



Task Force 02

**SUSTAINABLE CLIMATE ACTION AND INCLUSIVE JUST ENERGY TRANSITIONS**

## **Towards a Low Carbon Future: Circular Production and Consumption to Reduce Food Loss and Waste**

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## Abstract

One third of the world's food production is ultimately lost or wasted, a massive inefficiency in terms of resources, labour and environmental impact. Linear food systems significantly contribute to the triple planetary crisis of climate change, biodiversity loss, and pollution, leading to food insecurity and representing a humanitarian challenge in a hungry world. Around 13% of the food is lost in upstream processes, including crop spoilage, distribution damages, date expiration and other; and 17% is lost at food services and households, mainly because of consumer rejection, poor planning, and oversized portions.

A sustainable food system is crucial, as targeted in SDG 12.3, and a transition towards circular production and consumptions patterns is a key element. Enabling circular practices throughout the food production, distribution and consumption value chain represents a tangible and achievable step in the global pursuit of sustainable development, with cross-cutting benefits to many other areas of relevance worldwide.

This policy brief aims to call attention to the issue, fostering collaboration and enabling concrete actions among G20 countries to prevent food loss and waste. The food loss and waste drivers include upstream factors (environmental, production practices, infrastructure, market, policy and socio-economic) and downstream factors (consumer behaviour, commercial practices, storage and retail, food services and household practices). To overcome the challenges, recommendations encompass different approaches, including: developing national strategies; investing in data collection and analysis; improving infrastructures, using sustainable packaging; developing economic instruments; empowering local governments; and, maximizing knowledge transfer and

awareness. As an outcome, substantial GHG emission reductions could be obtained and be instrumental to prevent and abate methane, a potent short lived climate force.

**Keywords:** Food loss, Food waste, Circular economy, Climate change

## Diagnosis of the Issue

Food losses and waste occur both at upstream (cultivation, transportation) and downstream (retailers, food services, households) life-cycle stages. According to FAO (2011) one third of food production is lost or wasted "from farm to fork", and UNEP (2024) estimates that 931 million tons of food was wasted in 2019. Notably, most of this waste comes from households, which discard 11% of the total at the consumption stage. An estimated 13 percent of the world's food is lost in the supply chain from post-harvest before the retail stage of the supply chain; a further 17 percent of food is wasted in households, food services and retail (UNEP 2021).

This subject is also relevant to the 2030 Agenda, under the Sustainable Development Goal (SDG) 12 on sustainable consumption and production patterns. The specific target of SDG 12.3 aims to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" by 2030. This target emphasizes the need to address food loss and waste throughout the entire food supply chain, from production to consumption, in order to promote more efficient and sustainable use of resources.

Achieving SDG 12.3 involves implementing measures to reduce food loss and waste, improving food distribution systems, raising awareness, and promoting sustainable consumption behaviours towards more circular practices. This goal is crucial for advancing environmental sustainability, food security, and economic efficiency on a global scale. Reducing food loss and waste is crucial for lowering production costs, increasing food system efficiency, enhancing food security and nutrition, and promoting environmental sustainability, with considerable climate benefits.

Food loss and waste (FLW) are significant issues that arise throughout the food supply chain, beginning with agricultural production where crops may be left unharvested due to mechanical inefficiencies, market dynamics, or labour shortages. Post-harvest losses can stem from inadequate handling and storage, pest infestations, and spoilage. During processing, losses are incurred through inefficient operations and discarding during food 'trimming'. In distribution, inadequate infrastructure and poor handling lead to spoilage and damage. At the retail and market levels, overstocking, stringent cosmetic standards, and variable consumer demand result in discarded food. After those supply chain stages, there are also the losses at food preparation and consumption, both on food services and households. All of these losses not only represent a waste of consumable food but also squander the water, land, labour, transportation and inputs invested in production. Addressing these issues requires enhanced agricultural practices, improved storage and processing, better supply chain management, and effective distribution strategies, besides improved food preparation practices and more sustainable lifestyles (UNEP 2024).

