

Reduction of Food Loss and Waste: The Challenges and Conclusions for Actions



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1 Introduction

The global food system is malfunctioning, leaving large segments of the population undernourished or malnourished, and causing significant environmental damage. Food losses in the production, processing and marketing segments of food systems are part of the problem. Food-wasting at the retail, household and restaurant levels is a serious problem too. The analyses and calls for action in this volume are motivated by the United Nations Sustainable Development Goal (SDG) No. 12, i.e., Ensuring sustainable consumption and production patterns, and specifically, “By 2030, 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.”

This goal is very much in line with the Encyclical *Laudato Si'*, in which Pope Francis calls for changes for the purpose of overcoming “throwaway culture.” Food Loss and Waste (FLAW) is a moral issue, because of the adverse effects on people and our planet (Grizzetti et al. 2013). It is detrimental to the planet due to greenhouse gas (GHG) emissions and the wasting of the water and land used as inputs (Kummu

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et al. 2012),¹ and to people – the poor in particular – whose labor is squandered and whose livelihoods are compromised when FLAW occurs.

Box 1: SDG 12 – Ensuring Sustainable Consumption and Production Patterns

“By 2030, 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.”

Since loss and waste are related but distinct phenomena, each merits a unique indicator, as stated by FAO:

Sub-Indicator | Food Loss Index: The Food Loss Index (FLI) focuses on food losses that occur from production up to (and not including) the retail level. <http://www.fao.org/sustainable-development-goals/indicators/1231/en/>

and as developed by UNEP:

Sub-Indicator | Food Waste Index: A Food Waste Index, which comprises retail and consumption levels. <https://wedocs.unep.org/handle/20.500.11822/35280;jsessionid=37107F3730786C883BCABD606C13CBFE>

The aim of this chapter is to share the latest scientific evidence on how to reduce food loss and waste, and thereby contribute to global food and nutrition security. The second aim is to provide recommendations for expanded global and national actions, including public and private investments and initiatives by citizens, corporations, governments, and international organizations. We recognize that the alliance of actors must become broader in order to make significant improvements globally in reducing FLAW.

To fulfill these objectives, we focus on clearly defining food loss and waste, while adopting a value-chain approach. When considering the magnitude of the food loss and waste challenge, summing up the tonnage of different foods is not appropriate: not only must weight be considered, but also the economic and environmental cost of wasted and lost food must. The latest approaches to measurement in economic, caloric, or quality-adjusted weight terms are presented and discussed.

Further, food loss and waste reduction have huge benefits, but also costs, and these costs must not be ignored when aiming for efficient solutions (Aragie et al. 2018). Benefits and costs must consider environmental, as well as food and nutrition security, effects. We know that environmental change and people’s health cannot be easily captured by economic calculations (Kuiper and Cui 2021; Chen et al. 2020).

¹This chapter is based on the findings and recommendations for action identified by the participants of the International Conference by the Pontifical Academy of Sciences (PAS) with the Rockefeller Foundation. The book based on the conference is at <https://www.pas.va/content/dam/casinapioiv/pas/pdf-volumi/scripta-varia/sv147pas.pdf>

Successfully meeting SDG 12.3 requires approaches that foster education and awareness, behavioral change, a renewed global dialogue, and coordinated global action. Ultimately, we need to create incentives that will strengthen the business case for tackling food loss and waste and moving towards more sustainable consumption patterns (Qi et al. 2021).

As we aim to unite and improve our understanding and strengthen our conviction to act on food loss, we are aware that these phenomena are embedded within a broader food system context.

2 Food Loss and Waste

Until recently, there has been an absence of a uniform definition of food waste and loss (Xue and Liu 2019). Various definitions have been used in literature and in policy documents (Bellemare et al. 2017; Fabi et al. 2021). This lacuna stands in the way of analyses on food waste and loss, including its precise measurement at the national, regional and global scales. The FAO, therefore, provides a definition and defines food loss and waste as the “decrease in quantity or quality of food along the food supply chain” (FAO 2019). In this definition, *food losses* occur in the food supply chains from harvest to retail and *food waste* occurs in retail and consumption (Cattaneo et al. 2021). The definition has been expanded by others to include pre-harvest, quantitative and qualitative food losses (Delgado et al. 2021).

