UN environment programme

FORESIGHT Brief 020

November 2020

Early Warning, Emerging Issues and Futures

Food Loss and Waste in the Sustainable Development Goals' Nexus

Background

The Foresight Briefs are published by the United Nations Environment Programme to highlight a hotspot of environmental change, feature an emerging science topic, or discuss a contemporary environmental issue. The public is provided with the opportunity to find out what is happening to their changing environment and the consequences of everyday choices, and to think about future directions for policy. The 20th edition of UNEP's Foresight Brief highlights the challenges, possible solutions and their benefits the sphere of food loss and waste – one of the key challenges in creating a sustainable food and agriculture sector.

Abstract

Food loss and waste, occurring on different stages of food production, distribution and consumption cycles, is now a truly global phenomenon. It results in humanity losing about one-third of total food produce and ca. ¼ of its caloric value. The effects of such a situation lead to wasted social and economic opportunities, as well as environmental degradation due to rising pressure on ecosystems stemming from the need for agricultural land. The brief addresses the various reasons for food loss and waste across the world, offering both habit nudges and policy changes that may lead to better practices by farmers, retailers or consumers.

Photo credit: MaraZe / Shutterstock.com

Environmentally responsible, sustainable and zero waste living: Organic food waste from vegetable ready for recycling in compost bin
Photo credit: j.chizhe / Shutterstock.com

Why is this an important issue?

The objective of hunger elimination has been one of the foundations of the Sustainable Development Goals (SDGs) since their acceptance by the UN General Assembly in 2015 as a policy framework regulating global development until 2030. The issue of food availability and security comes as part of the public debate in several contexts. One of them is food loss and waste (FLW), which is very important given that an estimated one-third of all food produced for human consumption is wasted each year (Food and Agriculture Organization of the United Nations [FAO], 2011a).

This worrying phenomenon manifests in many ways across different cultures and locations. While having an existing target in the SDG matrix, the problem is often overlooked in discussions regarding the future of agricultural policies, which might potentially put the achievement of Sustainable Development Goals by 2030 into peril.

Among the SDGs, the need for sustainable consumption and production has been recognised as a distinct goal (SDG 12), with food production being one of its central interests. However, the status quo so far cannot be seen as a sustainable path for the future, since 820 million

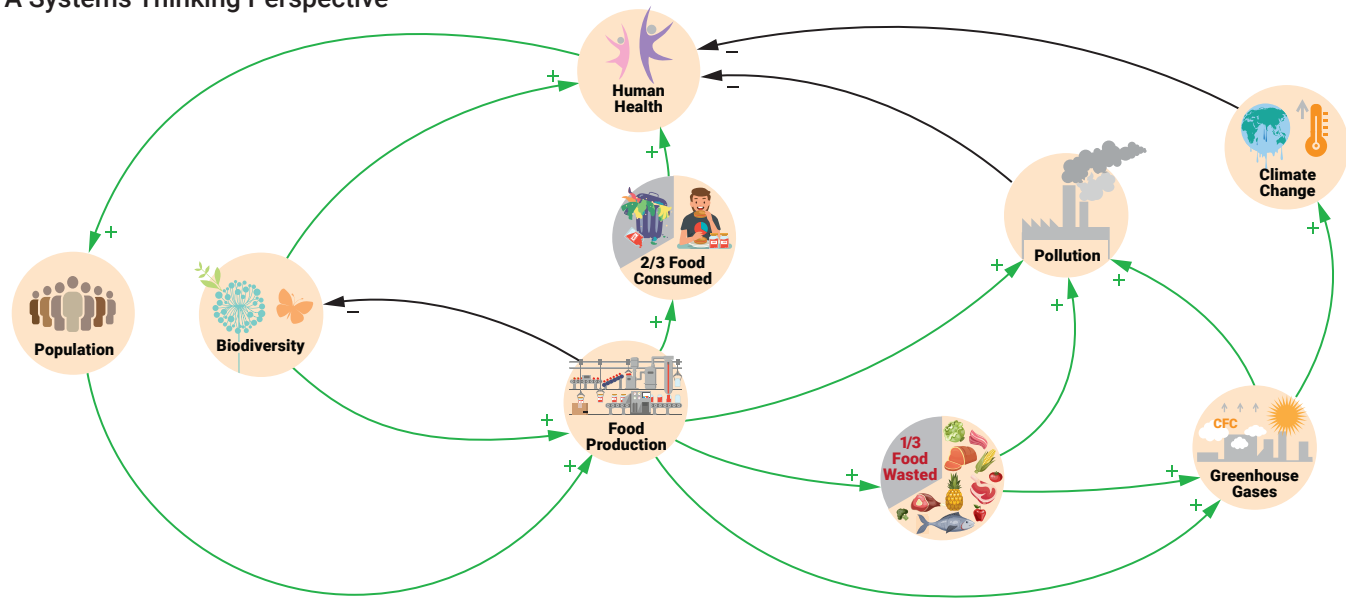
people are still undernourished whilst at the same time there are 650 million suffering from obesity (World Health Organization [WHO], 2020).