The Figure 1 below illustrates the journey of food from production to consumption and waste. Food destined for people can either be eaten or lost at various stages, leading to waste management processes like composting, bioenergy production, or landfill disposal.

The green arrows denote food that remains in the supply chain and orange for inedible parts that are repurposed or managed as waste, and red for food waste. It should be noted that industrial uses cover a range of products from biofuels to bioplastics, and that the bar lengths do not reflect actual volumes or values.

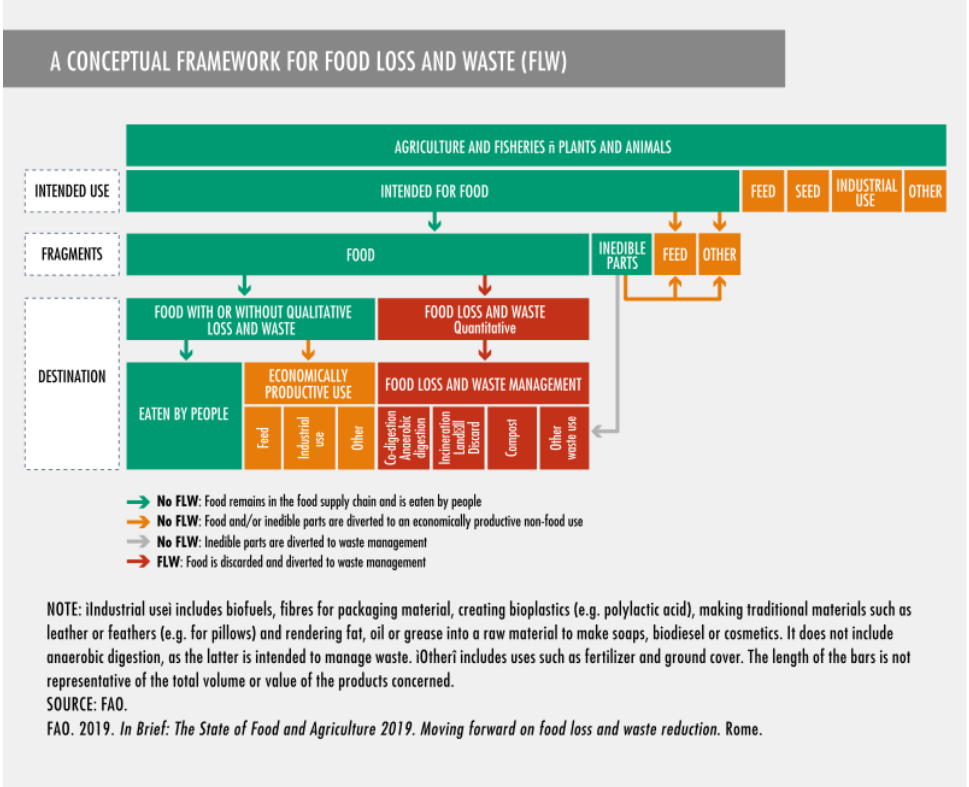


FIGURE 1: Identification of key stages in the food supply chain where losses occur (FAO, 2019)

There are several causes of FLW as exemplified in Figure 2, and pervade the entire food supply chain, with multiple factors contributing at each stage. In food production, unharvested crops and spoilage due to pests, diseases, and contamination lead to significant losses. During processing and distribution, edible parts are often trimmed away, products get spoiled or damaged, and overproduction exacerbates waste. Retail sees overstocking, disposal of unsold food due to expiration dates, and consumer rejection based on appearance. In food services and households, oversized portions, poor planning resulting in excess purchases and preparations, improper storage leading to spoilage, and bulk purchases left unused before expiration contribute to substantial waste. These

interconnected factors highlight the complexity of addressing food waste throughout the supply chain, necessitating comprehensive strategies at every level.

