



JRC TECHNICAL REPORT

Evaluation of Consumer Food Waste Prevention Interventions

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Abstract

The EU has committed to achieving Sustainable Development Goal (SDG) Target 12.3, which calls for halving per capita global food waste at the retail and consumer levels by 2030 and reducing food losses along the food production and supply chains. As part of the Farm-to-Fork Strategy, the Commission intends to propose legally binding targets to reduce food waste levels and accelerate the EU's progress towards the global target. The first EU-wide monitoring of food waste levels, based on a common methodology, has established a new baseline against which the EU can assess progress made over time. Over half of the food waste generated in the EU occurs at the consumption stage, as highlighted in findings reported by Member States referring to the year 2020. Targeting consumer food waste is therefore critical for achieving the future EU-level targets for food waste reduction and complying with international sustainable development efforts. Consumer food waste (both in and out of the home) is a multifaceted and complex issue influenced by food supply chain dynamics and the food environment and driven by behavioural aspects. To address the issue in a timely manner, many groups have carried out interventions to reduce food waste and/or support consumer behavioural change, but the efficiency and effectiveness of those interventions have not been consistently evaluated. To evaluate these interventions, the Directorate-General for Health and Food Safety (DG SANTE) and the Joint Research Centre (JRC) established a multi-disciplinary forum of researchers and practitioners working in the area of consumer food waste prevention under a pilot project called the European Consumer Food Waste Forum (ECFWF). As part of the project's tasks, the ECFWF has gathered data and evaluated 78 interventions across the EU and beyond, prioritising the analysis of interventions within the scope of the ECFWF (i.e. examining only certain types of interventions). The results show that the majority of these interventions were successful in either reducing food waste quantities or changing behaviour, thus indicating that deploying well-designed and monitored behavioural change approaches can lead to substantial reductions in food waste on a large scale, as has been shown in the Netherlands and the United Kingdom. The extent of the impact varies between interventions and not all are likely to be scalable to the country or regional level. The results also suggest that the success of behavioural change interventions greatly depends on the combination of practices put in place (such as a combination of nudges and awareness-raising campaigns) and on the collaboration and commitment from stakeholders implementing the intervention, including from policymakers at all levels. The practical output of this project consists of the development of an evaluation framework to assess the performance of behavioural change interventions, which can be applied by researchers and practitioners in order to understand the possible impact of new interventions. Evaluation is crucial to transferring knowledge on the implementation of effective interventions and to understanding the potential scalability and the cost-effectiveness of different approaches. The results of this analysis also suggest that resources should be made available to assess the impact of interventions over the medium- to long-term to fill the knowledge gap on the longevity and sustainability of any food waste reduction or the development of new 'low-waste' social norms.

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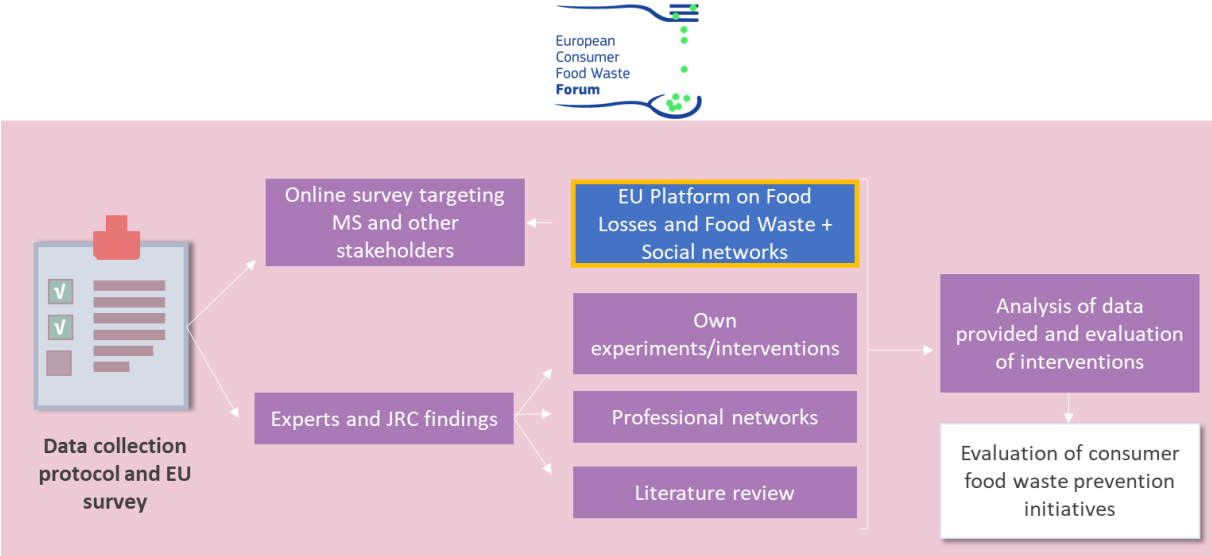
Executive summary