With stabilising trends in global population growth, the most likely outcome predicted today is a world inhabited by about 11 billion people by the end of this century – which will only increase the current disparities if current production and consumption patterns will continue (United Nations, 2020).

The rise of the global middle class, especially in countries such as China and India, means in the current "business as usual" scenario a growing demand for meat, which puts further strain on ecosystems due to eg. deforestation. This is the case because, as compared to most fruits and vegetables, animal products account for increased greenhouse gas emissions (GHG) due to the requirement for food provision, manure management, methane emissions and energy required for adequate animal housing (FAO, 2011a, p. 19).

Factory for the production of chicken meat
Photo credit: franz12 / Shutterstock.com

A Systems Thinking Perspective



A growing population requires more food and approximately two thirds of food produced is consumed. About one third of food produced is wasted, leading to greater impacts on pollution and greenhouse gases, worsening climate change, which in turn adversely impacts human health.(+) Influence is in the Same direction, (-) influence is in the Opposite direction.

At the same time, about a third of the global food production, representing almost a quarter of all calories produced, ends up in the FLW category (Lipinski *et al.*, 2013). Such a situation arises from two aspects: losses within the food production system along the food chain from farm to retail store (food loss), and losses that occur at the retail and consumer level (food waste) (Searchinger, Waite, Hanson, & Ranganathan, 2019, p. 53).

Food loss and waste means squandering energy and resources invested in producing nutritional goods that will not end up being consumed. It takes its toll on the natural environment and affects the global climate. If food loss and waste were a country, it would be the third largest emitter of global greenhouse gases (FAO, 2013a), generating 8% of total global GHG emissions per year (FAO, 2013b). The equivalent of the global agricultural land "occupied" by produce that is wasted would be the size of China (FAO, 2013a).

Available data shows that in the developing parts of the world, the largest problems with FLW occurs at the early stages of the production/consumption chain (post-harvest and processing levels) and are often related to barriers, such as access to information in regard to market opportunities or lack of suitable storage facilities (food loss), whereas in developed countries, consumer attitudes and inadequate responses from shops or restaurants (food waste) come to the fore (see **Figure 1**). However, food waste data at the retail and consumer levels in developing countries is extremely scarce, and urban household food waste in emerging economies is expected to be increasingly like levels experienced in developing countries.

