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Waste Disposal

Historically, efforts in the management of waste have focused primarily on the disposal part of the waste management. Whilst local governments are now moving towards recovery of resources from waste, disposal is still the most common form of managing waste, including open dumping, landfilling of waste and incineration. In developing countries, infrastructure for waste management may be limited, and waste is often left uncollected or disposed of in inappropriate locations, leading to significant environmental and public health problems.

For example, in India, the Yamuna river, which flows through Delhi, is heavily polluted due to the dumping of untreated waste and sewage. In Nairobi, Kenya, the Dandora landfill site, which was opened in the 1970s, has become a symbol of environmental degradation and pollution due to the lack of proper management and regulation.

Landfilling of waste is also carried out in places where land is available. In many cases, these landfills are unfortunately poorly designed and operated, resulting in environmental pollution and health hazards for the communities living near them. For example, in the Philippines, the Payatas landfill in Quezon City, Manila, is one of the largest landfills in the country, but it is also notorious for the large number of waste-related accidents and illnesses that occur in the area.

Some developing countries have also set up incineration plants to dispose waste. But incineration plants are poorly regulated and operated, resulting in significant emissions of toxic pollutants. For example, in Bangladesh, the Amin Bazar incineration plant, which was built to dispose of medical waste, has been found to emit high levels of dioxins.

While waste disposal methods such as dumping, landfilling, and incineration are still widely practiced in many developing countries, there is a growing recognition of the need to move towards more sustainable waste management practices, such as resource recovery and recycling, to reduce the environmental and health impacts of waste disposal.

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Waste Processing

Waste processing is the range of activities characterized by the treatment and recovery (use) of materials or energy from waste through thermal, chemical, or biological means. It also covers hazardous waste handling. Generally, there are two main groups of processes to be considered, (1) Biological processes, such as open composting, enclosed composting, anaerobic digestion, and vermiculture, and (2) Thermal processes, such as incineration, and gasification.

Examples of reuse in initiatives include: (1) Product reuse - rethreading tires, recovery of demolition materials, reuse of plastic bags, second hand clothing, reconditioning and repair of furniture and appliances; (2) Materials reuse - Liquid-paper board for seedlings planters, bottles, scrap paper for notes/phone messages, mulching; (3) Durable packaging - e.g. milk crates, bread trays, string or calico shopping bags.

- India: In the city of Bengaluru, an innovative project called the "Hasiru Dala" (Green Brigade) has been established to provide waste processing services to households and businesses. The project employs waste pickers to collect and sort waste, which is then processed through a variety of methods, including open composting, vermicomposting, and anaerobic digestion. The processed waste is then used to produce biogas and compost, providing a source of renewable energy and reducing the amount of waste sent to landfills.
- Bangladesh: The Dhaka North City Corporation (DNCC) has established a waste-to-energy plant to process the city's municipal solid waste. The plant uses incineration technology to generate electricity, which is sold to the national grid, while the ash residue is used for road construction.
- Kenya: The Nairobi Integrated Waste Management Project (NIWMP) is a public-private partnership that aims to promote sustainable waste management practices in the city of Nairobi. The project includes the establishment of a waste-to-energy plant that uses gasification technology to

convert municipal solid waste into electricity, as well as the implementation of composting and recycling initiatives.

- Brazil: The city of São Paulo has established a network of waste processing facilities that includes composting, anaerobic digestion, and recycling. The facilities are operated by cooperatives of waste pickers, who collect and sort waste from households and businesses.

Some of the positive effects associated with processed waste include, more effective use of resources, employment opportunities in the service and repair industries, support for charity based stores, better protection of products as durable packaging is more robust, and changes in attitudes towards disposable products.

Waste Recycling

Recycling is the breaking down of materials from waste streams into raw materials, which are then reprocessed either into the same material (called a "closed loop" system for resource recovery) or a new product (or an "open loop"). Recycling also generally includes waste separation and material reprocessing. There are various materials that are capable of being recycled - most common being paper, plastic, glass and metals - and technology is advancing to allow the recycling of more materials.

