Effective Pathways and Strategies for Managing Food Waste

Amtul Waris[1] and S. Arun Kumar[2]

[1]Principal Scientist (Agric Exn), ICAR-Indian Institute of Rice Research, Hyderabad
[2]Senior Scientist (Agric Exn), ICAR-Indian Institute of Rice Research, Hyderabad
Corresponding Author: amtul.waris@gmail.com

Food waste refers to food that is wasted or thrown away intentionally because of consumers be it in the food retail or food service sectors, or in households because of buying or preparing excess food, or food that has gone bad due to hoarding. To measure food loss accurately, FAO (2019) recommends data collection at all stages of food production cycle, harvest, post-production, storage, transportation, primary processing to take necessary measures to improve the efficiency and functioning of their food supply system. It is estimated that worldwide 17% of the food that is produced in the retail, food service sectors and at household level is wasted every year. Moreover 14% of the food produced globally is lost beginning from the harvest to reaching the retail stage (UNEP.2021). In the Indian context estimated food waste accounted for 73, 58 and 20 kg/per capita (Grover & Singh, 2014, Ramakrishna, 2016 and Suthar & Singh, 2015).

The Wasted Food Scale formulated by EPA (United States Environment Protection Agency) proposes actions for systematic disposal of wasted food. The different layers of the scale arranged in order from most preferred on the top left to least preferred on the top right represent the different pathways for preventing or managing wasted food. Within a given layer the pathways are ranked equally. The most preferred pathways *viz.* prevent food wastage, donate and upcycle food are the best options with the most benefits to the environment and to a circular economy that use food for its intended purpose *i.e.* to nourish people. The least preferred pathways of land filling, incineration, and sending food down the drain have the largest environmental impacts and have limited potential for circularity.

Pathways to manage food waste

Every individual, family, and organization have a crucial role in effectively managing food waste. Below are some key pathways to help reduce food wastage:

Prevent Food waste

Preventing food waste from occurring in the first place is the most environmentally sustainable option on the Wasted Food Scale. When food is wasted, all the resources used in its production, processing, distribution, and preparation are also wasted.

Donate-so no one's hungry

Unsold or uneaten wholesome food can be rescued, donated, or redistributed to help feed people in need. This approach spans the entire food supply chain, from produce gathered from farm fields to shelf-stable items at grocery stores and surplus meals from cafeterias. Donating food is one of the most preferred solutions, as it prevents both food and the resources used in its production from going to waste. By donating, food serves its original purpose—nourishing people.

Upcycle -Alternate uses

Upcycling food into new products typically occurs at the production or manufacturing stage of the food supply chain. Both edible portions and less desirable scraps can be transformed into new food items. For example, orange peels can be used to flavour beverages use in marmalades, broccoli stems can be made into slaw or dried into powder, and spent grains from brewing can be turned into bread. Upcycling is a highly preferred pathway because it keeps food within the human supply chain, preventing waste and conserving the resources used to produce it.

Feed Animals-supplement traditional feeds

Using wasted food as animal feed can help replace traditional feed crops like soy, corn, or barley, reducing the environmental impacts of producing those feeds. Often, this process requires some form of preparation, such as cooking or drying the food scraps. Feeding animals the wasted food is a practice farmer have relied on for centuries. By nourishing animals with food scraps, which in turn nourish humans, this method keeps food within the human food supply chain. It also decreases the need for conventional animal feed and lowers the environmental footprint of feed production. Additionally, converting food waste into animal feed can save money for both farmers and companies, as it is often cheaper than sending food waste to landfills. Companies can also provide scraps to manufacturers that produce animal or pet food. This approach offers multiple benefits—feeding animals, helping the environment, and reducing costs.

Leave Un-harvested-enrich soil: Food crops are ideally harvested to nourish people, but sometimes market conditions or environmental factors prevent

them from being harvested. These factors, often beyond the farmer's control, include fluctuating commodity prices, market standards, labor shortages, pest or disease damage, and weather events like flooding or drought. Alternative and secondary markets can process, sell, or upcycle crops that don't meet primary market standards. Gleaning organizations also help by harvesting surplus crops for donation. However, if crops won't be consumed even if harvested, leaving them in the field can be more sustainable, as it avoids the environmental impact of picking, processing, packaging, and distributing food that would otherwise go to waste. In such cases, unharvested crops can be grazed by animals or ploughed back into the soil, enriching it with nutrients and carbon that promote the growth of future crops.