Food waste reduction is a policy priority of the European Commission, as highlighted in the European Green Deal and, in particular, in the Farm to Fork strategy– which calls for the setting of legally binding targets to reduce food waste across the EU by the end of 2023. The EU initially implemented a dedicated action plan to reduce food loss and waste, including both regulatory and non-regulatory measures, as part of the 2015 Circular Economy Action Plan. The results of the first EU-wide monitoring of food waste levels, published by Eurostat (Eurostar, 2023a), shows that tackling consumer food waste remains a challenge. Households account for nearly twice as much food waste as the sectors of primary production and manufacturing of food products and beverages (14 kg and 26 kg per inhabitant, respectively, or about 11 % and 20 % of total food waste). To provide a strong evidence base to support stakeholders’ decision-making regarding food waste reduction, the European Parliament commissioned a pilot project focusing specifically on food waste arising at the point of consumption: the European Consumer Food Waste Forum (ECFWF). This pilot project includes a multidisciplinary forum of experts – researchers and practitioners – working in the area of consumer food waste prevention, who met to pool knowledge, evidence-based tools, best practices and recommendations. The ECFWF was established in June 2021 for a 2-year term, coordinated by the Directorate-General for Health and Food Safety (DG SANTE) and the Joint Research Centre (JRC). The pilot project works in close collaboration with the EU Platform on Food Losses and Food Waste (FLW), which was established to support all actors in defining measures needed to prevent food waste, sharing best practices and evaluating progress made over time. To identify the most effective and efficient consumer food waste prevention interventions for the ECFWF to recommend, this report reflects on the specific task of researching and collecting data on interventions to prevent and reduce consumer food waste and evaluates the identified interventions by following a specific evaluation framework developed under the ECFWF. The framework considers the following criteria: quality of the intervention design, effectiveness, efficiency, systemic effects, sustainability over time and transferability and scalability. Details of the evaluation framework and the data collection protocol developed to support the data gathering and analysis can be found in the evaluation framework report by García-Herrero et al. (2023). The interventions were prioritised based on the scope of the ECFWF described in that report, which covers interventions that aim to:

- educate children because they will shape the future;
- raise awareness because it is a prerequisite to motivating action;
- nudge behavioural changes because consumers need to be stimulated to change their habits.

The task was achieved by following a specific methodology, as summarised in Figure 1.

Figure 1. Overview of methodology presented in this report



Source: Own elaboration.

The data collection protocol was used to gather data and fill each criterion identified in the evaluation framework. To extend the data collection through additional sources of information, JRC and DG SANTE devised an EU survey to reach all stakeholders running food waste prevention interventions along the food supply chain (open from July to October 2022). This survey was disseminated to the EU Platform on Food Losses and Food Waste⁽¹⁾; members of the platform filled in the survey and shared the link with their networks. Moreover, the survey was circulated using social networks, through both corporate and personal channels. Experts and the JRC used their own data to fill in the evaluation, connected with their professional networks (contacting them by email or phone) and gathered data from a literature review conducted to identify food waste prevention interventions, while also reaching out to the main authors of those scientific works by email.

A total of 78 interventions targeting food waste at the consumer level were evaluated and are presented in this report. The findings indicate that some interventions worked better than others.

- Some evaluations were adapted to the local context and used community involvement and/or strong collaboration with stakeholders to reduce food waste.
- Interventions disrupting daily routines show promising results in reducing food waste at home.
- Highly tailored interventions work well, particularly when targeted consumers willingly sign up for the intervention.
- There is no ultimate intervention to reduce consumer food waste and a combination of interventions is required for large-scale action.

The application of the evaluation framework uncovered how, despite best efforts to target best practices in the field, a lack of data on the effectiveness and efficiency of food waste prevention interventions is a major shortcoming. Any systematic evaluation of these interventions is recent, and stakeholders need further support in terms of both intervention design (i.e. integrating the collection of data needed for the evaluation) and the analysis of findings. For instance, the effectiveness of interventions cannot readily be compared when there are differences in target groups and/or measurement methods.

The knowledge gaps that emerged from the analysis can help chart the way forward for further research. Improvements in the design and implementation of interventions are key for setting the basis for creating new approaches to food waste reduction at the consumer level. Further research should be dedicated to these approaches. Some interventions outside the scope of the ECFWF, briefly described above, were included in the evaluation – particularly redistribution apps, measurement efforts, national prevention programmes and studies uncovering new drivers. Despite being outside the initial scope, they were evaluated to gather any further insights on food waste. Other types of interventions, such as social influences, economic incentives or regulations, should also be considered and be further investigated when formulating recommendations for action. Their exclusion from the scope of this report is due only to data availability.

(1) EU Platform on Food Losses and Food Waste (https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste/eu-platform-food-losses-and-food-waste_en).

