SUSTAINABILITY STRATEGIES

Reducing Global Food Loss and Waste

Protecting food, extending shelf life, and addressing the supply chain are critical to reducing our carbon footprint and preventing hunger.

by Richard Coles

It is asserted that to stay relevant and be resilient, it will increasingly become a prerequisite, or "license to operate," for food businesses to be ethical or sustainable in order meet the rising expectations of society with a growing population of eco-aware consumers—particularly those who aspire to a lifestyle of health and sustainability.

Food businesses need to demonstrate that they are addressing global issues, such as food security and the climate emergency, as well as engaging with the emerging circular economy to reduce wastage of food and packaging.

Firstly, the term food loss and waste (FLW) will be defined and the scale of FLW and its associated climate impact outlined with a subsequent focus on produce loss and waste. Then, options for producers, food manufacturers, wholesalers, retailers, and foodservice providers to reduce FLW will be considered in terms of food redistribution, repurposing of food, and the role that packaging plays with due regard to sustainability concerns.

Definitions

In 2017, the Food and Agricultural Organization (FAO) of the United Nations defined FLW as a "decrease in the quantity or quality of edible food that is intended for human consumption." According to this definition, FLW is considered in two terms:

1. Food loss: mainly caused by the malfunctioning of the food production and supply system or its institutional and policy framework. This could be due to managerial and technical limitations, such as the lack of proper storage facilities, cold chain, proper food handling practices, infrastructure, packaging, or efficient marketing systems.

2. Food waste: the removal from the food supply chain of food, which is still fit for human consumption. This is done either by choice or after the food is spoiled or expired due to poor stock management or neglect.

However, it should be noted that the FAO has stated alternative definitions at different times and that other organizations may define food loss and waste in different terms.

› *Toast beer uses surplus bread to replace barley.*

Scale of FLW

Globally, it is estimated by the FAO that approximately one-third of the food produced for human consumption in mass—equivalent to 1.3 billion metric tons (t)—gets lost or wasted, costing the global economy US$940 billion *(FAO, 2020)*. FLW is especially concerning when one considers that almost 1.2 billion people suffer from malnutrition and hunger.

According to the Food Aid Foundation, 821 million people—more than 1 in 9 of the world population—do not get enough to eat *(Food Aid Foundation, 2020)*. In addition, although the UN expects the global population to increase by around 33% to approximately 9.7 billion people by 2050, up from 7.3 billion in 2016, FAO predictions indicate that the demand on the food supply system may rise by around 60% or more *(Elferink et al., 2016)*. The difference is mainly accounted for by changing food consumption patterns linked to rising incomes of consumers in newly industrializing countries (NICs) and emerging economies.

The UN's Sustainable Development Goal 2 (SDG2): "Zero Hunger," pledges to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture, and is the priority of the World Food Program. In addition, the UN's SDG 12.3: "Ensure Sustainable Consumption and Production Patterns" sets a target of halving the per capita global FLW at the retail and consumer levels *(UN, 2015)*.

In 2017, the FAO reported that FLW represents about US$680 billion in industrialized countries and around US$310 billion in developing countries *(FAO, 2017b)*. In developing countries, the problem of FLW is largely a function of the production and transportation of food from farms. In developed countries, however, it is most prevalent in the consumption phase, among both retailers and consumers *(BCG, 2018)*.

The European Project FUSIONS reported in 2016 that the EU-28 produced an estimated 88 million metric tons of food waste in 2012 (including both edible food and inedible parts), amounting to an estimated cost of €143 billion *(EU FUSIONS, 2016)*. Two-thirds of the costs were associated with food waste from households.

Greenhouse Gas Emissions

The UN's SDG 12.3 states that "The food sector accounts for around 30% of the world's total energy consumption and accounts for around 22% of total GHG emissions" *(UN, 2015)*. A 2018 study by Poore and Nemecek reported that almost 15 % of food emissions comes from losses in the supply chain which result from poor storage and handling techniques; lack of refrigeration; and spoilage in transport and processing. The other 9% comes from food thrown

away by retailers and consumers *(Poore & Nemecek, 2018)*. Consequently, food wastage is responsible for around 6% of total GHG emissions though, according to Our World in Data, this figure is likely to be slightly higher since the analysis from Poore and Nemecek does not include food losses on the farm during production and harvesting. It has also been reported by Our World in Data that when ranked alongside countries, food waste is the world's third-largest producer of carbon dioxide after the US and China *(Our World in Data, 2020)*.

According to the FAO in 2017, the one-third of food wasted in the world is responsible for 8% of global greenhouse gas emissions: "When accounting for the aggregated GHG emissions embedded throughout its life cycle, uneaten food is estimated to emit 3.6 Giga-tonnes (Gt) of CO2eq per year with an additional 0.8 Gt of CO2eq resulting from associated land use, land-use change, and forestry activities" *(FAO, 2017a, pp.3-4)*.

A strategy for reducing global carbon emissions are national climate plans, known as Nationally Determined Contributions (NDCs). However, to date, few countries have included FLW in their NDCs.

