is an option. The cradle-to-grave responsibility model should be a part of any new paradigm, with numerous parties involved (such as the product's maker, buyer, community, recycling sector, trade, city government, and the urban poor) all bearing some of the load. First, to help farmers with organic soil nutrients and second, to address the issue of urban garbage, which is constantly damaging land due to unregulated dumping, the government should launch measures to build the compost market and, if necessary, offer subsidies for compost manure. Rather than dealing with Municipal Solid Waste, which is a problem in most parts of the world, this would make everyone's lives easier.

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