1. Introduction

Globally, 570 million tonnes of food is wasted every year by households, leading to huge financial, social and environmental costs (UN Environmental Programme, 2021). Levels of household food waste have been estimated to be similar in high, upper-middle and lower-middle income countries, suggesting that this is genuinely a global problem. In addition, food loss and waste across the food supply chain account for around 8 % of total global greenhouse gas emissions (Flanagan et al., 2019), making food waste a much more significant contributor to climate change than global aviation (Ritchie, 2020). This is against a backdrop of around 828 million people being affected by hunger in 2021 (FAO, 2021).

In the EU, in 2020, households threw away over 31 million tonnes of food waste, with an associated market value estimated at EUR 70 billion (Eurostat, 2023a). Eurostat estimates that around 10 % of food made available to EU consumers (in retail, food services and households) may be wasted. Food waste accounts for about 5 % (204 million tonnes of CO₂ equivalent (CO₂eq)) of total EU greenhouse gas emissions associated with the EU's overall consumption footprint. At the same time, 7.3 % of the total EU population cannot afford a high-quality meal every second day (Eurostat, 2023b). The pressure on the global food system has also increased due to the impacts of war in Europe and COVID-19 driving food price inflation around the world (FAO, 2022; ONS, 2022). Taking all these environmental, social and economic factors into account, action to reduce food waste is urgently required.

Policymakers in the EU have committed to reaching the sustainable development goals and have set the ambition of halving food loss and waste from farm gate to fork, in line with sustainable development goal target 12.3 (European Commission, 2020). To deliver this ambition, it is essential to reduce household food waste. For example, household food waste constitutes up to 53 % of all the food wasted in the EU and around 70 % of the food wasted in the United Kingdom (WRAP, 2019; Eurostat, 2023a).

Addressing household food waste is particularly challenging, as waste generation can be a product of complex behaviours, social norms (?) and attitudes (Chauhan et al., 2021; Queded et al., 2013; Schanes et al., 2018; Stancu et al., 2016). Previous behaviour change campaigns have shown that, by raising awareness and providing the necessary tools and solutions, citizens can be motivated and enabled to reduce food waste and save money (Hanson and Mitchell, 2017; WRAP, 2013). There is a growing body of evidence showing that national-level programmes can deliver substantial reductions in household food waste over time. For example, in the Netherlands, household food waste has fallen by 29 % over a decade (Netherlands Nutrition Centre, 2019), and the United Kingdom has experienced a 31 % decrease (WRAP, 2019), potentially saving billions of euros every year. These examples show that reduction of food waste at scale is possible, but it also requires the capacity to implement cost-effective interventions, continuous monitoring, evaluation and knowledge sharing. This report collects many more examples to inform and inspire policymakers, municipalities, scientists and practitioners across Europe and around the world.

The main objective of this report is to provide the results of a large-scale data collection and evaluation exercise conducted by the European Consumer Food Waste Forum (ECFWF), a 2-year pilot project commissioned by the European Parliament and coordinated by the Joint Research Centre (JRC) and the Directorate-General for Health and Food Safety (DG SANTE).

The ECFWF aims to address existing knowledge gaps on consumer food waste prevention and issue evidence-based recommendations to help policymakers and practitioners design effective interventions and achieve food waste reduction at scale. The forum is composed of 16 international experts in the field of food waste prevention. The ECFWF's work covers a variety of tasks with the final aim of providing stakeholders with a compendium of best practices, recommendations and tools based on the knowledge collected in all previous tasks.

The present report concludes with observations on the analysis of consumer food waste prevention interventions and what this tells us about how to help citizens reduce food waste rapidly and effectively. It also makes recommendations as to what further work could help ensure that more of the food produced is actually consumed. We hope and believe that this will inspire actors around the world to tackle

(?) Social norms are often defined as rules and standards that are understood (or perceived) by members of a group and guide social behaviours.

household food waste effectively and rapidly, while providing a clear framework for these actors to monitor and evaluate the progress of their interventions over time. Given the scale of global household food waste, taking action is crucial to establish a sustainable food system and achieve the EU's 2030 climate targets. Adopting life cycle thinking and assessment is crucial to assess both the impacts and the benefits of food value chains and to support the identification of potential interventions to move towards a more sustainable food system. This is even more crucial when considering that food wasted at the end of the food supply chain (consumers) will have greater impacts (environmental, economic and social) than that discarded at earlier stages (FAO, 2016).

2. Framework for the evaluation of consumer food waste prevention interventions

The evaluation framework applied throughout this report was developed by the ECFWF and is detailed in García-Herrero et al. (2023).

The goals of the evaluation framework are to **identify effective and efficient interventions** and to understand the adequacy of the interventions in **addressing specific food waste drivers** and levers for prevention. There is a consensus in the literature on the lack of systematisation of knowledge regarding consumer-level food waste prevention, and this evaluation framework provides a set of criteria to assess the performance of a preventive intervention, in terms of both food waste reduction quantities and behaviour change. In particular, this framework captures the differences in consumers' food waste behaviours, thus encouraging data collection on behaviour change and the specific consumer segments targeted by the intervention. Some key elements that guided the development of the evaluation framework included modularity (being adaptable to the evaluation of many typologies of interventions), adaptability and accessibility for a variety of stakeholders (i.e. maintaining a balance between thorough data collection and usability). The ultimate objective of this framework is for it to be applied by a wide range of practitioners who need to assess whether their food waste prevention intervention works or – just as importantly – whose interventions do not work and require a redesign.