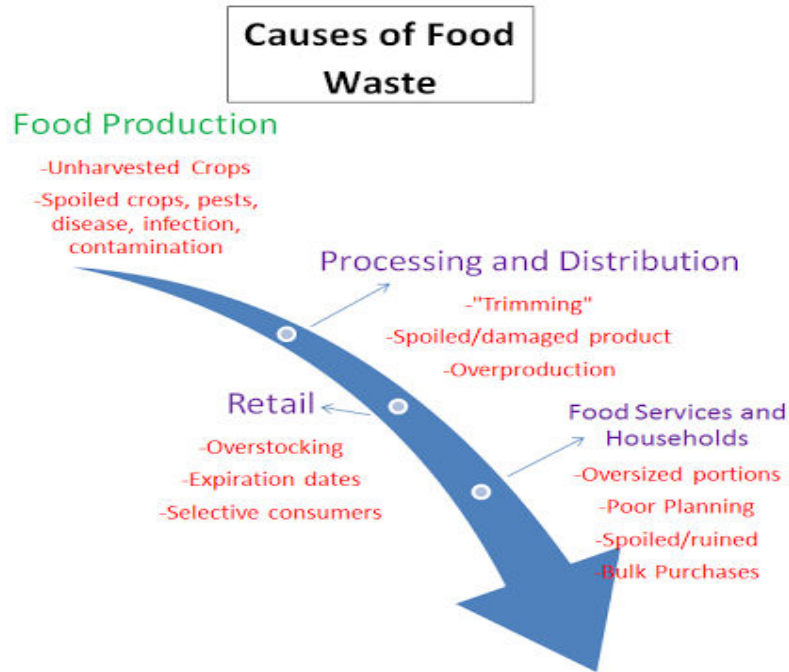


FIGURE 2: Socioeconomic, infrastructural, and behavioural drivers

## Recommendations

The drivers of FLW can be examined at two different moments: at upstream level (production, processing, distribution, and retail); and downstream (consumption at food services and households).

From the upstream side, the Global Waste Management Outlook 2024 (UNEP & ISWA 2024) addresses FLW within the larger context of municipal solid waste (MSW), pointing to various factors mainly: unharvested crops and spoiled crops (due to pests, diseases, infection, and contamination) at agricultural production; and losses due to trimming or removal of edible parts, spoiled/damaged products, and overproduction relative to demand, at processing and distribution.

A research study at Sony Brook University (Thyberg and Tonjes 2016) explored FLW drivers at the downstream side, as:

- **Consumer behavioural choices:** Poor planning often results in impulse purchases and over-provisioning during shopping, leading to excess food in households. Additionally, difficulty estimating portions and a preference for abundance contribute to excess food preparation. Furthermore, limited cooking skills and a lack of knowledge on how to effectively utilize leftovers often result in their disposal.
- **Institutional and commercial practices:** Decisions regarding quantities, visual quality, and stocking practices in retail and institutional settings. Moreover, offering oversized portions in food service establishments leads to plate waste. Strict appearance quality standards in supermarkets result in the discarding of slightly imperfect items. Additionally, inaccurate forecasting of food needs leads to surplus inventory and subsequent disposal.



- Food spoilage and storage issues: Consumers often discard food prematurely due to misinterpretation of date labels, even if the food is still safe to eat. Additionally, consumer sensitivities to food safety and misconceptions about food safety contribute to the disposal of edible food perceived as unsafe. In some countries inadequate storage systems or electricity cuts also contribute.
- Retail practices: Overstocking, expiration dates, and selective consumer behaviour contribute to food wastage, with perfectly edible food often discarded due to aesthetic imperfections or overcautious date labelling.

Managing FLW effectively requires a comprehensive approach, that includes reducing food loss at the source, improving supply chain logistics, encouraging consumer behaviour change, and developing policies that promote sustainable consumption and production patterns, considering the following recommended actions:

### **1.1. Develop and implement Food Waste Reduction strategies**

Governments at both national and sub-national levels should develop comprehensive strategies to tackle FLW, incorporating circular economy principles, and including measures to prevent, recover, and recycle food waste across the entire supply chain. This could be done firstly by establishing clear targets aligned with international goals, such as the SDG 12.3, covering various stages of the food supply chain.