Anaerobic Digestion –nutrient rich Biosolids

Anaerobic digestion is the process of breaking down organic materials, like food waste, in an oxygen-free environment. This process can take place in different types of digesters, including stand-alone digesters that primarily handle food waste, on-farm digesters that co-digest food waste with manure, or digesters at water resource recovery facilities that co-digest food waste with wastewater solids. Anaerobic digestion produces biogas, a renewable energy source, and biosolids—nutrient-rich by products that can be used as fertilizer, soil amendments, or animal bedding. When this process occurs at a water resource recovery facility, the end product is referred to as biosolids. Both digestate and biosolids can be further treated, such as through composting, before being applied to land. Their use can reduce the need for synthetic fertilizers and improve soil health.

Compost-recycle organic matter

Composting is the controlled, aerobic (oxygen-requiring) decomposition of organic materials by microorganisms. When food waste is composted along with other organic materials like yard trimmings, it creates a valuable, stable soil amendment that enhances soil health, improves water retention, and reduces erosion. Composting also recycles organic matter and nutrients, which are essential for long-term soil health and ecosystem resilience. In some cases, raw food waste from the manufacturing and processing sector is applied directly to fields as a soil amendment. This method, known as land application, involves spreading, spraying, or injecting the food waste on or below the soil surface. The benefits and environmental impacts of this practice can vary greatly depending on the composition of the food waste.

Least Preferred Pathways for wasted food handling

When the above-mentioned pathways cannot be undertaken described below are a few of the actions that can be considered as the least preferred pathways for handling wasted food.

Landfill-a last resort action

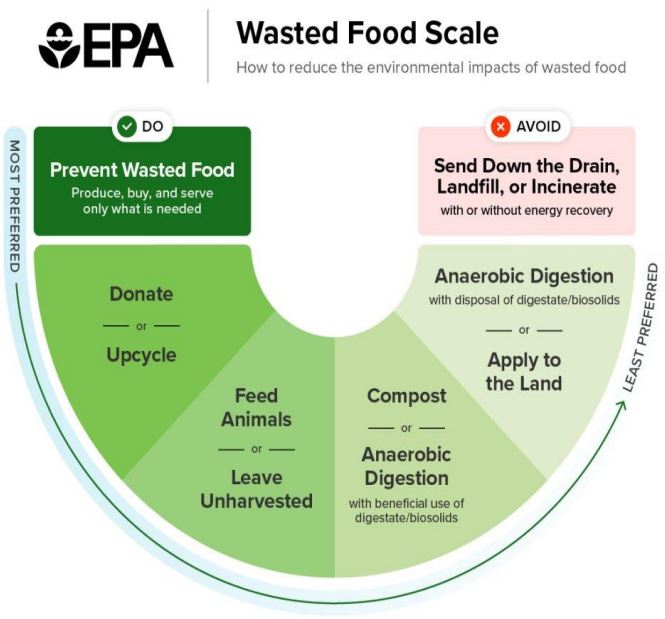
Landfilling is one of the least preferred options for managing food waste because it leads to the generation of methane, a potent and short-lived greenhouse gas. Since food waste decomposes quickly, much of the methane it produces escapes capture by landfill gas collection systems. Food waste has a disproportionately large impact on landfill methane emissions, accounting for 58% of methane released into the atmosphere from landfills. Additionally, when food is landfilled, valuable nutrients are lost and not recovered for beneficial use.

Incinerate

When wasted food is mixed with other municipal solid waste, it may be incinerated, a process also known as combustion with energy recovery or controlled combustion. Incineration is one of the least preferred pathways for managing food waste because the valuable nutrients in the food are not recovered. While this method does generate energy, food waste is a poor feedstock due to its high moisture content, resulting in significantly less energy production compared to other types of municipal solid waste.

Send Down the Drain

When wasted food is sent down the drain, it mixes with other waste in the sewer system and ultimately reaches a water resource recovery facility, or wastewater treatment plant. This method is one of the least preferred pathways for managing food waste because it decomposes quickly in the sewer, generating methane, a potent greenhouse gas that is released directly into the atmosphere. Treating wastewater that contains nutrient-rich food waste also requires energy. Depending on the facility's operations, the valuable nutrients in the wasted food may not be recovered for beneficial use. Even if energy is generated through anaerobic digestion at the facility, it does not compensate for the methane emissions from food waste in sewers or the additional energy needed for wastewater treatment.



Source: EPA-United States Environment Protection Agency

How can we avoid food wastage at home?