Some examples:

- Brazil: The city of Curitiba has one of the most successful recycling programs in the world. The program, which began in the 1980s, has achieved a recycling rate of 70%, and has reduced the amount of waste sent to landfills by 50%. The program includes door-to-door collection of recyclables, and incentivizes residents to recycle through a program that provides food and other goods in exchange for recyclable materials.
- India: The informal sector plays a major role in recycling in India, with waste pickers collecting recyclable materials from households and selling them to recycling facilities. This has been a sustainable source of income for

many low-income households, and has contributed to the recycling of a significant amount of waste.

- Kenya: The Flipflopi project, based in Lamu, Kenya, is a unique initiative that creates new products from waste materials. The project builds boats and other products using discarded flip-flops and other plastic waste, raising awareness about the problem of marine plastic pollution and promoting sustainable waste management practices.
- South Africa: The PET Recycling Company, a non-profit organization, has established a successful recycling program for PET (polyethylene terephthalate) plastic bottles in South Africa. The program has achieved a recycling rate of 65%, and has created thousands of jobs in the recycling industry.

The benefits of recycling do not lie solely in diversion of waste away from disposal but, even more importantly, in the reduction of the amount of virgin/natural resources that need to be harvested and processed for the manufacture of new products. Recycling initiatives in developing countries can also have significant environmental, social, and economic benefits, while also providing economic opportunities for communities.

Waste Minimization

Waste minimization is aimed at reducing the production of waste through education and improved production process rather than aiming to increase technology to improve treatment of waste. The idea of minimization is not centered on technological advances, it can be viewed a method of managing existing resources and technology in order to maximise the efficiency of available resource use.

Minimizing waste generation has the potential to reduce costs or increase profits by maximizing the use of resources and by reducing the amount of waste to be disposed of the cost of waste management is also decreased.

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Waste avoidance for individuals: Buying goods in bulk; reconsidering superfluous purchases; purchasing products in materials/packaging that is readily recycled; use of alternatives, e.g. landscaping that creates mulched gardens in place of lawns; and use of composting and vermiculture practices.

Waste minimization in industry: Change in product design to reduce materials consumption; using crates instead of pallets to avoid the need for shrink wrap; incorporate Eco-Design technology into production processes; adoption of Cleaner Production practices that ensure avoidance through efficiency measures; and conduct regular audits and monitoring of waste reduction/resource recovery practices.

Waste minimization for Local Government: Encourage community 'avoidance' activities, e.g. promote competitions rewarding initiative in this area of resource recovery; lead by example, e.g. display mulched gardens throughout the municipality; and provide facilities and infrastructure to assist industry, business and the community to undertake resource recovery practices, e.g. kerbside recycling and resource exchange registers, initiate greener procurement programmes.

Some examples:

- Bangladesh: The Waste Concern group is a social enterprise that focuses on waste management in Bangladesh. They have developed a decentralized waste management system that emphasizes waste minimization by promoting the 3Rs (Reduce, Reuse, and Recycle) approach. The program works with local communities to educate them about waste reduction strategies and provides them with the resources and tools to implement these strategies.
- South Africa: The South African Waste Information Centre (SAWIC) is a government-run initiative that aims to promote waste minimization through improved data collection and reporting. The program collects data on waste generation and disposal across the country and uses this information to develop waste minimization strategies and policies.

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- Thailand: The Thai Environmental Institute has developed a waste minimization program that focuses on the hospitality industry. The program provides training and resources to hotels and restaurants to help them reduce their waste generation through improved production processes and consumer behavior.
- Peru: The city of Lima has implemented a waste minimization program that focuses on the informal waste sector. The program provides support and resources to informal waste pickers to help them improve their waste collection and sorting methods, thereby reducing the amount of waste that ends up in landfills.

Taken together, the four issues of waste disposal, recycling, processing, and minimization, can be laid out on a dual-axis continuum as illustrated in Figure 1.