The following criteria were used for the evaluation.

- **Quality of the intervention design.** This includes definition of objectives and aim, establishment of appropriate targets and related key performance indicators (KPIs) in terms of both impacts (food waste reduction quantities) and/or outcomes (behaviour change or outreach), presence of a consistent monitoring plan, and the identification of food waste drivers and levers in the design of the intervention.
- **Effectiveness.** This measures whether the intervention reached the objectives set out in the design phase, preferably providing quantitative evidence of food waste reduction or consumer behaviour change.
- **Efficiency.** This entails providing the information on effectiveness as a ratio of the resources spent.
- **Perceived wider systemic effects of the intervention.** This includes eliciting the connections between the food waste prevention intervention and other impacts on the food system. For example, if the intervention leads to increased vegetable consumption as well as reduced vegetable waste, then this could be seen to have a wider systemic effect, by encouraging a healthy diet. It is also worth assessing potential negative systemic effects. For example, an intervention involving the use of a smart indicator to generate a more accurate 'use-by' date, reflecting the actual temperature of storage, may have a higher carbon footprint than the food saved due to the application of the new device where also carbon emissions are embedded.
- **Sustainability over time.** This covers the longevity of the intervention (for how long the effect of the intervention was maintained), if known, and the availability of resources needed to maintain the effect (funds, dissemination efforts).
- **Transferability and scalability.** This concerns whether an intervention can be transferred to a different context or geographical area and if it can be scaled up.

The interventions presented in this report were used to validate the evaluation framework and highlight any gaps or inconsistencies. For example, while initially four out of the six criteria were described as essential in evaluating an intervention, the data collection exercise showed that, in most cases, only the quality of the intervention design and the effectiveness criteria could be evaluated thoroughly, given the data available.

A protocol for data collection was developed to accompany the evaluation framework and was shared with the experts participating in the task. The full version of the evaluation framework and data collection protocol is available in García-Herrero et al. (2023).

3. Overview of data collection and evaluation

This section provides an overview of the data collected in this task and the main characteristics of the interventions. As discussed in García-Herrero et al. (2023), the scope of the ECFWF was narrowed to prioritise interventions covering awareness raising, education and nudges. Nudges are aspects of the decision-making environment that predictably alter behaviour without limiting options or altering economic incentives (see Section 4.1 for further explanation).

3.1. Data collection

Primary data was collected for evaluation by the experts in the ECFWF and the JRC through various channels.

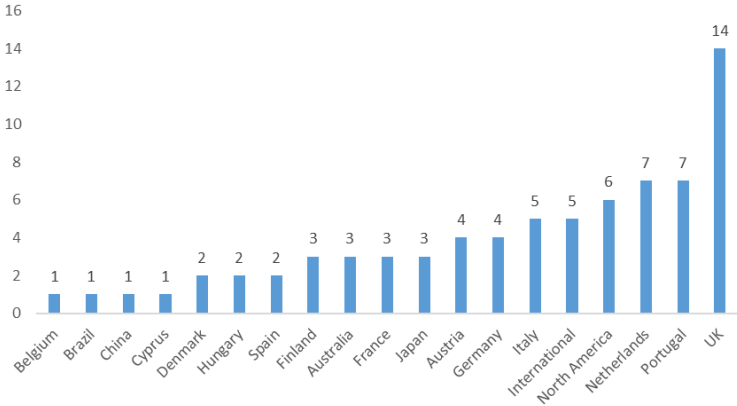
- The experts of the ECFWF were tasked with sourcing interventions from their own knowledge or networks.
- An EU survey was launched in the spring of 2022 and sent to EU food system stakeholders to gather information on best practices and interventions. The EU survey targeted all stakeholders and all measures for food waste prevention along the food supply chain. For the purpose of this exercise, only consumer interventions targeting consumer food waste were selected. Annex 2 shows the survey details.
- Scientific and grey literature was consulted.

In the scoping phase of this task, a list of 86 prospective interventions was compiled by the experts of the forum to establish contact points and avoid duplication in the data collection; 13 submissions to the EU survey were considered to fall within the scope. Of those, 78 interventions were evaluated through this task, out of which only four were excluded due to scarcity of information. The final number of interventions evaluated was 74; 5 were categorised as “out of scope” of the ECFWF; therefore, information on such is only provided in Annex 1 and in this overview chapter. The interventions selected were first processed by making the information in their data collection protocols consistent in terms of content and language; the information was systematised in a file and summarised in factsheets to ease the initial analysis. The factsheets can be found in Annex 1.