Secondly, comprehensive assessments should be conducted to identify primary causes of food loss and waste at local, regional and national levels, involving factors such as agricultural practices, transportation, distribution and consumer behaviour. Collaboration among government agencies, private sectors, NGOs, and civil society is crucial, and

policy instruments should be implemented to incentivize food waste reduction. Furthermore, supporting innovation and technology adoption, raising public awareness, and strengthening food recovery systems are essential. In France comprehensive legislation passed in 2016 bans supermarkets from throwing away or destroying food, donating it to charities and food banks instead. The Food Waste Reduction Law in Italy passed in 2016 encourages businesses to donate unsold food by offering tax incentives and simplifying the donation process. The laws also promote educational campaigns to raise awareness about food waste.

### **1.2. Invest in data collection and analysis**

According to UNEP (2024), among G20 only Australia, Japan, UK, USA and EU have food waste estimates suitable for tracking progress to 2030. Governments should invest in reliable data collection and analysis methods to accurately measure FLW across the supply chain and in households. This data will inform evidence-based policy making and help identify priority areas for intervention. Additionally, standardized methodologies for measuring FLW should be implemented to enable meaningful comparisons and tracking progress over time.

### **1.3. Support food waste recovery infrastructure**

Governments should provide support for the development of food waste recovery infrastructures at regional and local levels. This includes investing in composting facilities, anaerobic digesters, and food recovery networks to divert food waste from dumpsites and landfills, and also to redistribute surplus food to those in need. Public-

private partnerships can be leveraged to maximize the efficiency and effectiveness of these initiatives. Several good examples can be found across the world for instance the Mesa Brazil SESC network recovers food from supermarkets, restaurants and farms to redistribute it to social organizations. In South Korea the ‘pay-as-you-throw’ programme discourages the wastage of food. The Food Waste Recovery Network operating on college campuses in the United States recovers surplus food from dining halls, restaurants, and grocery stores and donates it to local agencies fighting hunger. In India the ‘dabbawallas’ of Mumbai collect surplus food from households and redistribute it to those in need.

#### **1.4. Promote sustainable packaging practices**

Adequate packaging is an essential part of food life extension and quality assurance, and governments should establish standards and incentivize the use of innovative sustainable packaging solutions, that minimize FLW while reducing environmental impact.

This could involve providing incentives or subsidies for businesses that adopt packaging alternatives that maximize reuse, and encourage the use of recyclable, recycled and biodegradable materials.

#### **1.5. Implement economic instruments**

Economic instruments to prevent FLW could encompass a range of initiatives and incentives, including subsidies, tax incentives, direct grants for innovation and research, and public-private partnerships to fund infrastructure like cold storage. (UNEP 2024)

Other possibilities include the use of: green bonds to finance environmentally beneficial projects; impact investments to seek returns alongside positive social or

environmental impacts; climate finance to deliver practical solutions to mitigate GHG emissions, specially methane; microfinance products to aid small-scale farmers; risk-sharing instruments like insurance to offer protection against losses; and investments in supply chain efficiency to streamline food distribution.

### **1.6. Foster innovation and collaboration**

Governments should support innovation in the agri-food sector by fostering collaboration between industry stakeholders, research institutions, and technology providers.

This includes promoting the adoption of new business models and technologies, such as mobile-based supply platforms, that improve efficiency, reduce FLW, and contribute to transformative change in agri-food systems.

### **1.7. Empower subnational governments and cities**

Subnational governments and cities are key actors to many stakeholders at food supply-chains, and central governments need to empower subnational authorities for action through planning, policy support, capacity building, and financial resources.

This could involve providing support to structuring appropriate collection systems, to establish local food recovery and recycling programs of inedible food waste and the required infrastructures, as regional or community composting initiatives, and public education campaigns to raise awareness and promote behaviour change at the grassroots level, such as campaigns to “take-home” leftovers from restaurants and catering.

### **1.8. Promote knowledge sharing and awareness**

Governments should also facilitate knowledge sharing and awareness-raising efforts through platforms, communities of practice, and education campaigns.