Food waste concepts have also been further clarified by UNEP with its Food Waste Index Report 2021, which “... for the purposes of the Food Waste Index, ‘food waste’ is defined as food ... and the associated inedible parts removed from the human food supply chain in the following sectors: Retail, Food service, Households. ‘Removed from the human food supply chain’ means one of the following end destinations: landfill; controlled combustion; sewer; litter/discards/refuse; co/anaerobic digestion; compost/aerobic digestion; or land application. Food is defined as any substance – whether processed, semi-processed or raw – that is intended for human consumption. ‘Food’ includes drink, and any substance that has been used in the manufacture, preparation or treatment of food. Therefore, food waste includes both ‘edible parts’: i.e., the parts of food that were intended for human consumption, and ‘inedible parts’: components associated with a food that are not intended to be consumed by humans. Examples of inedible parts associated with food could include bones, rinds and pits/stones” (United Nations Environment Programme 2021).

A lack of consensus on the definition spills into measurement of food loss and waste (Delgado et al. 2021; Bellemare et al. 2017). FLI (Box 1) measures the economic value of food losses based on commodity prices. FLI is helpful in cost-benefit analyses. FLI and FWI are also used to monitor SDG 12.3. Other measures, such as food loss in terms of calories or reduction in GHGs, are suitable for analyses of targeted interventions such as improvements in nutrition outcomes and impact on environmental sustainability (Xue and Liu 2019).

Actions to reduce food loss and waste are already planned or in place in many countries, but, so far do not add up to sufficient global impact and joint learning. The most promising actions can and must be enhanced. By bringing together a group of prominent leaders, actively engaged with this issue, from academia, religious communities, the private sector, government, civil society, and the United Nations (UN), we aim to create an interdisciplinary space for analysis, the sharing of knowledge and focused solutions. Ultimately, reducing FLAW requires a change in mindsets among those who waste food and large-scale investments in value chains that are losing food. The State of Food and Agriculture Report (2019) by the Food and Agriculture Organization (FAO) of the United Nations and Reducing Food Loss and Waste: Setting a Global Action Agenda (2019) by the World Resource Institute (WRI) and a coalition of partners, along with other reports, provide a basis for action. How to go about these challenges is summarized in the conclusions and proposed actions below.

3 Proposed Actions

1. *Increased Commitment for Action*

Food loss and waste (FLAW) has serious moral repercussions, in view of the prevailing hunger of more than 820 million people and the lack of access to healthy diets for 2 billion people (FAO's SOFI report 2019). Resources such as water and fertile land are becoming scarcer, because food is produced but never eaten.

FLAW significantly contributes to GHG emissions (SOFA 2019), and thereby to climate change and its consequences (Read et al. 2020). FLAW is detrimental to the planet and its people. It is morally, economically and environmentally unacceptable in the era of the SDGs. There is a need for an increased commitment to action from national, regional and global leaders towards SDG 12.3, i.e., by 2030, 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 – an achievable goal based on existing knowledge and technology. Yet, even though it is within our ability to tackle, FLAW reduction needs more attention and investment.

Successfully achieving Target 12.3 of the United Nations SDGs requires a new perspective on how to reduce the use of resources and increase the efficiency of the production, preservation, processing and distribution of food at the producer, intermediary, processor and wholesale levels (i.e., losses in the value chain). It also requires addressing our “throwaway culture.” For that, education, awareness, and behavioral change among consumers and retailers are critical. A renewed global dialogue at the highest levels of government, business, religion, and civil society is urgently needed to achieve the target of halving FLAW by 2030.

2. Localizing the FLAW problem, while tapping into global solutions

Data deficiencies mask the diversity of the FLAW problem – which varies greatly across regions and value chains. While a high percentage of food is currently lost at the production, handling and processing stages in low-income and emerging economies, food is wasted in retail and consumption stages in higher income countries due to market design and consumer behavior (Min et al. 2021). Yet, market design and food waste patterns are increasing in low- and middle-income countries as the global middle class grows and urbanizes. Solutions are within reach for all country groups, but need to be tailored to specific contexts (Brander et al. 2021) and differentiated as to food loss versus food waste, as these are related but distinct concepts. Food waste happens due to a lack of appropriate infrastructure, regulations, profit-seeking, negligence, time scarcity and economic abundance at the consumer level. Food loss occurs due to unfavorable climatic conditions, improper post-harvest handling, and incentive structures that cause food loss to be seen as a rational economic option, as well as a lack of information, education, technology, infrastructure, affordable financing and market access. FLAW has social equity and gender implications. Food production, and not just that in low-income countries, involves large shares of unpaid labor done by women and often low-paid workers, including migrants, producing cheap food that might be undervalued, and thus is wasted by customers. In addition, all steps in supply chains should be reviewed and monitored in order to prevent the use of forced labor and modern slavery (according to SDG 8.7).

