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How to manage food and organic waste in Global South cities

Food Waste

Originally Published: **July 2019**

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In Global South cities, food and organic waste is the main component of municipal waste, comprising as much as 80% of total waste generated. Around 30% of all the food grown for human consumption is lost or wasted every year, with most of it ending up in landfills.[1, 2]

When disposed of in landfill organic waste produces methane, an especially potent short-lived greenhouse gas, as well as water-polluting leachate. In some Global South cities, waste can represent up to 35% of cities' overall emissions. This organic waste can instead be treated to produce compost and a renewable energy source (biogas), create good green jobs, and support local agriculture, urban greening and forestry. Treating organic waste also reduces waste disposal costs and leads to cleaner (and more profitable) recyclables, increasing the potential earnings of local recycling cooperatives, as well as avoiding greenhouse gas emissions. As waste management is usually within the power of cities, cities can often implement food and organics waste schemes quickly. This is how cities that are early on a sustainable waste management path can tackle food and organic waste to deliver swift, local rewards. Cities with more advanced waste management systems can read *How to manage food waste and organics on the path towards zero waste*.

Reducing methane emissions is the fastest way to tackle global heating.[3] Methane's contribution to global heating is 87 times higher than CO_2 in the near term; each kilogram of food waste disposed of in dumpsites

and landfills has the same global warming potential as burning one litre of petrol. *Methane: Why cities must act now* explains more.

Prioritise segregated collection and treatment of organic waste

This article focuses on **food *waste***, which comprises both the inedible parts of food left over after consumption, and edible food purchased and discarded by consumers. **Food *loss*** is edible food that is lost or damaged in the production, storage, processing and distribution phases of the food lifecycle, before it reaches consumers – and, typically, cities.

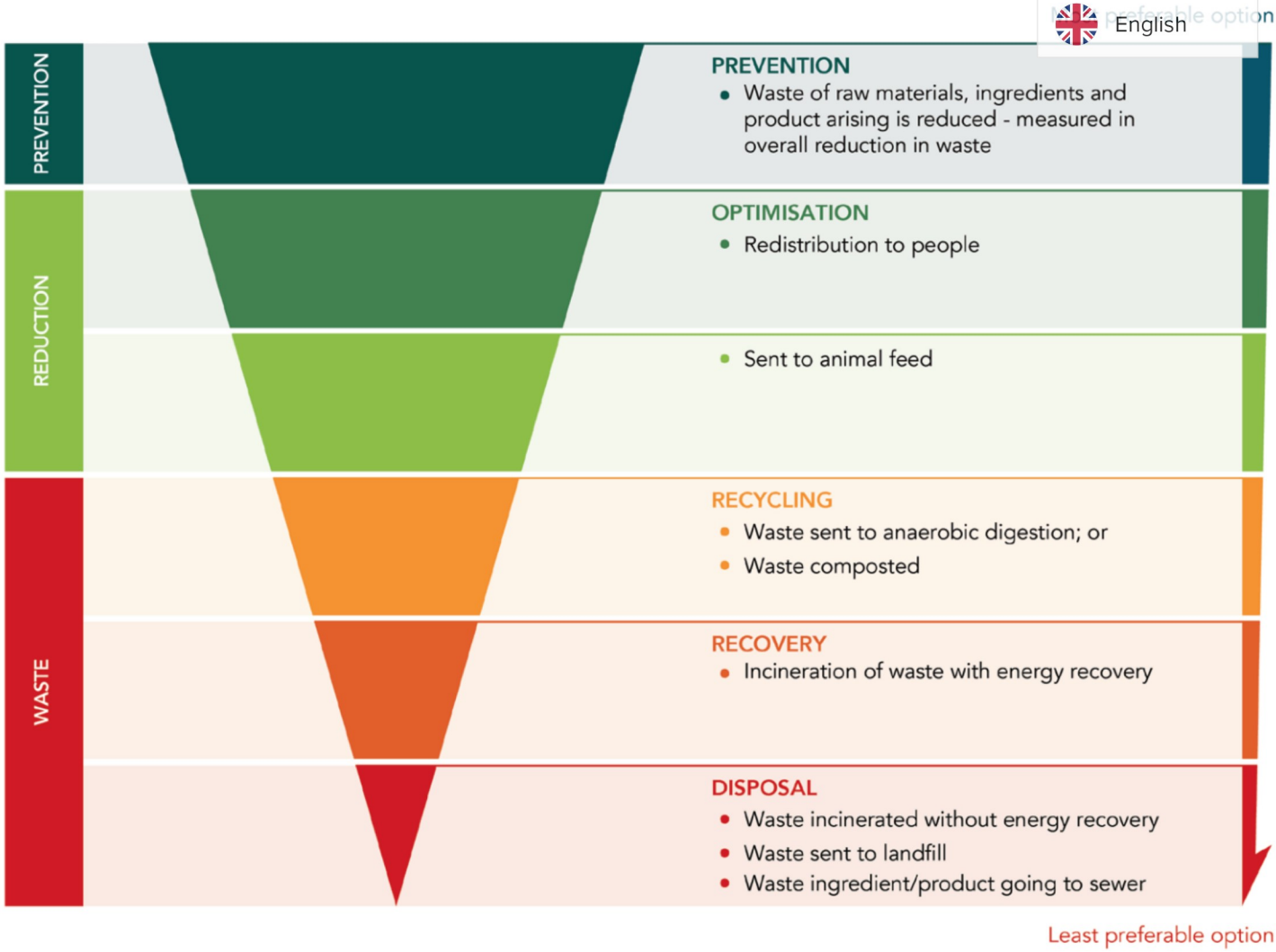
Cities taking the first steps towards sustainable food and organic waste management can reap the biggest and most rapid benefits by prioritising **the segregated collection of organic waste for safe disposal or treatment**. At minimum, organic waste should be sent to a sanitary landfill with landfill gas capture. Read *Why every city needs universal waste collection and safe disposal as the foundation for sustainable waste management* for information on the benefits of establishing collection and safe disposal systems.