3.2. Descriptive overview of collected interventions

As agreed in the scope of the ECFWF, the geographical coverage of the interventions was limited to continental Europe and countries/continents that have similar socioeconomic contexts to Europe (e.g. Australia, China, Japan, New Zealand and North America). As shown in Figure 2, the greatest number of evaluated interventions were chosen from the United Kingdom (14), followed by the Netherlands (7) and Portugal (7). Five international interventions were also evaluated.

Figure 2. Country of implementation



Source: Own elaboration.

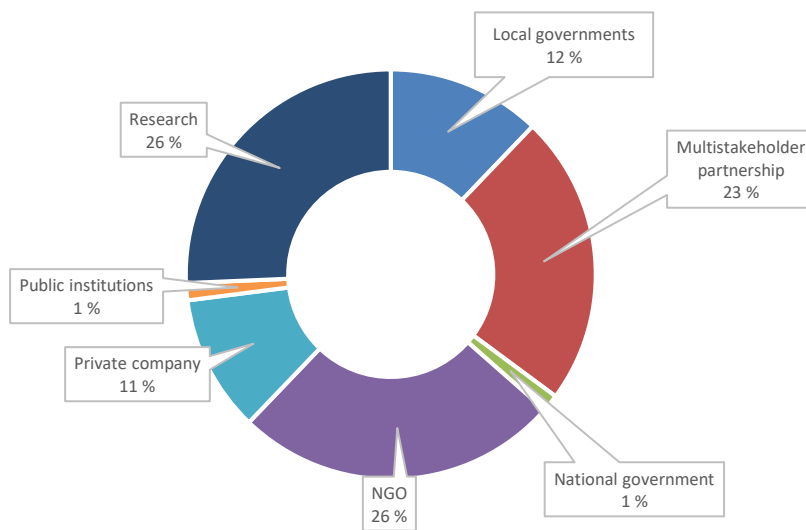
3.2.1. Implementation of the intervention

The interventions were mostly implemented by non-governmental organisations (NGOs) and through multistakeholder partnerships and research. National and local governments, other public institutions and private companies reported fewer interventions.

Interventions were attributed to multistakeholder partnerships whenever the evaluation indicated that a group of organisations had been involved in their implementation. The nature of these partnerships differed; for example, some involved a university collaborating with an NGO whereas in other cases private businesses worked in partnership with research centres. The prevalence of multistakeholder partnerships highlights the need and advantage of pooling resources together in running an intervention.

Many evaluated interventions were experimental, thus explaining the high prevalence of research organisations as the main implementer of the interventions reported (Figure 3).

Figure 3. Actor(s) implementing evaluated interventions



Source: Own elaboration.

3.2.2. Typologies and classification

The data collection protocol, which was developed within the scope of the ECFWF, focused on nudges, education and awareness-raising interventions. Initially, the nudges category was subdivided into social influence / leverage of social norms, default rules, simplification and increase in ease/convenience, warnings, pre-commitment strategies and feedback. As it was possible to select multiple types of nudges, grouping interventions based on these categories was difficult. To overcome this difficulty and possible confusion in analysing the interventions, these interventions were recategorised according to their function rather than the previously agreed, more academic, characteristics.

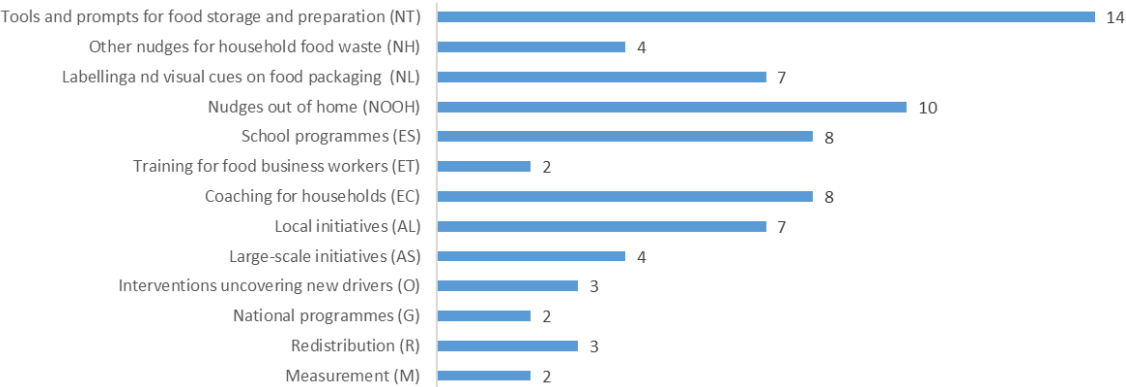
Furthermore, the data collection exercise highlighted some instances that were initially excluded from the specific scope of the ECFWF, but have been included in the analysis nonetheless. These categories were redistribution, measurement, national cross-cutting prevention programmes and interventions uncovering new drivers.