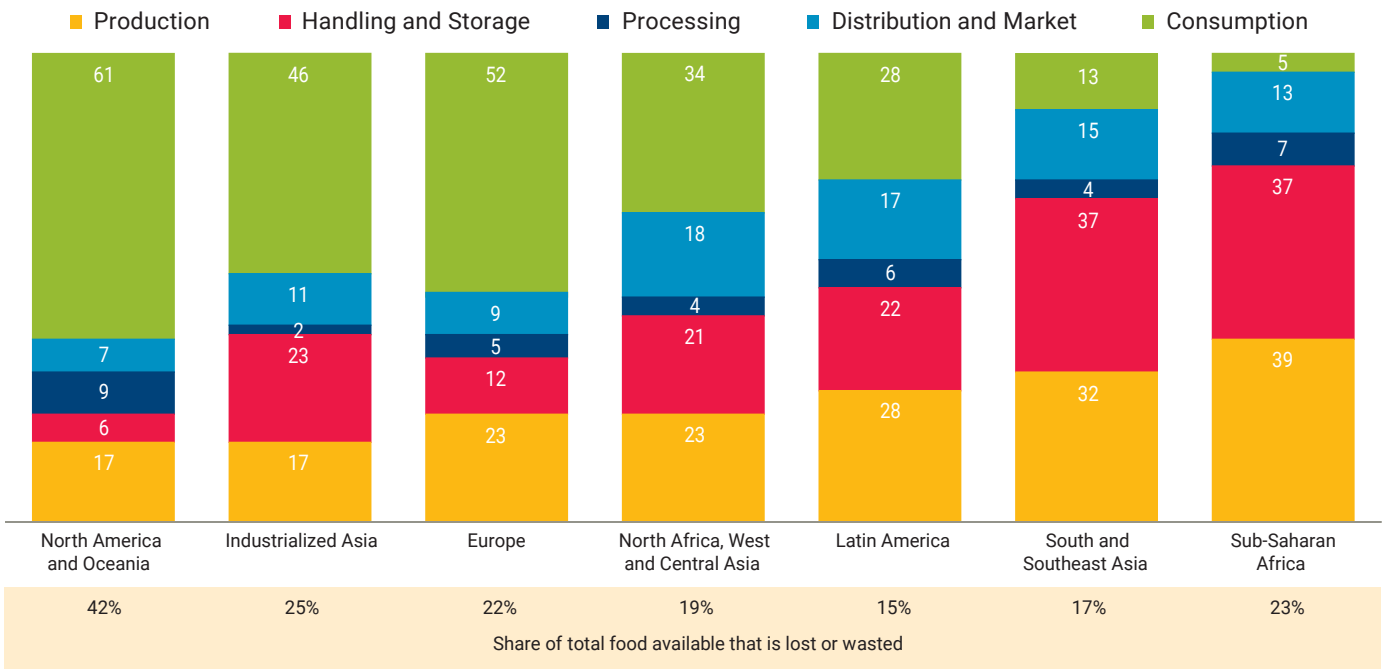


Figure 1: Graphical representation of food lost or wasted as viewed by stage in a value chain per region (Lipinski *et al.*, 2013). (Percent of kcal lost and wasted).

Note: Number may not sum to 100 due to rounding.
Source: WRI analysis based on FAO. 2011. Global food losses and food waste—extent, causes and prevention. Rome: UN FAO

It is important to note that the FLW levels for these three regions are not the world's highest. The largest share of these three belongs to Sub-Saharan Africa and it accounts for 23% - below the global average of ca. 32%, giving the region just third place after North America and industrialised Asia.

The scale and prevalence of this phenomenon breaches all principles of sustainability. FLW not only entails an increased pressure on the environment inflicted by humanity, but also threatens the level and quality of life of people from different, vulnerable groups – from food producers in the Global South, to disadvantaged pockets of society across the globe. In specialised literature on the subject its connections with questions of 'right to food' or 'food security' are often discussed (FAO, 2019).

Interior of an agricultural greenhouse or tunnel with long rows of fresh green spring salad seedlings being cultivated for the table with lettuce and corn salad.
Photo credit: Photography 1971 / Shutterstock.com

What are the main findings, possible interventions, and potential benefits?

Environmental unsustainability

Lake Geneva covers the space of over 580 square kilometres and has a water volume of 89 cubic kilometres. According to estimates by the Food and Agriculture Organization (2013a), the total yearly amount of water used for food that was lost or wasted is three times the volume of the lake at the Swiss French border.

This finding, along with the previously mentioned data describing FLW-related greenhouse gas emissions, clearly shows reasons for environmental concern. Climate change is projected to increase global water stress, affecting 2 billion people across the world on a regular basis (4 billion for at least one month of the year). It is important to note, that agriculture is responsible for 92% of overall human freshwater consumption (Searchinger *et al.*, 2019, p.10).

The role of agriculture in accelerating climate change has been a subject of thorough expert investigation. The most prominent recent example is the IPCC report on land use (Intergovernmental Panel on Climate Change [IPCC], 2019), showcasing ways in which human activities are changing the landscape and resulting in escalated emissions of greenhouse gases, such as carbon dioxide or methane.