The FAO also reports, "As the middle class in emerging economies continues to grow, cold chain systems are expected to become more widespread, along with changes in consumption patterns towards more meat-based diets and fresher products" *(FAO, 2017a, p. 19)*.

The development of cold chain infrastructure based on the use of fossil fuels and hydrofluorocarbon (HFCs) refrigerants would result in a rapid increase in associated emissions and impacts to climate change.

Cold chains are already considered as a significant contributor to global GHG emissions even though it is reported that less than 10% of perishable foods are being refrigerated *(James and James, 2010)*.

Produce Loss and Waste

Global losses and waste for root crops, fruit, and vegetables are between 40%–50% *(FAO, 2020)*. Fruits and vegetables, plus roots and tubers, are recorded as having the highest wastage rates of any food. Being highly perishable, fresh produce represents one of the highest loss rates in primary production (at the farm stage).

The FAO reports that in developing countries, 40% of losses occur at post-harvest and processing levels, while in industrialized countries more than 40% of losses happen at retail and consumer levels. In Africa, for example, it is estimated that around half of all the fruit and vegetables grown are thrown away.

Also, 20% of roots and tubers, and 20% of cereals—all of which are staple foods—are lost in the post-harvest stage or processes *(The Rockefeller Foundation, 2016)*. Intermittent power supplies and poor storage facilities mean that these foods are too often lost after being harvested and before they arrive at market *(The Guardian, 2017)*.

In Europe, vast quantities of produce are wasted due largely to post-harvest grading quality standards set by retailers that over-emphasize appearance in terms of size, shape, and natural blemishes. In addition to these cosmetic/retail marketing requirements, however, there are other reasons for FLW in primary production. For example, these may include the level of produce sweetness, weather damage, overproduction, and reduced retail orders on account of order forecasts mismatching supply and demand.

In the UK, WRAP reports that over 2 million t of produce are lost or wasted each year in the supply chain (WRAP, 2020b). WRAP estimates that through action to reduce or prevent this waste, the UK fresh produce industry could make savings of between £400 million and £500 million a year (approx. US$420 million to US$650 million).

› *Sirane's Dri-Fresh Fresh-Hold absorbent pads containing active natural materials which inhibit mold and fungal growth on fruit.*

What's Being Done Today?

A 2019 report entitled "Reducing Food Loss and Waste: Setting a Global Action Agenda"—published by the World Resources Institute (WRI) and produced with support from The Rockefeller Foundation and other partners—lays out a "Global Action Agenda" to overcome the world's food loss and waste problem (WRI, 2019). The Agenda includes a 10-step plan to halve food loss and waste *(sustainablebrands.com, 2019)*.

In the UK, WRAP claims that the most significant causes of waste to target for reduction are *(WRAP, 2020)*:

- Products that do not reach their intended market outlet—oversupply, not meeting or changing specification requirements.
- Loss of product because of poor supply chain management—for example, changing packaging specifications which provide less protection for products or incorrect demand forecasting. Such losses are estimated to be between 100,000–150,000 t a year—between 5% and 7.5% of total annual waste arisings.
- Damage through handling and storage at depots and stores.

There is a wide range of policies, measures, and approaches that can be applied at all levels of society to reduce FLW. However, options briefly considered here include the redistribution of food, repurposing of food, and the role of packaging.

Redistribution of Food

By the end of 2019, WRAP's "Courtauld Commitment" had been signed by 53 UK retailers who committed to measure and reduce food waste by 2025. In recent years, there has been a recent trend for multiple retailers, such as Morrisons and Lidl, to market boxes of "wonky produce" at a discounted price

There are also sustainable food businesses offering home-delivered surplus seasonal fruit and vegetables packed in corrugated fiberboard boxes direct from farms. These initiatives save food going to waste and reduce carbon emissions.

For example, London-based Oddbox claims on its website that "Our goal is to tackle 5% of the pre-farm gate fruit and vegetable waste by 2022 (500,000 t) in the UK and the EU (produce lost or wasted before it leaves the farm) with innovative solutions." Oddbox also claims to have saved "4.2 million kg of fresh produce, 3.5 million kg of CO_2eq (equivalent to 3607 return flights from London to New York) and 817 million liters of water" *(Oddbox 2020)*.

Across Europe over recent years, numerous movements and organizations have been established using apps to raise public and industry awareness of the food waste issue. These initiatives encourage the diversion of food at risk of waste from stores, restaurants, etc. to consumers who can purchase products at a significantly reduced cost. These include food-waste-saving firms such as "Too good to go," which is a Certified B Corporation. There are also other organizations with a similar food rescue mission such as Olio, Foodcloud, and Karma.

Repurposing of Food

Plenty of commercial opportunity exists to repurpose food that would otherwise be lost in retail supply chains. For example, produce that cannot be sold may be dehydrated or commercial freeze-dried and marketed as an ingredient or coloring agent for breakfast cereals, snack bars, fruit drinks, and yogurts.

