



C40 CITIES: Topic 2

THE ISSUE OF SOLID WASTE IN METROPOLITAN AREAS

Background:

Municipal Solid Waste (MSW) is the waste produced, collected, and/or treated by cities and municipalities. It covers categories ranging from simple household waste to bulky commerce and trade waste, waste produced by office buildings, natural garden waste, and hazardous materials. However, it does not include any waste accumulated through city sewage systems and construction/demolition activities. MSW is measured and analyzed in thousands of tonnes as well as total kilograms of waste per capita (per individual citizen).¹ In developed cities, pre-existing infrastructure is the main body responsible for the disposal of waste, nevertheless, the quantities of waste generated can be too large for such programs to manage them. When landfills get full, crises can ensue such as the 2015 Beirut Trash Crisis, which led to a year of protests in Lebanon.²

Current Situation:

In 2016, over 2 billion tonnes of municipal solid waste were generated globally. To add to the current issue, global solid waste generation is expected to nearly double the 2016 figures by the year 2050. With such predicted figures of increase in the generation of solid waste, it is expected that underdeveloped areas of cities will experience severe drops in the quality of their environment and living standards. This is a great cause for concern as 90% of waste in underdeveloped areas is disposed of through unregulated landfills or more commonly openly burned at large masses. Such practices have major consequences on human health and the preservation of the environment. The sustainable management of solids waste is a very commonly disputed topic in terms of the cost of infrastructure, as 20%-50% of municipal budgets are allocated towards the function and development of city-wide waste management programs.³ While many cities are trying to develop a more circular economy, most still rely on a linear economy where goods are made, consumed, and thrown away.



¹ "Waste - Municipal Waste - OECD Data." TheOECD. Accessed November 07, 2021. <https://data.oecd.org/waste/municipal-waste.htm>.

² <https://www.bbc.com/future/article/20180328-lebanon-is-drowning-in-its-own-waste>

³ World Bank Group. "Solid Waste Management." World Bank. June 01, 2021. Accessed November 07, 2021.

<https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management>.

⁴ <https://media.istockphoto.com/vectors/circular-and-linear-economy-compared-vector-id1149058286?k=20&m=1149058286&s=170667a&w=0&h=uQcssl0TOF5Kj115UCMxww3p02kgLz7fHDgYLOYD0U=>



Important bloc positions:

Management of MSW:

- Beijing:
 - MSW generation increased in the city by more than 3 million tonnes from 1978 to 2006.
 - The present infrastructures are unable to cope with the increasing generation of wastes.
 - Currently, approximately 90% of waste is disposed of in landfills, 8% is disposed of through incineration, and 2% in compost disposal.⁵
 - Local authorities are now focusing on developing and financially supporting more efficient incineration technologies to overcome the current overload problem.⁶
- New York City:
 - New York is commonly regarded as the world's most wasteful city.⁷
 - NYC generates more than 3.5 million tonnes annually.
 - Due to the nature of the city, NYC's waste is transported to landfills in other states, creating widespread criticism on the city's environmental effect on the other, more commonly lower-income, areas.⁸
- Mumbai:⁹
 - The Mumbai metropolitan area generates one-third of the total solid waste in the Maharashtra region despite having only one-fifth of the region's total population.
 - Mumbai's total solid waste is disposed of through landfill sites; however, two of the four major sites of the metropolis, Gorai and Mulund, have been closed primarily due to the high population density in their surrounding areas.
 - Having reached capacity, city authorities decide to terminate these two facilities in light of the city's project of developing more green areas for citizens.
 - Mumbai is currently working on implementing more developed forms of waste management to meet its sustainability goals.