The interventions were assigned a code to signal the main typology to which they belong (Figure 4). It is acknowledged that, especially for this data collection exercise, the classification was not straightforward, as some interventions incorporated elements of several intervention types.

Nudges were divided into tools and prompts for food storage and preparation (NT), labelling and visual cues on food packaging (NL), nudges out of the home (NOOH) and other nudges for household food waste (NH). Education and training interventions were characterised as school programmes (ES), training for food business workers (ET) and coaching for households (EC). Awareness-raising campaigns were

divided into local initiatives (AL) and large-scale initiatives (AS). Redistribution (R), measurement (M) and national programmes (G) were also included, along with interventions uncovering new drivers (O).

Figure 4. Types of intervention evaluated



Source: Own elaboration.

3.3. General evaluation

The initial screening established whether enough information was reported to proceed with evaluation and selection of best practices. The quality of intervention design and effectiveness-related information were considered sufficiently clear for the majority of the interventions, while the other criteria were harder to assess in this exercise, as data was reported inconsistently.

The effectiveness of the intervention could be established if information was reported on food waste quantities, behaviour change or outreach. Effectiveness was defined as the achievement of the intervention’s objectives (although monitoring techniques may have varied). Generally, 38 interventions reported changes in food waste quantities, 32 reported changes in consumer behaviour and 37 reported outreach. Section 4 of this report delves deeper into the details of the food waste reduction potential of the types of interventions, as it is difficult to reach a consensus on their actual effectiveness.

Efficiency, or the effectiveness per euro spent, was seldom calculated, but 29 interventions provided information on economic cost or total budget. A negligible number of evaluations provided efficiency as a ratio of effect to resources. Information on the economic costs of running consumer-level interventions is scarce; therefore, the minimal cost data gathered in this exercise is valuable.

The criterion of perceived systemic effects was particularly hard to assess, partly because it relies on an additional evaluation step that is based on the general narrative of the intervention rather than on strong empirical data. However, this criterion is instrumental in uncovering the multidimensional components of an intervention and indicating potential trade-offs, which could be particularly useful if the intervention is not at scale yet. Nonetheless, the interventions collected provide some interesting insights, such as new drivers of wasteful behaviours (e.g. lack of specific food management skills and motivation, lack of awareness of the quality and value of food), levers to prevent these behaviours (e.g. providing specific nudges to change habits, promoting the environmental or economic benefits of food waste prevention) and synergies with wider food system dynamics (e.g. food literacy, diet and related food management skills, trade-offs with food safety).

Sustainability over time, understood as any activity put in place to ensure that the results are supported over time or are communicated to stakeholders, was reported for 31 interventions. The long-term effects of the interventions were reported in very few cases, but this is an evidence gap that is also generally acknowledged in food waste prevention literature (Quested, 2019). The short-term outlook of consumer-level interventions is also linked to the experimental nature of many of the interventions evaluated (31); long-term effects and longevity can be assessed only through the implementation at scale of the intervention and thorough monitoring, which are often expensive. It is worth noting that some countries, such as the Netherlands and the United Kingdom, have achieved long-term reductions in food waste levels, suggesting that interventions can have a long-term impact. By contrast, the experience of the COVID-19 lockdowns has shown that, although people can rapidly change their behaviours in the home,

these effects can quickly be reversed once people have returned to a more 'normal' condition (WRAP, 2020).

The data collection protocol regarding transferability and scalability used questions requiring a yes/no response to differentiate between the intervention's current state of implementation and the possibility of transferring it or upscaling it in the future. Qualitative information on enablers of and barriers to these processes was also gathered to complete the evaluation of this criterion, but this information was reported inconsistently. Almost half of the interventions had not yet been transferred (36) or scaled up (32), but an overwhelming majority of respondents stated that the interventions could be potentially transferred to another context (62) or scaled up (59). The scarcity of complete information on enablers and barriers hampers the ability to assess the interventions' transferability and scalability, as details of the processes that respondents planned to implement to actually transfer, scale up or replicate the intervention are missing.

4. Results of the evaluation

The following sections present the evaluation of the interventions, divided by the main intervention category. They highlight the outcomes for each evaluation criterion: quality of the intervention design, effectiveness, efficiency, transferability and scalability, sustainability over time and systemic effects. We conclude each section with a brief list of take-home messages. Section 4.5 gives an overview of the net economic and nutritional benefits and the environmental savings of the food waste prevention interventions, where this data was available.

Table 1 indicates the code and name of the interventions, according to their classification (type and subtype). Annex 1 provides the detailed information of each intervention.