This includes engaging stakeholders to exchange best practices, lessons learned, and innovative solutions for reducing food loss and waste. Public awareness campaigns can also help educate consumers about the importance of food waste reduction and provide practical tips for reducing waste at home and promoting more sustainable and circular lifestyles. An example is, LiFE, or Lifestyle for Environment, Mission launched by the Government of India as part of its NDCs.

## Scenarios of Outcomes

This policy paper underscores the importance of adopting circular practices to reduce food loss and waste and thus contributing to environmental sustainability, conserving natural resources, and improving global food security. It specifically has the following objectives:

- establish a harmonized understanding by providing common concepts and definitions of food loss and waste across the supply chain (from production to consumption stages) combining it with circular economy principles and drivers;
- propose the establishment of quantifiable reduction targets in alignment with Sustainable Development Goal (SDG) 12.3; and
- identify primary challenges contributing to food loss and waste, proposing scalable solutions at both national and sub-national levels, while also focusing on enhancing data collection and monitoring mechanisms for informed decision-making and progress tracking

The paper also aims to contribute to promote collaborative efforts among G20 countries and sectors, fostering public awareness, and encouraging behavioural changes to prevent food loss and waste through circular practices.

Among the diverse benefits of reducing FLW is the mitigation of GHG emissions. Figure 3 shows the estimates of GHG emissions from food production from 2020 to 2100 under different scenarios (Ritchie 2021).