The relationship between food, people and the planet goes much deeper – as currently observed in the tropical regions of the world. Pristine forests, acting as carbon sinks and landmarks of high biodiversity, are being cut or burned down and turned into agricultural land for food production purposes, such as cattle grazing, or growing plants used as animal feed.

According to data presented by FAO (2013a) 'between 1980 and 2000 across the tropics, more than 55 percent of new agricultural land came at the expense of intact

forests and another 28 percent came from disturbed forests'. The report also notes that 'crops are responsible for 44 percent of species threats in developed countries, compared with 72 percent in developing countries. The threat is lower for livestock production, with developed countries responsible, on average, for 21 percent of the threats, compared with 34 percent for developing countries' (FAO, 2013a).

Given that agriculture already covers 37% of Earth's landmass (excluding Antarctica) (Searchinger *et al.*, 2019, p.8) our approach towards food production and consumption – including food loss and waste – is of utmost importance in terms of averting runaway climate change.

The world may be in a risk of a climate-agriculture reinforcing feedback loop. Rising GHG emissions may be the cause of failing crops – IPCC predicts a 3% fall in maize harvest in the tropics, in the 1.5-degree warming scenario, and 7% in case of 2 degrees (IPCC, 2019). This may further increase pressure on tropical forests and in turn accelerate further emissions rise (Levin, 2018).

Reducing food loss may help the regions of the world most at risk from climate change to break this vicious cycle. It is especially relevant to the initial stages of food production, including farm production, handling and storage, which accounts for a larger proportion of FLW in these regions, including Sub-Saharan Africa, South and South-East Asia, and also Latin America.

Social costs of food loss and waste

In the regions mentioned above, women are an important part of the agricultural workforce, with four females per every 10 labourers in the Middle East-North Africa, East and Southeast Asia, as well as Sub-Saharan Africa regions (FAO, 2011b, see **Figure 2**). For women, already suffering from effects of economic and social inequality across the globe, high FLW levels mean unrealised economic gains, putting more financial stress on households and limiting chances for personal development.

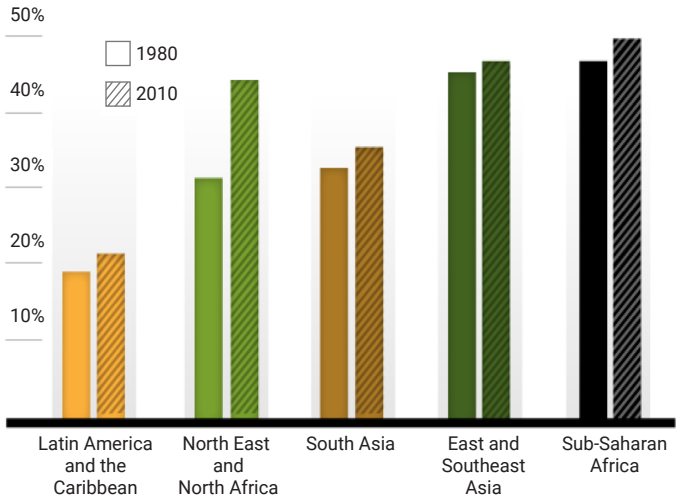


Figure 2: Female share of population active in agriculture in the developing countries (FAO, 2011b).

Distribution of Male and Female Employment, by Sector
Of those women in the least developed countries who report being economically acive, 79% report agriculture as their primary source of livelihood (48% of economically active women worldwide).
Source FAO

Lack of proper storage possibilities may work as a disincentive for gathering whole crop yields from fields. The crops left over are the first stage loss in the food production process. In addition, low access to storage shortens the maximum time a crop is suitable to be used as a staple.

This results in subsistence farmers being able to feed themselves for a shorter period. It also limits their bargaining power as the time span for selling their produce narrows. When such limited opportunities are experienced not only on an individual level, but also on a local and national level, they result in price slumps during the gathering season of certain cash crops on which farmers depend.

As a result, farmers must sell their produce for a lower price, which means limited purchasing power for their households. This in turn has a direct influence on limiting opportunities, such as access to quality healthcare and education. This often leads to difficult situations, such as having to decide on which children in the family get to go to school, and in such a situation it is often the girls that lose out first.