Ideally organic waste should be treated or 'recycled', using composting or anaerobic digestion. This article explains these treatment options, and how cities can establish them.

Solid waste incineration or other thermal-based processes are often falsely presented as a 'quick-fix', energy-producing and revenue-generating waste solution for Global South cities. Read *Why solid waste incineration is not the answer to your city's waste problem* to understand why this is among the worst approaches cities can take, especially if the city's waste stream has a high quantity of food and organic waste and if no universal segregated collection is in place.

While collection, safe disposal and treatment should be prioritised as the first step, cities should also begin to develop food waste prevention and food loss reduction programmes. Cities can implement initiatives to connect large generators of edible surplus food with food banks to ensure that surplus food is redirected to those in need, for example. Read *How cities can reduce food waste by households and businesses* for more information on these approaches.

The food waste management hierarchy[4]



Determine the amount of food waste generated in the city and its sources

Organic waste content in the Global South ranges from 50% in middle-income cities to as high as 80% in some cities in South Asia. Most of this organic waste is food waste – in densely populated cities, food waste often represents almost 90% of the organic waste generated.[5] Cities have an opportunity to divert a large portion of the total waste generated from landfilling for productive uses like composting or anaerobic digestion.

Cities should measure food waste and understand its sources to inform policies to reduce, divert and treat waste, and track the effectiveness of these efforts. The *Food Loss and Waste Accounting and Reporting Standard* provides a framework that cities can use to shape their approach to this data collection. Methods for quantifying and characterising organic waste usually target a sample of commercial and residential generators to approximate results for the city as a whole, and the sampling is repeated over the relevant annual seasons, for example one sampling during the dry season, and another during the wet season. Resource-constrained cities can use surveys to gather this data and begin engaging local stakeholders. Start by targeting facilities that are likely to generate large amounts of food waste, such as markets.

Surveys can also be valuable tools for gathering information on willingness-to-pay and willingness to change, as well as on food waste quantities, current methods of disposal and the major industries producing edible surplus and inedible food waste.

Determine the locally appropriate treatment option(s)

The two most common ways to process organic waste sustainably are composting and anaerobic digestion. Composting is the simpler and cheaper process (see *Sustainable financing and policy models for municipal composting*). Anaerobic digestion is better suited to large-scale facilities due to the higher upfront costs related to the technology, but both can be used at any scale. Composting produces compost for local agriculture, parks and forestry, while anaerobic digestion produces renewable fuel.

The importance of oxygen

When organic waste is buried in landfill, it is cut off from the air and so decomposes anaerobically. A high level of methane is produced as a result, alongside CO_2 meaning that the resulting landfill gas is approximately 50% methane, 50% CO_2. Treatment using a controlled anaerobic digestion facility produces and captures methane-rich biogas. Composting provides the conditions for organic waste to decompose while being exposed to oxygen, with the benefit of producing more CO_2 but less – or even zero – methane.