Value chains of perishable and nutrient-rich foods (both crops and animal-sourced protein) are significantly affected. More nutritious and healthier dietary patterns require managing and preserving these nutritious foods and fostering attention to food safety.²

FLAW requires attention, along with all aspects of wasteful processing, transportation, packaging (e.g., the plastics issue) and energy usage along food supply chains – issues that, it is hoped, a circular economy and bioeconomy can address systemically. Attention to prevention, not just reduction, should be considered, and solutions need to consider further the possible impacts on food access and affordability.

3. Strengthening of information and data

Only when sound data are gathered and made available will measurement and monitoring progress against benchmarks become feasible and viable for investors and companies (Xue and Liu 2019). When considering the magnitude of the FLAW challenge, summing up the tonnage of different foods does not appropriately capture food, environmental, and economic issues. We must move beyond a weight metric and assess the economic, environmental, institutional, health, and human costs of

²The issue has been addressed in the Conference by the Pontifical Academy of Sciences and the Global Alliance for Improved Nutrition on Food Safety and Healthy Diets in 2018 <http://www.pas.va/content/accademia/en/events/2018/food/statement.html> accessed on 08.12.2021.

lost and wasted food. The hotspots in value chains where food losses occur are increasingly identified, as are effects in terms of quality losses, economic costs and emissions costs (FAO's SOFA report 2019).

While FLAW reduction has huge benefits, the costs of action cannot be ignored when aiming for effective and efficient solutions. A comprehensive approach of cost of action versus cost of inaction may be helpful.

Efforts to collect and analyze data need to be doubled down, not only for reporting purposes, but also for the identification of causes of FLAW and decision-making for action by all players in value chains. We encourage agencies in charge of these metrics and analyses to step up efforts in these areas, donors to enhance financial support, and the private sector to report on a volunteer basis.

4. Research in science, technology and extension

Research initiatives by FAO, WRI, IFPRI (International Food Policy Research Institute), UNEP, the World Bank, the IADB, the InterAcademy Partnership, and universities, as well as others, highlight opportunities and challenges for research on food and nutrition security and sustainable food production, and propose priorities for natural science, social science and food post-harvest and food technology research on FLAW reduction.

Close cooperation among research communities and different stakeholders across food systems is called for to make progress on evidence-based FLAW reduction and action, including food market analysis, in order to understand the potential of solutions and innovations, as well as the feasibility of their adoption (Ellison et al. 2019). The FLAW problem needs further clarification as to what it means for people and the planet, and what it takes to move towards a more sustainable future. As waste is partly a behavioral issue, research on the behavioral aspects of FLAW needs more attention.

The causes of FLAW from a food system perspective need to be comprehensively investigated in order to avoid trade-offs across interventions if practiced within silos, and in order to point at their policy implications in the short and long term. The main knowledge gaps and the research agenda have been outlined in various recent publications, such as the InterAcademy Partnership report on "Opportunities for future research and innovations on food and nutrition security and agriculture" (2018). Urgent action, especially in Sub-Saharan Africa, Central and Southern Asia, and other developing regions affected by high incidence of food insecurity and food loss, is needed.

Pathways to effective alliances need to reflect a systemic approach to FLAW reduction, incorporating innovations in science and technology, and in monitoring food items transiting through the system. There is a role for extension services in dissemination, and for universities in building FLAW into their curricula. Information and communication technologies (ICT) and data science have proven to be game-changers in this respect. The research community must communicate, coordinate and collaborate, and governments, businesses and foundations must invest new resources to fund FLAW research.

5. Civil society actions

Civil society is taking action in areas related to FLAW. Different groups across the globe lead campaigns and disseminate information and good practices, educating consumers across all age groups, youths in particular, and advocating for more sustainable consumption patterns. Consumers are becoming aware of their environmental footprint when making choices about food purchases, portion sizes, packaging materials, and the distances that foods travel. Other groups, such as Food Banks, have developed models to collect, repurpose and re-distribute food in urban settings. Broadening efforts at the grassroots level from national or regional networks towards a global network will be fruitful. Efforts led by conscious youths need support, including consumer and producer/farmer perspectives that care about the sustainability of the planet and the people.

Education, for instance, through the global sharing of experiences in successful actions, can help countries identify solutions pertaining to issues of relevance tailored to specific circumstances. Toolkits in many languages for civil society organizations would be helpful. Dialogue on FLAW needs to be replicated more globally, reinforcing positive social norms and engaging influencers and role models.