Innovative storage solutions are also crucial for reaching sustainability in the social sphere, not only at an individual level, but also regarding the abilities of whole countries to provide social services financed from taxation. The spread of such innovations allows farmers to be more flexible in terms of selling their food to the market and to not be forced to sell it at the same time as other producers of the staple, which plunges price and then limits the family income.

Untapped economic opportunities

Reducing food loss and waste is an important step in creating a circular economy – an economic model in which waste from one production process can be a valuable resource in another. In such a break from the current linear production model, the very idea of waste is to see it as an untapped potential for reaping economic rewards, and improving overall economic and resource efficiency.

Circular economy ideas and practices are most visible in the Sustainable Consumption and Production SDG 12. Goal 12.3 specifically targets food waste, declaring the need 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 (United Nations, 2015).

Champions 12.3, a multi-stakeholder initiative of executives from governments, businesses, international organisations, research institutions, farmer groups, and civil society, was co-created by the Government of Netherlands, the World Resources Institute and UNEP, to catalyse action on SDG 12.3, exchanging knowledge and good practice, accelerating ambition and advocating for positive solutions to the FLW problem.

One source of increased efficiency could be a more thorough use of agricultural products. Due to factors, such as cultural preferences, some plant or animal body parts are prized more than others, while the rest is often discarded, leading to lost economic opportunities. Encouraging the consumption of previously unused or underused parts of fruits and vegetables (which would amount to more efficient caloric use) or redirecting this as animal feed can help us make the most of the food we already produce (see **Figure 3**).

Another market opportunity comes from branding produce made in accordance with circular economy principles as "hip" and "sustainable", reducing – in the best-case scenario – the stigma of using food past its peak performance in different consumer groups. Examples in this case include crafting a beer using unused bread or using "ugly" fruits to produce jams or juices (Akbar & Stuart, 2019).

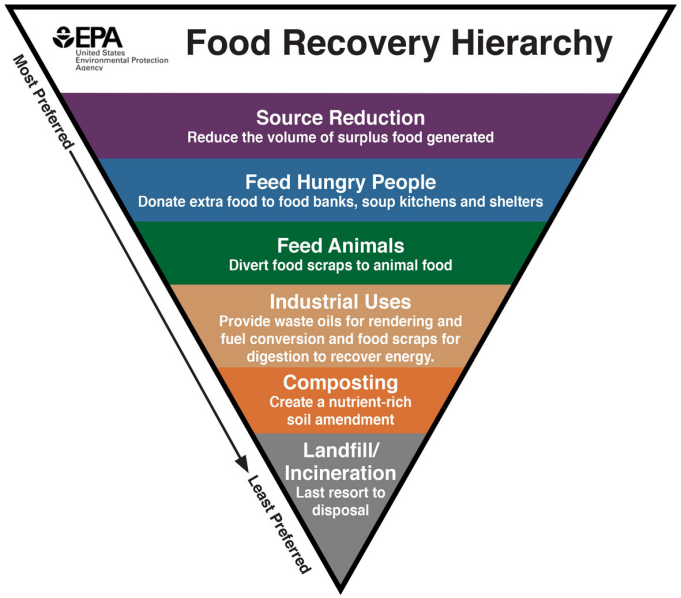


Figure 3: Food recovery hierarchy (US EPA).

Investments in different sectors of the economy may also have a positive, albeit indirect effect on reducing FLW. They may include upgrading the transport network, allowing farmers to more easily access new markets, expanding the energy grid with the aim of bringing affordable and clean energy to producers, allowing them to invest in better storage facilities (FAO, 2011a, pp.10-14), as well as developing sustainable cold chain technologies and infrastructure.

As the estimated global value of the FLW is in the range of 1 trillion USD each year, the economic opportunities in cutting these losses are significant (Searchinger *et al*., 2019, p.52). Savings may be made not only at the consumer level, with money literally "saved" from being wasted, but also at the hospitality and catering level. For example, restaurants and bars can reduce food waste through minor adjustments within their business practices, such as using smaller plates, phasing out the use of trays, and offering a range of portion sizes. Gathering data during the process of reducing FLW is of vital importance as it allows one to see the direct effects that investments in this area leads to longer-term savings, which may be as high as 7 USD for 1 USD spent on reducing kitchen waste in the case of hotels (Clowes, Hanson, & Swannell, 2019).