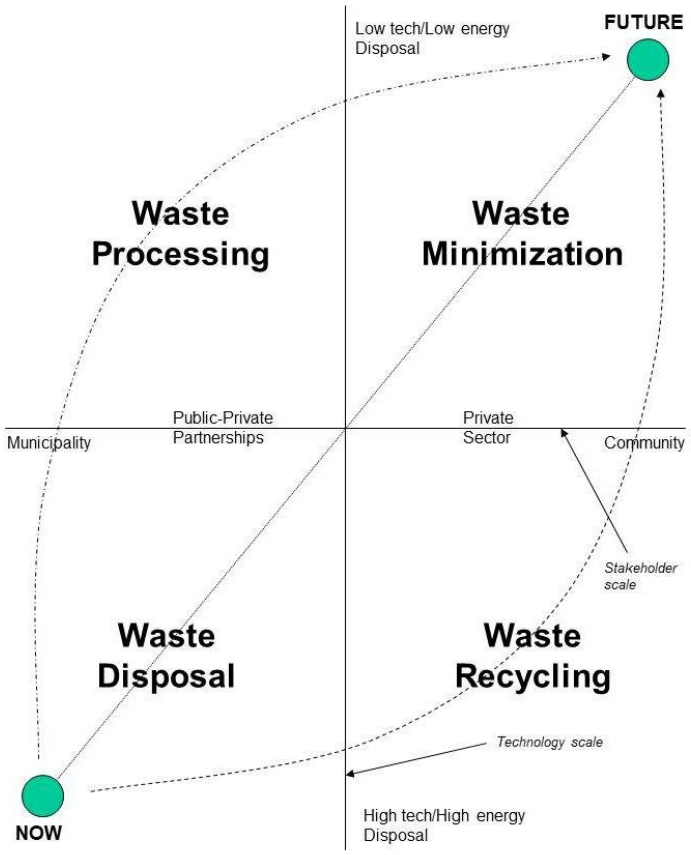

Figure 1: The Waste Management Continuum

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The Waste Management Continuum has two axes. One is the horizontal axis that lays out the different stakeholders involved in waste management - ranging from municipalities and local governments to the local neighbourhoods and communities. The other is the vertical axis that lays out the different technologies used in waste management - ranging from high tech/high energy disposal systems to low tech low energy systems.

Much of current waste management efforts is focused on local government programmes that use high tech/high energy disposal systems (the 'NOW" position in the continuum). Waste management systems need to move towards a scenario that is more community based using low tech/low energy, and focused on waste minimization.

In achieving this goal, we also have to pass through the two 'gray' areas of waste processing (treatment and recovery of waste to recover materials or produce energy from waste) and waste recycling (breaking down of wastes to facilitate their reuse into new products).

The continuum helps us understand the different systems of waste management currently practiced in different countries, and the pathways that will lead to an "ideal" situation where waste is minimized and materials are recovered and recycled back into manufacturing systems.

The two axes of the continuum also illustrate important aspects of waste management systems -

1. The different stakeholders involved in waste management from local governments and private sector entities to local community organizations. Each of these stakeholders have a role to play to move the waste systems to focus on minimization. Local governments focus on laws and regulations, community organizations focus on lifestyle choices and awareness raising while private sector entities focus on developing technologies and products that are easy to process and recycle after their lifespan.
2. The technologies (and associated costs) needed for waste management. Considering the vast volume of wastes being generated and the costs of

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> energy needed to process the waste, technology becomes an important element of waste management - technologies that are easy to use by households and individuals (essentially "low tech") and do not need too much energy for their processing ("low energy").

The current systems of waste management use the opposite - high tech systems that need considerable amounts of energy to dispose wastes. The continuum illustrates the point that we need to focus more on waste minimization that uses low levels of technologies (for example easy disassembly of products to their constituent raw materials, and not use composite materials) and can be carried out by local communities themselves (for environmental reasons, but more so for economic opportunities). Ultimately, waste is not just an environmental issue that needs to be "disposed" - but is a broader that has many social and economic dimensions as well. Lifestyle choices and household consumption patterns that help to minimize waste lie at the core of waste management systems - along with better product design, "Design for disassembly" and other issues that facilitate such choices. Ensuring that such systems also provide economic opportunities - additional jobs and increased income - provides the necessary incentives for better waste minization.