Tools such as *OrganEcs*, a cost estimating tool for managing source-separated organic waste, can also support cities at the planning stage, once some information has already been gathered, particularly to guide cities at financial planning and technology selection based on cost estimation.

Resource constrained cities should focus on composting because it requires less upfront capital and creates more jobs. However, anaerobic digestion is increasingly being used by Global South cities to process waste while producing energy and biofertilisers, and integrated resource recovery centres offer a low-cost way for cities to use both these treatment processes alongside the recovery of recyclable materials. Cities can build relatively large-scale facilities and centralised systems, and/ or decentralised, neighbourhood-scale waste management systems, which collect and treat waste using community composting or small scale digestors.

These options are introduced below. The World Biogas Association and C40's report *Global Food Waste Management: An Implementation Guide for Cities* explains them, their costs and guidance for their implementation, in more detail. *Technical Guidance on the Operation of Organic Waste Treatment Plants* and *OrganEcs* are further technical resources that can help cities to work out the appropriate treatment system.

Composting

Composting is the aerobic (in the presence of oxygen) decomposition of organic waste, and it significantly reduces or even prevents the production of methane during the breakdown of organic matter. Compost can be used to enrich soils, by returning nutrients to depleted soils and supporting moisture retention, which boosts crop productivity – it can increase crop production by 15–25%, while reducing the use of chemical fertilisers (the manufacturing and application of fertiliser has a heavy emissions toll).[6] Compost can also be used for urban forestry initiatives, as it supports the early growth of seedlings.[7]

Cities can earn revenue and support local food security by investing in the facilities to produce and sell compost, with larger investments delivering faster processing time, and increased quality and quantity of outputs. They can also support private companies to turn composting into a business opportunity, such as in Dhaka, Bangladesh (see box).

Read *Sustainable Financing and Policy Models for Municipal Composting* for guidance on how to design and fund city-scale composting, including how to attract private sector participation in composting.

Composting: A business opportunity in Dhaka, Bangladesh

In Dhaka, food markets generate vast volumes of food waste every day – up to 70 tons of waste from one market alone. Dealing with this waste is a burden for the market workers and the city. Local organisation Waste Concern – Bangladesh's first organic waste recycling company – has turned this problem into a business opportunity, seeing waste as a resource. It collects waste from markets and some homes free of charge and turns it into compost as farming fertiliser. The company has expanded across Bangladesh and into Cambodia, India and other South and Southeast Asian countries.[8]

Anaerobic digestion

Anaerobic digestion is the decomposition of organic waste in controlled conditions using a sealed, oxygen-free tank. It creates biogas – a renewable energy resource that can be used or sold to generate revenue – as well as avoiding the release of methane into the atmosphere. Biogas can be used locally to produce hot water and for cooking, for example. It also produces digestate, a bio-fertiliser that can be used as a bio-based supplement for food production.

Integrated resource recovery centres (IRRC)

IRRCs are decentralised, small-scale waste recovery facilities that use low-cost techniques to recover resources from waste – including, but not limited to, organic waste. They typically process between 2 and 20 tons of waste per day, and comprise small scale:

- Composting and anaerobic digestion.
- Co-composting of faecal sludge along with organic solid waste, using natural filtration systems to treat water prior to discharge.
- Recovery and sorting of recyclable materials – plastics, metals, papers, and glass – for recovery and marketing.

They can be designed to receive segregated or non-segregated waste, and varying quantities and quality of waste, responding to local needs. These systems are in operation in cities in Bangladesh, Cambodia, Pakistan, Indonesia and Sri Lanka.

Read *Sustainable Development Benefits of Integrated Waste Management: Integrated Resource Recovery Centers* for more information about these systems.

Low-cost, decentralised organic waste management in Alappuzha, India

In 2014, in response to increasingly complicated waste disposal challenges, officials in Alappuzha in India subsidised the installation of small-scale biogas plants and compost bins across the city. Today the city has over 3,000 biogas (anaerobic digestion) systems and 2,800 compost bins. It has also closed its dumpsite, resulting in avoided land disposal costs. The biogas produced is used for cooking and to heat water in homes, and the compost and digestate fertilisers produced are used in local parks and gardens.[9]

Run pilots to test and develop waste collection, transport and treatment options

Cities should initially target the large generators of organic waste for collection and treatment which already have a good rate of source segregation of organics (such as food markets, hotels and restaurants) as well as communities or neighbourhoods with higher potential uptake (based on history of environmental awareness, use of community gardens, for example), and build towards universal segregated waste collection.