Religious communities also have a role to play. These communities can engage in leading community initiatives against food waste and loss. Both loss and waste are moral issues causing harm beyond their economic and environmental tolls. Faith-based communities should initiate dialogues on acting together to support, advocate and collaborate on reducing FLAW.

6. Government actions

Governments at all levels need to set explicit, ambitious and realistic FLAW reduction targets, measure the level and change of FLAW, and implement an effective and economically efficient FLAW reduction strategy. Some countries have invested in developing plans and actions to reduce FLAW. So far, however, they do not add up to sufficient global impact and joint action.

Investments in critical value-chain infrastructure need to be prioritized in low- and middle-income countries. Such investments would allow for vertical coordination and modernization of value chains. The need for such investments is particularly acute when dietary patterns are changing and demand for a more diverse and nutritious food basket, especially in urban areas, is rising. Innovative solutions for financing such government plans as the Sustainable Development Bond launched by the World Bank and innovative financing solutions such as a fund for investments in FLAW reduction might facilitate progress in this area.

Governments should also seek to redress incentive structures (including through price and regulatory measures like standards) such as those that encourage farmers and other supply chain actors, as well as retailers and consumers, to adopt practices that help reduce FLAW.

Furthermore, two issues need government consideration at the macro scale: (1) diversion from rule-based free trade can accelerate FLAW and needs attention;

and (2) as FLAW accounts for a significant share of GHG emissions (Galford et al. 2020), the issue should feature on the action agenda of climate negotiations and Nationally Determined Commitments (NDCs).

7. Business case and corporate actions

A business case for addressing FLAW seems to exist, yet needs to be clearly demonstrated. Public support is initially required for implementation at scale and to reap societal benefits. A case in point is connecting to small farmers: As food companies aim to create value, business can lead the way in developing models that are more inclusive, such as sourcing from small-scale producers. New product lines that are more sustainable will result from implementing business solutions that create shared value and measure progress towards tangible targets (Martins et al. 2019). However, to convince customers, corporations need to assure transparency of actions and results in terms of FLAW targets.

Creativity is encouraged. For example, FLAW reduction can be a large domain for innovative start-ups targeted by the financial sector. Voluntary efforts being made by businesses can be an effective mechanism if transparency of results is assured. Market-based approaches can help, but attention to impacts on low-income people and to the indirect effects on environments is necessary. Given simple metrics, setting targets and following up company by company, including input suppliers and company employees, is a practical approach.

Taking a shared value approach is promising when FLAW issues are included in corporate monitoring, auditing and reporting to shareholders. There are also roles for farmers, farmer organizations and small- and medium-sized enterprises to create awareness of the benefits of FLAW reduction and, where possible, seek collaborative responses (e.g., cooperative-organized cold chain development and other value chain improvements).

8. Joint actions, leadership and governance

To address the FLAW challenge effectively requires collective action. Joint government and private sector action at the global, regional and national levels, with engagement by religious communities, civil society and consumers, is required. Such joint actions will need to keep the following ideas in mind:

1. Alliances of different actors require clearly defined strategies to reduce FLAW (e.g., among farmers, traders and the corporate sector, as well as among funders);
2. Government commitments to measure and report on FLAW metrics are essential for joint actions. For this, SDG 12.3.1.a (for losses) and SDG 12.3.1.b (for waste) are the indicators that need to be collected;
3. Institutional innovations and incentive systems are required to bring together broad, stable and well-funded alliances for the reduction of FLAW;
4. Examples of joint actions need to be systematically assessed and evaluated in relation to their effectiveness. This can provide the bases for good storytelling;

5. Increased, aligned and coordinated investments (and information on investment returns) will help to expand investments further;
6. Initiatives for complementary and joint action between civil society and businesses can be win-win if based on mutual respect and well-defined goals;
7. Joint action for FLAW must also address food safety, to ensure that foods are properly handled, stored and prepared according to strict health and consumer protection standards. Moreover, supply chains should be carefully checked to prevent the use of forced labor and modern slavery;
8. Pathways towards a global action plan and key commitments to address existing knowledge and research gaps and investments for the realization of SDG 12.3 need to be promoted;
9. A focused food loss and waste summit conference should be considered, and the planned 2021 United Nations Food Systems Summit led by FAO with IFAD, WFP, and others, in addition to further high-level global gatherings, should include a strong focus on FLAW reduction. FLAW reduction action for the achievement of SDG 12.3 needs a facilitating mechanism, adhered to by the United Nations, governments, civil society and the private sector;
10. We aim for coordinated communication efforts to raise the profile of the FLAW issue in the media and mobilize civil society and religious communities to embed FLAW reduction efforts as part of an inclusive and sustainable food system.

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