Table 1. Types, subtypes, codes and names of the intervention evaluated

Type	Subtype	Code	Intervention name
Nudges	Tools and prompts for food storage and preparation	NT1	Behaviour change tool package
		NT2	Cozzo mobile app
		NT3	Effect of sharing recipes to use up leftovers
		NT4	First aid box against food waste
		NT5	Food trainer app test
		NT6	Kitsain – app trial for food management
		NT7	<i>Koelkastklem</i> (refrigerator tab to use leftovers in the fridge)
		NT8	Online experiment on effects of different messages
		NT9	PUSH notification reminders to use up food in the fridge
		NT10	Reducing food waste by cooking meals from a meal box versus from scratch
		NT11	Seika social experiment
		NT12	Study on effect of gamification
		NT13	Study on use of social marketing for food waste reduction
		NT14	Use It Up Tape – visual prompt for leftover consumption
	Other nudges for household food waste	NH1	Food waste calculator
		NH2	Study leveraging cognitive dissonance to reduce household food waste
		NH3	Study on eco-feedback device
		NH4	Study on social media use for awareness
	Labelling and visual cues on food packaging	NL1	Day on date label
		NL2	Evaluation of date labelling campaign encouraging consumers to look–smell–taste
		NL3	On-pack storage and consumption guidance (Refresh)
		NL4	Stickers on bread packaging and communication campaign
		NL5	Time–temperature indicator – Germany
		NL6	Time–temperature indicator – the Netherlands
		NL7	Visual cue study on labels – effects on consumers
	Nudges out of the home	NOOH1	Food waste reduction at music and arts festival
		NOOH2	Lariso
		NOOH3	Nudging strategies in school canteens
		NOOH4	Online experiment in retailers
		NOOH5	Posters displaying social norms

Type	Subtype	Code	Intervention name
		N00H6	Prompts encouraging right portion consumption
		N00H7	Study investigating effect of context manipulation
		N00H8	Study on types of restaurants and food waste production
		N00H9	Take away doggy bags
		N00H10	Use of anthropomorphic food in messages
Education and training	School programmes	ES1	Intervention targeting children's and parents' food-related behaviours by encouraging them to make lunch
		ES2	Food and nutrition education programme - the Netherlands
		ES3	Food waste battle for teenagers (<i>Hävikki-battle</i>)
		ES4	Green Chef - youth-targeted competition
		ES5	'Do good, save food' campaign
		ES6	Study on food and nutrition education - Italy
		ES7	<i>Programa Z(h)ero</i> - zero-waste schools
		ES8	<i>Mon École Anti Gaspi</i> (my school against food waste)
	Training for food business workers	ET1	PENNY apprenticeship programme
		ET2	Zero-waste restaurant
	Coaching for households	EC1	<i>Alimentar Sem Desperdicar</i>
		EC2	Coaching methods and measurement
		EC3	Cooking classes and workshops - Germany
		EC4	FoodWIN Brugge
		EC5	'Love food, hate waste' Scotland cascade training
		EC6	Study on comprehensive intervention/coaching for households - the United States
		EC7	Tailored intervention with personalised coaching
		EC8	Volunteer and community advocate programme
Awareness raising	Local initiatives	AL1	Fish scale
		AL2	Food waste prevention campaign in public housing areas
		AL3	Keep your refrigerator tidy
		AL4	Maizuru city food waste reduction pilot project
		AL5	Reduce food waste, save money
		AL6	Trifocal project
		AL7	West London food waste prevention campaign
	Large-scale initiatives	AS1	Best before exhibition
		AS2	COP26 campaign with Rankin
		AS3	Food waste-free week
		AS4	Great taste, no waste
National programmes		G1	Project wasteless
		G2	Life foodprint
Interventions uncovering new drivers		O1	Education and leveraging social influence in school environments
		O2	Good deeds calendar
		O3	Study on domestic food practices
Out of scope	Measurement	M1	Gladsaxe measurement
		M2	Copenhagen municipality

Type	Subtype	Code	Intervention name
	Redistribution	R1	Olio app
		R2	Munch app
		R3	Food saving event catering

4.1. Nudging interventions

A nudge is any aspect of the environment in which people make decisions (i.e. the choice architecture) that alters people's behaviour in a predictable way and without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid (Thaler and Sunstein, 2008). The category of nudges is subdivided into tools and prompts for food storage and preparation, labelling and visual cues on food packaging, other nudges for household food waste and nudges out of the home.

Tools and prompts for food storage and preparation encompass all interventions that provided a physical, textual or digital prompt to encourage consumers to reduce food waste at home and adopt new habits and routines. These tools and prompts specifically targeted behaviours related to developing food preparation skills, including correct food storage and repurposing leftovers. Examples of these interventions include apps to improve food management, toolkits to be used in the kitchen while preparing or storing food and recipes to use up leftovers.

Labelling and visual cues on food packaging interventions are based on the observation that a main driver of food waste is consumers' misunderstanding of date labels. This category includes interventions that introduce new labelling options to help consumers better understand the difference between 'use-by' and 'best before' date markings⁽⁹⁾. Alternative options for date markings are also being investigated by the European Commission (European Commission, DG Health and Food Safety, 2018), but are not being considered by EU legislation.

Other nudges for household food waste encompass nudges that target food waste occurring in households but that do not belong in the previous two categories, for example a website with information on food waste's impacts. Nudges out of the home specifically target consumer food waste occurring outside the home in contexts such as collective catering for companies, school canteens (if they do not include a pedagogical or educational component), festivals and restaurants.