Families can effectively prevent food waste at home by planning meals, purchasing ingredients mindfully, and properly storing food. Here are a few tips to help reduce food wastage

1. Plan meals ahead and shop smart for ingredients

Creating a weekly meal plan can save you both time and money. By purchasing only what you plan to use, you'll be more likely to consume everything you buy. Here are some helpful tips:

- **Keep a running list of favourite meals and ingredients**: This way, you can easily select, shop for, and prepare meals your household enjoys, reducing the chance of food going to waste.
- **Check your fridge, freezer, and pantry first**: Before shopping, take inventory of what you already have. Create a list of items that need to be used soon and plan your meals around them.
- **Plan meals before shopping**: Organize your meals for the week in advance and buy only what's necessary for those dishes.
- **Tailor your shopping list to your weekly needs**: Consider how many meals you'll eat at home, factoring in dining out, frozen meals, and leftovers. Adjust your shopping list accordingly.
- **Include quantities on your list**: Note how many meals each item will cover to avoid overbuying.
- **Beware of bulk deals**: While buying in bulk (e.g., buy one, get one free) can save money, it only works if you use everything before it spoils.
- **Choose imperfect produce or upcycled products**: Imperfect produce, despite its cosmetic flaws, is just as nutritious and can often be found at a discount. Upcycled products use ingredients that would otherwise go to waste, offering a sustainable option.

2. Proper storage: Store food correctly to extend its shelf life and reduce spoilage

Properly storing fruits, vegetables, and other foods can maximize their freshness; making them last longer and helping you reduce food waste. Here are some useful storage tips:

Store fruits and vegetables correctly

- Most vegetables that can wilt (like leafy greens, carrots, cucumbers, and broccoli) should be placed in the fridge's high-humidity drawer.
- Fruits and vegetables prone to rotting (like mushrooms and peppers) belong in the low-humidity drawer.
- Fruits like bananas, apples, pears, stone fruits, and avocados release ethylene gas, which can speed up the ripening of other produce. Store these separately to avoid early spoilage.
- Avoid washing berries, cherries, and grapes until you're ready to eat them to prevent mold.
- Store potatoes, eggplants, onions, and garlic in a cool, dry, dark, and well-ventilated place.

Refrigerator storage tips

- The refrigerator door is the warmest area, suitable for condiments, but not ideal for perishable items like milk or eggs.
- The coldest part of the fridge is the lower shelves—store meat, poultry, and fish here.
- Ensure your fridge is set to 40°F (4°C) or below to keep food fresh and safe.
- Grains storage: Keep grains in airtight containers, and label them with the contents and the date to track freshness.
- Use your freezer often: Freeze items like bread, sliced fruit, meat, or leftovers that won't be eaten soon. Be sure to label them with the contents and date so you can easily track what's inside.

Benefits of Preventing Food Waste at Home

- **Save money**: By purchasing only what we need, consuming what we buy, and minimizing food waste, families can save significantly.
- **We can reduce our environmental and climate impact**

Conserve resources and energy: Wasting food means wasting the land, water, energy, and other resources used in its production, processing, transportation, preparation, storage, and disposal.

Lower greenhouse gas (GHG) emissions: Most GHG emissions related to food waste occur before the food even reaches a landfill, through processes like production, transport, and distribution. Once in a landfill, decomposing food releases methane—a potent greenhouse gas. By reducing food waste, we can help decrease methane emissions and lessen our environmental footprint.

References

EPA (2023) Wasted Food Scale https://www.epa.gov/sustainable-management-food/wasted-food-scale

FAO. (2019). The State of Food and Agriculture Report: Moving Forward on Food Loss and Waste Reduction. Food and Agriculture Organization of the United Nations. http://www.fao.org/3/ca6030en/ca6030en.pdf

Grover, P., & Singh, P. (2014). An Analytical Study of Effect of Family Income and Size on Per Capita Household Solid Waste Generation in Developing Countries. Review of Arts and Humanities, 3(1), 127–143.

Ramakrishna, V. (2016). Municipal Solid Waste Quantification, Characterization and Management in Rajam. The International Journal of Engineering and Science, 5(2), 8.

Suthar, S., & Singh, P. (2015). Household solid waste generation and composition in different family size and socio-economic groups: A case study. Sustainable Cities and Society, 14, 56–63. https://doi. org/10.1016/j.scs.2014.07.004

United Nations Environment Programme (2021). Food Waste Index Report 2021 Nairobi.

****