Culture of food waste

As with other issues brought forward in the Sustainable Development Goals, concern for food security is pervasive in nature. If in low- and medium-income countries it is impacted by technological, infrastructural, and market limited-access setbacks (Lindgren *et al*., 2018), in other regions of the world, it may take quite different forms perpetuated by cultural norms.

In industrialised countries it is the retail sector and consumers that are the major contributors to food waste, driven by socio-economic factors, dietary transitions and diversification, product and packaging characteristics, retailer marketing strategies, as well as consumer skills, behaviours, lack of knowledge, and motivation (Lindgren *et al*., 2018). Data indicates that in affluent economies such as the US, industrialized Asia and Europe at least 50% of food waste occurs due to the decisions made on a consumer level (FAO, 2011a).

Wind turbines on agricultural field producing clean and renewable energy
Photo credit: ESOlex / Shutterstock.com

An average US family of four wastes ca. 1,500 USD worth of food per year. Similarly, a UK family with children loses 700 GBP per year for the same reason. Limiting FLW at a consumer level would not only help in reducing environmental impacts but also would offer an opportunity for substantial household savings. Traditionally, pro-environmental behaviour includes two factors: external (demographic variables), and internal (psychological factors). Research on food waste motivations (Russell, Young, Unsworth, & Robinson, 2017) investigates traditional cognitive variables, such as attitudes, subjective norm, perceived behavioural control, as strong predictors of the intention to behave (Ajzen, 1991). Yet, even well-meaning purchasers do not always engage in pro-environmental behaviours when the non-cognitive factors (habits and emotions) come into play.

The research findings

suggest that the more negative the emotions (e.g., anger related to how much food is globally wasted), the stronger are intentions to engage in food waste reduction, and at the same time the higher the levels of food waste (Russell *et al*., 2017). This may be partly explained by the time-lag between intention and action but also by the very nature of negative affectivity which is associated with avoidance.

Considering the dynamics of habits and emotions, and their presence in individuals' decisions, an effective strategy for communicating food waste issues to consumers would involve constant strengthening of cognitive factors of subjective norms (what would be good for my close-ones) and a sense of control (self-efficacy). Examples can include showing other people's success in reducing food waste in households, ideas of shopping smarter, storing better, planning, or anything which would support consumers who have already committed to reduce food waste but have not yet engaged in the waste-reducing behaviours (Russell *et al*., 2017).

As a volitional choice, pro-environmental behaviour is determined by perceived behavioural control. However, as mentioned, internal psychological factors are in constant interplay with external drivers, which may reflect social/cultural, financial and structural barriers

Irregular shaped vegetables are usually discarded
Photo credit: Molishka / Shutterstock.com

Resolving this problem can happen on three fronts: a) legislative regulations, for example, requiring large retailers to sign food donation agreements with charitable organisations or food banks; b) public-private partnerships around SDG 12.3; and c) addressing consumer demand and nudging. An example would be offering "ugly" fruits and vegetables and using innovative solutions, such as apps connecting consumers to shops and restaurants offering unsold products at discounted rates that might otherwise have been wasted.

Food waste enablers

Another important issue concerns our overall relationship with the world, and with food in particular, including ways in which both throw-away culture and fast food consumption propel the vicious cycle of massive food wasting. Breaking this cycle requires reconnecting

Their increasing prevalence in Non-Western countries noted between 1960 and 1995 (Makino, Tsuboi, & Dennerstein, 2004) historically coincides with the westernisation or modernisation of the Non-Western societies. This correlation also prompts ideas about culture-specific nature of these behaviours in the Western states.

Westernised Non-Western societies experience a cultural shift which involves changes in social and family structure. This fosters self-orientation pivotal for individualistic cultural values. A body of evidence from numerous research indicates a link between these socio-cultural influences and the development of body image dissatisfaction (Stojcic, Dong, & Ren, 2020). As found in one of the recent studies, exposure to media content promoting overvalued body image may be a sufficient factor leading to increased body dissatisfaction in the resource-limited setting, thus predicting the prevalence of future eating disorders in the developing regions of the world (Terhoeven *et al*., 2019).