Once the preferred treatment option(s) have been determined, identify waste generator(s) to participate in the pilot, informed by your analysis of local food waste generators. This should be a facility or neighbourhood that:

- Produces quantities of organic waste in line with the scale of the pilot and the planned treatment facility. A small number of larger producers will be easier to manage for a pilot – a vegetable market or well-managed school canteen are often good options.
- Produces consistent rates of waste generation.

- Produces waste with manageable levels of contamination with plastics and other waste. Low levels of contamination are easier to manage.
- Is easily accessible for collection.
- Is motivated and able to make the decision to participate.

Cities should ensure any initiatives provide equitable distribution of benefits, such as by prioritising waste pickers and cooperatives for the new jobs and opportunities in waste collection and treatment, as well as prioritising communities most affected negatively by waste disposal sites for pilots on and incentives for segregated collection, community-based systems, and urban garden and farming.

Cities can expand to commercial and residential generators as waste operators and the city authority gains experience with organics collection and treatment. At the point of expansion to larger numbers of smaller generators, cities will need to plan and pilot separate food and organics waste collection schemes. The most commonly used approaches for separate collection of food waste are:

- 'Drop-off schemes', where organics are deposited at collection points by waste generators.
- Kerbside residential collection and commercial collection. Food waste is typically collected together with garden waste, or collected separately but alongside other waste or recyclables. These wastes can be collected in separate vehicles (often on alternative days), or at the same time as other waste, which requires a compartmentalised vehicle.[10]
- On-site treatment, where larger multi-household communities or large generators have the obligation to source segregate and treat their organic waste locally with or without financial support.

Cities can use a combination of these collection approaches, for instance using 'bring-schemes' for smaller food waste generators and collection focussed on large-scale generators. Collection schemes should be coupled with incentives and/ or education and outreach to encourage participation. For example, in 2017 Mexico City passed a law requiring the separation of waste into four categories (namely organics, dry recyclables, dry non-recyclables and special or bulky wastes) and relies on awareness-raising, rather than fines for non-compliance, to maximise participation. The city is aiming to reduce the 12,000 tons of waste produced each day, for which the city pays approximately $22 per ton for landfill disposal.[11]

Read *Collection of Municipal Solid Waste in Developing Countries* for guidance on piloting and establishing waste collection schemes.

São Paulo is scaling up its composting operations

In São Paulo, organic waste comprises 51% of the city's solid waste, totalling around 6,600 tons a day. That volume of organic material could potentially produce around 700,000 tons of compost, or 290 million cubic

metres of biogas, annually – enough to meet the cooking and heating needs of 500,000 households.[12]

The city began with voluntary home-composting under the Composta São Paulo scheme in 2012, which by 2015 had participation from 5,000 people. Next, it targeted the 1,100 municipal schools, launching an online platform to collect data about the organic waste they produced and releasing a handbook on home-composting in schools in 2016 for teachers seeking to practice composting with students.

São Paulo opened its first composting facility in 2015. It processes six tons of organic waste every day, from 52 markets and five central neighbourhoods, using a local, small-scale, low-tech approach. Learning from experience of managing operations for the first facility, and building on the success of the initiative and the good quality of compost produced, the city opened a second facility in 2018 and now has five in operation.[13]

The city is working towards having 17 facilities in operation, aiming to divert 500,000 tons of waste a year. To achieve this, the city is examining options for expanding organics collection to households, focusing initially on street and municipal markets, and garden waste. The network of composting plants will serve as bring-scheme facilities for residential organics, encouraging residents to divert their organic waste from landfill, ahead of more intensive residential collection.[14]

Take steps to prevent loss of food before it reaches consumers

Much of the food loss occurring in Global South cities happens before shipment to a market, often due to transport delays or poor storage conditions.[15] Cities typically have limited control over supply chains, but they can help to reduce food loss by strengthening urban–rural linkages and improving infrastructure. For example, cities can:

- Improve infrastructure at markets and distribution hubs in the city, such as sanitation and electricity for cold storage, to reduce market losses.
- Support collectives that provide value-added activities, such as industrial kitchens preserving excess fruit and vegetables. In Kenya, for example, the development of a new dried mango product has significantly reduced rates of food loss in mango production. Until recently, around half of the mango production was lost before reaching the market; dried mango is more resilient to transport and storage.
- Investing in capacity building to support those producing and processing food entering the city to reduce food loss.[16]

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