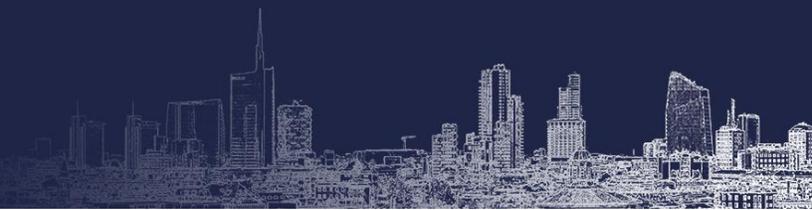
⁵ Zhen-shan, Li, Yang Lei, Qu Xiao-Yan, and Sui Yu-mei. 2009. "Municipal Solid Waste Management in Beijing City." *Waste Management* 29 (9): 2596–99. <https://doi.org/10.1016/j.wasman.2009.03.018>.

⁶ Wang, Hao, and Chunmei Wang. 2012. "Municipal Solid Waste Management in Beijing: Characteristics and Challenges." *Waste Management & Research* 31 (1): 67–72. <https://doi.org/10.1177/0734242x12468199>.

⁷ Adler, Ben. 2018. "Which Is the World's Most Wasteful City?" *The Guardian*. The Guardian. May 11, 2018. <https://www.theguardian.com/cities/2016/oct/27/which-is-the-worlds-most-wasteful-city>.

⁸ "How Does NYC's Waste Management System Work?" n.d. City & State NY. <https://www.cityandstateny.com/politics/2021/07/how-does-nycs-waste-management-system-work/183994/>.

⁹ "India's Megacities, Mumbai and Delhi, Sitting on a Pile of Waste." 2019. Mongabay-India. October 11, 2019. <https://india.mongabay.com/2019/10/indias-megacities-mumbai-and-delhi-sitting-on-a-pile-of-waste/>.



Possible solutions:

- Impose stringent regulations on waste output with an emphasis on more harmful materials and materials with longer decomposition times.
- Develop more effective and more extensive scale forms of waste treatment and implement such technologies as the primary infrastructures of a city.
- Implement or merge city-wide waste collection and treatment programs/organizations to achieve more efficient waste disposal practices.
- The main methods of dealing with solid waste are Composting, Recycling, Incineration, and Landfills. There are summarized in the tables below, which are taken from MrG Science:

Composting

Advantages

- Reduces amount of waste in landfills
- Low cost
- Composting can be done at the commercial and industrial levels, but also on a household level
- Creates fertile soils
- Decrease the use of synthetic fertilizers (which has its own environmental issues it causes)
- Improves soil porosity and water retention

Disadvantages

- If not done correctly can attract pests
- Requires public buy in
- Only for organic matter
- Windrow and aerated static pile composting require relatively large areas, and odor control is a common problem.
- Residential composting bins can get very dirty, and be hard to clean
- Amount of effort involved. All the materials must be carried to the compost pile,

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Landfills

Advantages

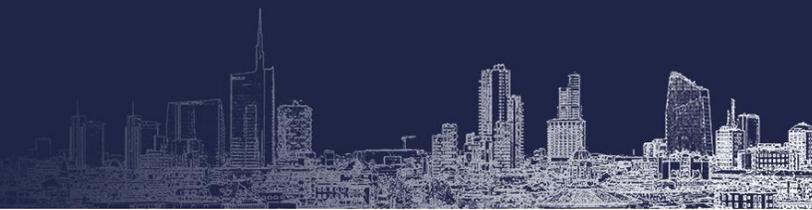
- Primary way SDW is disposed of
- Initially cheap, but costs increasing rapidly as sites fill up
- Methane from decomposition may be captured for energy production. Used to generate local district heating in Denmark and Sweden.
- Old landfill sites can be landscaped and re-used for building projects.
- Creates jobs for the local community - though they are usually unskilled and low paid jobs
- Landfill sites that are close to settlements reduce the cost of transporting the waste

Disadvantages

- Landfill sites give off dangerous gases that cause air pollution and global warming (methane). There is also the potential for explosions if methane is allowed to build up.
- Liners can fail and leachate leak into the local environment and groundwater sources.
- Settling after compaction can cause problems for future uses – must be left a long time to settle fully.
- Most landfill sites close to populations are full so waste collection vehicles have to travel a long way to alternative sites.
- Landfills are filling up. Even with daily compaction of waste the life span of landfills is limited.
- Poorly managed sites cause problems with vectors such as rats, mice and flies increasing the spread of diseases.
- Heavy vehicles cause traffic problems and damage local roads.
- Poorly managed sites cause problems with dust, odor, visual and noise pollution - these can negatively impact local property prices in the area.