In Australia, for example, Natural Evolution Foods is producing banana flour from surplus or second-grade bananas that don't meet retail specifications. New markets are being opened up for the gluten-free flour which can be transformed into dietary fiber supplements and medicinal ointment *(Natural Evolution Foods, 2019)*.

A main challenge is connecting key stakeholders, including processors, producers, and retail businesses. Such cross-industry collaboration and coordination are being driven by the World Business Council for Sustainable Development (WBSD) through its Food Reform for Sustainability and Health (FReSH) project *(WBSCD, 2018)*.

There is a growing number of brands which have upcycled food that would otherwise have been wasted or lost. Examples include Toast beer and Snact fruit jerky. Not only are such initiatives good for boosting a brand's sustainability credentials in advancing societal goals, but they are also positive for the bottom line.

Role of Packaging

Besides its vital role in protection and preservation for food safety and product integrity, other key challenges for packaging include reducing ecological impact, enhancing pack usability, assuring product authenticity or provenance, enabling traceability in supply chains, and providing appropriate labeling.

There is a wide range of packaging formats, material options and technologies which can serve to reduce FLW. For example, smaller portion pack formats may be justified in terms of reducing food waste and associated GHG emissions, particularly in the case of high-climate-impact products such as cheese or meat. However, smaller pack portion sizes can be justified even for relatively low-climate-impact products, such as ready prepared salads, if they serve to reduce waste by the consumer and in terms of saving GHG emissions. Portion snap-packs provide particular convenience for smaller or single households—particularly younger urban consumers with irregular lifestyles—who can benefit from avoiding food waste and so derive a financial saving. Portion packs may also deliver value in terms of assisting consumers with dietary control.

A major industry challenge is to ensure that manufacturers, brand owners, and retailers are made aware of the range of packaging technologies and material options available. Examples of packaging technologies which can serve to significantly extend product shelf life include modified atmosphere packaging (MAP), aseptic packaging, canning, bottling, vacuum packaging, active and intelligent packaging.

Active packaging includes, for example, ethylene absorbers, antimicrobial coatings, and treatments that can be used to extend the shelf life of fresh produce. Intelligent or smart packaging refers to packaging that senses and informs. These include, for example, indicators for temperature monitoring of chilled and frozen products, fresh produce ripeness, and freshness. Another interesting development is the use of QR Codes and blockchain technology for optimizing supply chain efficiency, traceability, and preventing food waste both at consumer and store level. Such benefits are delivered by IBM's Trust Food System which enables businesses to quickly re-

spond to scarcity, trends, food safety, and abundance. For example, this system has been live since 2018 with French retailer Carrefour *(IBM, n.d.)*.

Reducing Plastics

The drive to more sustainable packaging—spurred on by media attention and growing Blue Planet II-motivated public anti-plastics sentiment—is having a major influence on packaging design and innovation, particularly in the food and beverage industry. Increasingly, retailers and brand owners are responding to the demand for reduction in single-use plastics packaging, adoption of reusable packaging, designed-in recyclability, and substitution by more "natural" eco-designed packaging alternatives, such as paper-based and other biomaterial constructions. The latter includes biobased bioplastics made from renewable resources such as bacteria, algae, fungi, seaweed, cereals, and other plants. For example, corn starch-derived polylactic acid (PLA) is both industrially compostable and recyclable. There is growing interest in biodegradable and compostable packaging in niche market applications such as fresh produce, teas, coffee, confectionery, and snacks.

The Whole Life Cycle

However, decision-making regarding selection of the most sustainable packaging solution should go well beyond a simple material focus and carefully consider the life cycle impacts of the packaging-food system. For example, a lower carbon compostable biobased wrap for high-climate-impact cheese might yield a shorter product shelf life than using a conventional plastic with high gas barrier properties for MAP. In seeking to reduce environmental impact through the adoption of an alternative packaging solution, one might inadvertently incur far greater impact from product wastage due to compromised shelf life and/or higher transport emissions. In addition to cost, there may be implications for production efficiency, which also need to be taken account of.

One should note, however, that significant technological advances are being made for biobased bioplastics and that conventional multi-material plastic films may be chemically recycled, through a process called pyrolysis, to produce recycled food-grade material. The latter development has been recently demonstrated by a collaboration between SABIC, Sealed Air, Tesco and its cheese supplier, Bradburys (*PackagingInsights, 2020*).

A Circular Economy Future

Future packaging innovations that offer valid sustainability/circular economy benefits will require a high level of stakeholder collaboration and merit more complexity regarding insight on "life cycle thinking" beyond materials, materials minimization, and recycling. Company sustainable packaging targets, industry commitments, government legislation, and the EU's new Circular Economy Action Plan *(EC, 2020)* will spur packaging innovation and development of resource management infrastructure to support the emerging industry circular economy paradigm with its aim of zero waste.

In fact, the idea of circular economy packaging has a long history extending back to at least Roman times when amphorae were used for the transport and storage of wine, olive oil, fish products, produce, and dry foods. There is evidence of local reuse and repurposing following the amphora's primary product containment function *(Peña, 2016)*…so, *Pack to the Future!*▼

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