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FOOD SYSTEMS

Saving food mitigates climate change

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Life Cycle Assessment reveals that the emissions from the treatment and disposal of lost and wasted food account for around half of greenhouse gas emissions from food systems. Therefore, saving food is essential to reduce food systems' environmental impacts.

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Limiting global warming below 2°C by 2100 requires transforming food systems[1], which currently contributes to a third of global anthropogenic GHG emissions[2]. Various response options are available to make this transformation happen[3]. One of the responses from the food system is to reduce food loss and waste, known together as food wastage, which occurs at various stages of the supply chain. Food loss refers to reduced edible food during production, post-harvest, and processing. Food waste refers to food discarded by consumers, retailers, or food service providers, which would increase in the future under business as usual[4]. Although many studies highlighted the GHG emission reduction potential of saving food, a holistic understanding of this potential considering the overall life cycle of food, i.e., from pre-production to end-of-life (Figure 1), is missing[5].

Writing in *Nature Food*, Zhu and colleagues[6] fill this knowledge gap by comprehensively estimating the GHG emissions associated with food wastage in 2017. They constructed a material balance model for food systems covering 54 food commodities and four major categories at a country level using food supply data from FAOSTAT[7] and considering food wastage at nine stages of the supply chain[8]. Food wastage is responsible for embodied emissions, i.e., from pre-harvest and logistics, and emissions during its treatment or disposal, i.e., end-of-life. Therefore, Zhu and colleagues synthesized data for embodied emissions based on a comprehensive literature review. They applied the Life Cycle Assessment approach to evaluate emissions from the treatment and disposal of lost and wasted food. Besides estimating food wastage emissions, they investigated strategies to reduce emissions under various policy and technological interventions.

The study estimates that the embodied and end-of-life emissions of food wastage were ~9.3 Gt CO_2 eq/yr, or around half of the food systems emissions[6]. This estimate is more than double the previous one of 4.4 Gt CO_2eq/yr for 2011[5]. This difference is due to the consideration of end-of-life emissions and increased food production to nourish the growing population. Saving food avoids these emissions but varies worldwide. Four countries, i.e., Brazil, China, India, and the United States (US), are responsible for ~40% of these avoidable emissions due to their large populations, dietary habits, or inefficient food systems.

Zhu and colleagues[6] highlight significant differences in GHG emissions due to food wastage across various supply chain stages. Food discarded by consumers embodies consists of ~35.5% of the total embodied emissions of food wastage. These emissions are higher than embodied emissions in food thrown by wholesalers, retailers, and traders, which are ~11% of the total embodied emissions of food wastage. Reduced edible food in the other stages, e.g., harvest, storage, processing, and transport, are responsible for the rest of the emissions.

Looking at the GHG emissions from the supply chain, the study estimates that pre-harvest stage emissions of food lost and wasted are mainly related to food production activities, e.g., land use, crop cultivation, synthetic fertilizers, and animal husbandry. Logistic activities of food wastage, mainly from food processing and transport, are responsible for the GHG emissions of 0.09 Gt CO_2eq/yr. These emissions are only a tiny fraction of the total emissions from logistic activities of food systems (~2.65 Gt CO_2eq/yr), because of no logistic needs for lost or wasted food across the supply chain. Due to a higher consumption level[4], food wastage emissions at pre-harvest and logistic stages increase with a per capita gross domestic product at a country scale. The treatment and disposal of lost and wasted food generates ~2.8 Gt CO_2eq/yr of GHG emissions. Interestingly, these end-of-life emissions are lower in countries with a higher per capita gross domestic product due to the availability of advanced and environmental-friendly technologies for waste treatment.

The findings present strategies to reduce emissions due to food wastage. Besides saving food at various supply chain stages, these strategies include dietary shifts toward a low consumption of animal-source foods and treatment and disposal technologies for food wastage. During end-of-life, plant-based foods emit more GHGs than animal-source foods. Still, animal-source foods generate much higher GHG emissions than plant-based foods during production and logistics. Therefore, dietary shifts towards plant-based diets also reduce GHG emissions associated with food wastage. Similarly, food wastage emissions can be reduced by proper treatment, e.g., composting and anaerobic digestion, instead of disposal in landfills and dumping sites (Figure 1). For example, a 50% increase in market shares of these technologies can decrease food wastage emissions by ~15%.

As shown by Zhu and colleagues[6], a holistic understanding of food wastage would also support better strategies to prioritize food system responses across supply chain stages. For example, high-income countries could focus on reducing food waste and promoting plant-based diets. In contrast, low-income countries could prioritize avoiding food loss and proper waste treatment using appropriate technologies[5]. Although this study enriches our understanding of food wastage, some open questions remain. For example, due to increased food trade, it is essential to identify the roles of producer, consumer, and intermediary trading countries in reducing food wastage as in agricultural emissions[9].

Saving food mitigates climate more than previously thought. However, halving food waste, as targeted by Sustainable Development Goals, is not enough. Avoiding GHG emissions from food wastage requires a combination of responses, and these responses should contribute beyond halving food wastage to rescue Sustainable Development Goals from failing[10].

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Ethics declaration

The author declares no competing interests.

Figure 1. Food waste is being treated in anaerobic digestion in Dharan, Nepal, to generate biogas for human mobility. Foods are mainly dumped in landfills, emitting methane, a greenhouse gas even more potent than carbon dioxide, while decaying. Waste treatment using anaerobic digestion can capture and reuse these methane emissions. Credit/Copyright: Photography by Sagar Kafle from Department of Agricultural Engineering, Purwanchal Campus, Institute of Engineering, Tribhuvan University, Dharan, Nepal.