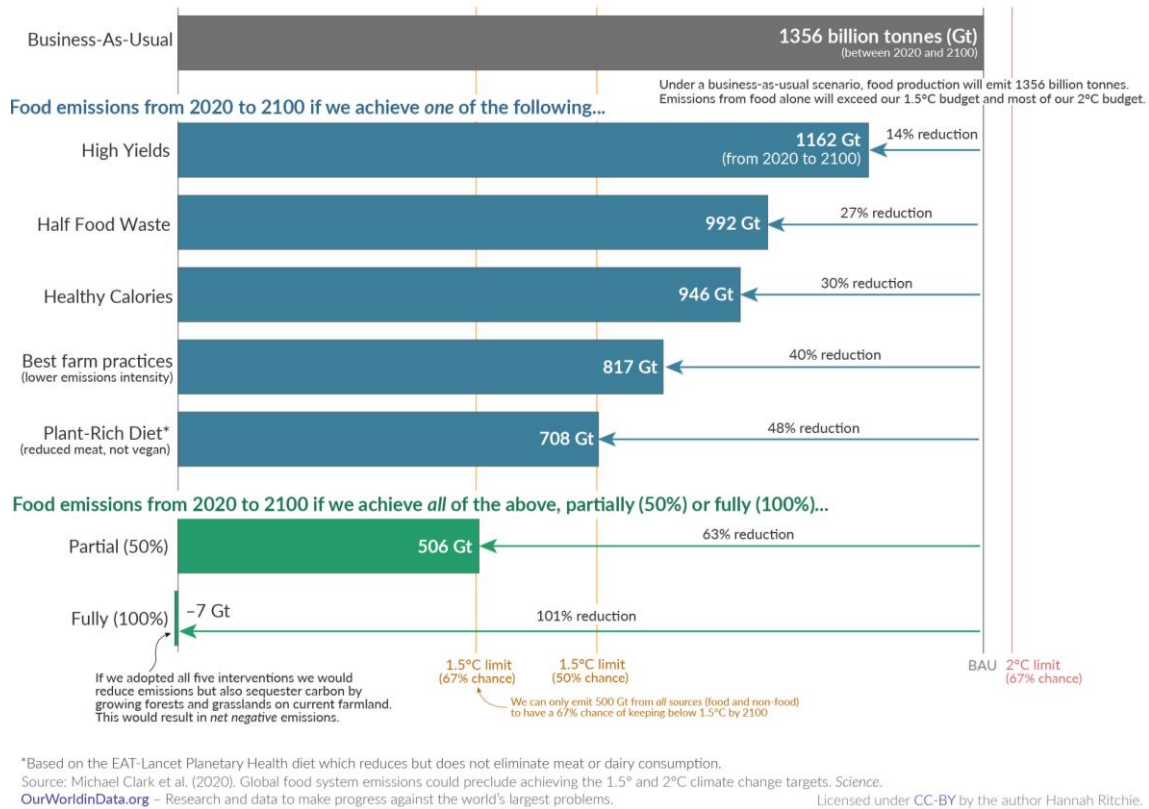


FIGURE 3 Reduce GHG emission from food (Ritchie 2021)

In a partial best-case scenario, where half of the proposed improvements are successfully implemented, a 63% reduction on GHG emissions is obtained – which means a reduction of more than 850 Gt CO<sub>2</sub> eq/ year. Conversely, in a BAU scenario, where food loss and waste remain unabated, the consequences for GHG could be alarming.

If FLW continues at current levels or even increases, it would exacerbate the environmental impact of the food production. More resources would be expended on growing, processing, transporting, and disposing of food that ultimately goes uneaten, leading to higher emissions across the entire food supply chain. However, with a substantial decrease in FLW, fewer resources would be required for food production, resulting in lower emissions from processes such as deforestation, land use change, fertilizer use, and energy consumption throughout the supply chain.

Having the suggested recommendations embraced by G20 members, cities and metropolitan areas shall be empowered to act as pivotal agents to instigate transformative changes within the food ecosystem through some strategic interventions for a circular system:

1) Optimization of food use by leading the transition towards a circular food system, thus incorporating measures to reduce avoidable food wastage and incentivizing upstream solutions to prevent/eradicate food loss and waste throughout the supply chain.

2) Enable regenerative and local cultivation practices by employing production techniques that bolster the overall sustainability of the food chain at local level.

3) Promote health-oriented food products by supporting business opportunities for food items directed to promote healthiness across the value chain (production to consumption).



## References

- Ellen MacArthur Foundation (2023). Food and Circular Economy – deep dive.  
<https://www.ellenmacarthurfoundation.org/food-and-the-circular-economy-deep-dive#>
- FAO - FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (2022). Tracking Progress on Food and Agriculture-related SDG Indicators. Rome: FAO. Retrieved from <https://www.fao.org/3/cc1403en/online/cc1403en.html#/12>
- \_\_\_\_ (2011). *Global food losses and food waste – Extent, causes and prevention*. Rome: FAO.
- \_\_\_\_ (2019). *The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction*. Rome: FAO.
- Minor, Travis, Gregory Astill, Sharon Raszap Skorbiansky, Suzanne Thornsbury, Jean Buzby, Claudia Hitaj, Linda Kantor, Fred Kuchler, Brenna Ellison, Ashok Mishra, Tim Richards, Brian Roe, and Norbert Wilson. 2020. *Economic Drivers of Food Loss at the Farm and Pre-Retail Sectors: A Look at the Produce Supply Chain in the United States*. USDA EIB-216.
- Ritchie, Hannah. 2021. “Emissions from food alone could use up all of our budget for 1.5°C or 2°C – but we have a range of opportunities to avoid this.”  
<https://ourworldindata.org/food-emissions-carbon-budget>.
- Thyberg, Krista L, and David J Tonjes. 2016. *Drivers of Food Wastage and their Implications for Sustainable Policy*. Technology & Society Faculty Publications.
- UNEP . 2021. *UNEP Food Waste Index report 2021*. Nairobi: UNEP (United Nations Environment Programme).
- UNEP. 2024. *Food Waste Index Report 2024. Think Eat Save: Tracking Progress to Halve Global Food Waste*. Nairobi: United Nations Environment Programme.

UNEP & ISWA. 2024. *Global Waste Management Outlook 2024: Beyond an age of waste Turning rubbish into a resource*. Nairobi: United Nations Environment Programme.

WWF-UK. 2021. “Driven to waste: The Global Impact of Food Loss and Waste on Farms. Woking.”



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