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¹⁰ <https://www.mrgscience.com/ess-topic-83-solid-domestic-waste.html>



Recycling

Advantages

- Prevents the loss of useful raw materials.
- Reduces the consumption of new raw materials.
- Reduces energy usage in some areas (though collection and processing does use energy).
- Creates Green jobs
- Reduces pollution at the extraction phase of the process - getting the raw materials out of the ground.
- Lowers the release of greenhouse gases.
- materials are collected, separated, and processed first. Success depends on how much energy and raw materials are required to produce the material in the first place.
- plastics
- glass can be melted and re-shaped into new bottles or jars indefinitely; this requires less energy than making new bottles and jars
- paper
- metals (aluminum is most common and cost-effective material for recycling; steel is also frequently recycled)

Disadvantages

- Requires public buy in
- Not always cost effective
- Building up a new waste recycling unit takes up a lot of capital.
- Products may not be as durable. These kinds of products are almost always made of trashed waste material collected from other waste materials that have been overly utilized and fragile. This makes products of recycled waste less durable and low priced.
- Locations where every manner of waste is piled provides a nice ground for the formation of debris and spread of infectious diseases

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Incineration

Advantages

- SDW burned at very high temperatures. Very useful for clinical waste and any hazardous waste containing pathogens
- Landfill space is running out. Incineration can burn up to 90% of the total waste generated in a chosen area
- Dioxin emissions from incineration have been reduced with new technology.
- Can be used to produce electricity ('waste-to-energy' plants)
- Takes up much less space than landfills.
- Reduces the volume of waste by 80 – 85% therefore it is very popular in countries where land is scarce e.g. Japan.
- Used to generate local district heating. Sweden generates 8% of its heating needs from waste incinerators..
- Can function in any type of weather
- Bottom ash can be recycled and used to build roads
- Avoids the methane emissions of landfills.
- Incineration doesn't add any toxic elements to the groundwater. Incineration plants retrieve metal from the ashes and this can then be recycled.
- Nutrients returned to soils in agriculture, parks, or home gardens

Disadvantages

- Toxic fly ash is difficult to dispose of safely and adds waste miles (distance the waste is transported) as it is moved to landfills.
- Emits smoke from the chimneys includes nitrogen oxide, particulates, heavy metals, acid gases and the carcinogen dioxin.
- May produce dioxins and heavy metal deposits from materials burned
- New incinerators are taking away the funding from other renewable energy research and development.
- Old incinerators emit dioxin and furan. These are toxic gases which have been cited as being carcinogenic.
- Causes property devaluation in the surrounding areas.
- Causes visual pollution due to the intrusive chimney stack.
- There are some concerns as to the safety levels of bottom ash and the UK Highway Authority has banned its use in concrete work.
- Filters do not remove the finest particles from air emissions.
- Set up costs are very high.

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¹¹ <https://www.mrgscience.com/ess-topic-83-solid-domestic-waste.html>

¹² <https://www.mrgscience.com/ess-topic-83-solid-domestic-waste.html>

¹³ <https://www.mrgscience.com/ess-topic-83-solid-domestic-waste.html>



Further reading:

- <https://sites.google.com/site/janeesssite/topic-8-human-systems-and-resource-use/8-3-solid-domestic-waste>
- <https://www.epa.gov/hw/criteria-definition-solid-waste-and-solid-and-hazardous-waste-exclusions>
- https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Municipal_waste_statistics
- <https://www.municipalwasteeurope.eu/>
- <https://www.frontiersin.org/articles/10.3389/frsc.2020.00008/full>
- <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/solid-waste-disposal>

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