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Food Waste: Impacts, Reduction, and Management Practices

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Food waste collected from a cafeteria. Photo by Ashmita Bhandari

Introduction and background

- Food waste refers to edible food intended for human consumption that is discarded or left uneaten at the retail, food service, or household level (FAO, 2015).
- Uneaten food leads to inefficient use of land, water, and energy sources required for its production.
- EPA estimated that, in 2019, 66.2 million tons of wasted food were generated by the food retail, food service, and residential sectors, with 59.8% sent to landfills (EPA, 2023).

Negative impacts of food waste

- Food waste in landfills generates methane, a greenhouse gas that is more effective than carbon dioxide at trapping heat in the atmosphere.
- It can increase landfill burden, produce unpleasant odors, contribute to soil and water contamination, and attract pests (Buzby et al., 2014).

Steps to reduce and manage wasted food based on EPA's wasted food scale

1. **Prevent wasted food:** Produce, buy, prepare, and serve only what is needed.
2. **Food donation/upcycle**: Donate excess food to food banks, soup kitchens, and shelters. Edible food parts can be used to make new food products, such as using orange peels to flavor beverages.
3. **Animal feed/leave unharvested**: Use suitable surplus food as animal feed, or leave crops unharvested in the field when appropriate.
4. **Compost/anaerobic digestion**: Recycle unavoidable scraps into compost or recover biogas and nutrients through anaerobic digestion.
5. **Apply to the land**: Raw food waste such as vegetable and fruit scraps can be incorporated directly into the soil.
6. **Landfill/Incineration:** Last resort for food waste disposal and should be avoided whenever possible.

Why food waste composting matters

- Composting is one of the most practical and environmentally friendly approaches that convert organic materials to more stable forms of carbon through the action of microorganisms (Aziz, 2018).
- It can reduce methane emissions, improve soil health, and support sustainable agriculture.
- Different composting and management methods can be used depending on the type of food waste, available space, cost, and management capacity.

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Methods suitable for food waste management

1. **Vermicomposting:** It is a biological degradation process in which earthworms, mainly two species: *Eudrilus eugeniae* and *Eisenia fetida*, decompose organic waste into nutrient-rich biofertilizer known as vermicompost. It is a low-cost composting method suitable for small-scale farmers (Moledor et al., 2016).

    - **Best for**: Vegetable scraps, fruit peels, cereal by-products, tea leaves, coffee grounds, and other plant-based residues**.**
    - **Consideration**: Avoid high-fat, high-protein, and oily foods, such as dairy products, cooked foods, and meat, because they may attract pests, produce odors, or even kill earthworms.

2. **Backyard composting:** This method of composting involves layering nitrogen-rich 'greens' with carbon-rich 'browns' in a well-aerated bin. Fruits and other degradable residues perform well. The pile should be kept moist and turned regularly. This method requires little maintenance and expense to set up in a garden or outdoor space (EPA, 2025b).

    - **Best for**: A balanced mixture of **greens**, such as fruits and vegetable scraps, grass clippings, coffee grounds, paper tea bags, and crushed eggshells, and **browns**, such as dry leaves, plant stalks and twigs, shredded paper and cardboard, and untreated wood chips.
    - **Consideration:** Avoid meat, fish, dairy, and oils.

3. **Bokashi (Fermentation):** This method of compost preparation involves the use of effective microorganisms (yeast, fungi, and bacteria) to ferment food waste in anaerobic or air-free containers for at least two weeks. It can be practiced indoors as it is sealed, odor-free, and does not attract pests (Bokashi Research and Education, 2024).

    - **Best for**: All kitchen food waste including meat, bones, dairy, baked items, seafood, raw, or cooked food items.
    - **Consideration**: After fermentation, incorporate the fermented materials into soil or further compost them. Allow about 2 to 4 weeks for curing before use.

4. **Anaerobic digestion:** Anaerobic digestion is a controlled process where food waste and other organic materials are converted into energy (biogas) and nutrient-rich digestate by microorganisms in the absence of oxygen (Czekała, 2022). The biogas can be converted into electricity, fuel, and thermal energy while the digestate can be used as nutrient-rich fertilizer.

    - **Best for:** All food waste including meat, dairy, oily, and cooked food items.
    - **Consideration:** It is a technologically sound method for large-scale waste treatment (O'Connor et al., 2021).

5. **In-vessel composting:** In this method, composting is carried out in closed containers where temperature, moisture, and aeration are strictly controlled to accelerate decomposition and minimize odors. This method can reduce pathogens when properly managed, as the temperature inside the vessel may reach up to 70°C (Malakahmad et al., 2017).

    - **Best for:** High-volume composting in limited space; wood chips can be added to balance carbon-to-nitrogen ratio.
    - **Consideration:** More expensive than other composting methods and require regular maintenance.

6. **Windrow composting:** In this composting method, organic wastes are arranged in long piles called "windrows," which typically have triangular or rounded cross-sectional shapes. The piles are turned either manually or mechanically to provide aeration. The temperature of raw materials is commonly used as a turning indicator (Aziz, 2018).

    - **Best for:** Composting large volumes of organic waste generated by restaurants and cafeterias. When properly managed, windrow systems may process some materials that are not suitable for backyard composting.
    - **Consideration:** Requires adequate space and equipment such as loaders, excavators, and windrow turners.

Conclusion

Food waste is a global issue leading to environmental pollution. The best approach is to prevent food waste whenever possible and recover safe, edible food for people. Unavoidable food waste can be converted into useful resources through vermicomposting, backyard composting, bokashi fermentation, anaerobic digestion, in-vessel composting, and windrow composting. Compost and digestate produced through these processes can be used as a soil amendment to improve soil quality and support sustainable food waste management.

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