4.1.1. Tools and prompts for food storage and preparation

A total of 14 nudge interventions were reviewed under the subtype tools and prompts for food storage and preparation. Four were technology based: push notification reminders to use up leftovers in the fridge (NT9), a mobile application (app) to keep track of purchased and cooked food (NT2), a food trainer app to train users to choose healthy food (NT5) and open-source software to help consumers manage their groceries (NT6). Eight interventions used physical tools such as fridge tabs, shopping lists and recipes (NT1, NT2, NT3, NT4, NT7, NT8, NT11, NT14). Two were information campaigns providing tips to reduce leftovers and background information on the environmental and economic effects of food waste (NT9, NT13).

Eight of the interventions were reported in one of four European countries, namely Austria, Finland, the Netherlands and the United Kingdom, Two interventions were reported in Australia (NT13, NT14), two in North America (NT3, NT12) and one in Asia (NT11); another had an international reach (NT10).

The target groups were rather homogeneous. Most often, interventions were aimed at the general population. Only NT4 and NT10 were directed to customers of specific products (NT4 handed out first aid boxes fighting against food waste, giving them to consumers of retail stores, and NT10 targeted meal box users). Most were implemented in households and three were implemented online (NT3, NT6, NT8).

The interventions targeted the whole range of food management stages, with most targeting multiple stages. Five interventions targeted the purchase stage (NT4, NT6, NT11, NT2, NT14), while the storage stage was targeted by nine (NT1, NT2, NT4, NT5, NT6, NT7, NT10, NT12, NT14), the preparation stage by 10 (NT1, NT2,

⁽⁹⁾ Notably, removing date labels altogether can also be a viable option to reduce confusion (WRAP, 2019).

NT3, NT4, NT6, NT7, NT10, NT11, NT14, NT15) and the consumption stage by eight (NT2, NT3, NT4, NT5, NT6, NT7, NT11, NT14).

As for the duration of the interventions, six lasted less than 3 months, five between 3 and 6 months and three more than 6 months (NT5, NT7, NT10).

Those outside academia implemented the interventions in all but one case (NT15). However, multistakeholder partnerships involving researchers, public and private institutions and local governments were also present (NT1, NT7, NT9). One intervention was co-created with consumers (NT14). Five of the studies included a control group in their design (NT1, NT5, NT9, NT10, NT14), and four of these (all except NT1) were experiments. However, not all interventions described as experiments used a control group: NT13 was an experiment and claimed that it used a control group, but the control group appears to have been a treatment group that was given a different task from the other treatment groups.

Quality of intervention designs

The design of the interventions reviewed was mostly of acceptable quality, albeit with some shortcomings. Generally, the problem was clearly identified and the final aims were reported. In most cases, a more or less detailed description of the design, implementation and monitoring of the intervention was also provided. On the other hand, the baseline against which to measure the effects of the implementation was rarely reported, and none of the interventions specified the objectives following the SMART (specific, measurable, assignable, realistic, time-related) approach. It is noteworthy that only three interventions were explicitly grounded in a theoretical framework: NT3 used the motivation–opportunity–ability theory, NT8 and NT9 used the theory of planned behaviour and NT13 used social marketing theory.

All the interventions defined their aims and objectives. These were mainly related to the provision of tools, skills and information resources as means to increase the relevance of foods at risk of being thrown away. At the same time, the objectives were also to test the efficacy of these tools. NT5 aimed to train consumers to choose healthy foodstuffs and resist unhealthy ones, and NT6 aimed to support consumers in managing their groceries. The expected outcome objectives were improved skills to manage leftovers and an increased awareness of food-waste-related issues. Together, these were expected to change behaviour and reduce food waste (the impact objectives). The KPIs used to monitor the effects of the interventions were based on measures for the quantity of food waste and/or measures for awareness, attitudes or intentions to change behaviour (NT3, NT5, NT7, NT9, NT10, NT12, NT14). However, notably none of the interventions specified a target for the reduction of food waste. Measures for awareness, attitudes or intentions to change behaviour were all assessed using self-reported surveys or questionnaires.

The monitoring of the interventions' effectiveness used different units in terms of both mass and reporting period. Some used kilograms (NT2, NT13); others used grams (NT1, NT11). Some reported weekly data (NT1, NT2, NT13, NT15); others reported data per meal (NT11, NT12), per household (NT1, NT15) or per person (NT1, NT12, NT13). In some cases, the units can be scaled to be comparable (e.g. food waste amounts in kilograms and grams can easily be compared). However, this inconsistency makes it difficult to compare the outcomes of different interventions and to determine which were most effective. Furthermore, none of the interventions considered, either during the design of the interventions or during assessment, the likely variability created by seasons or special days such as birthdays and festivities. These occurrences could influence the reliability and generalisability of certain measurements and, consequently, further hinder the comparability of the effectiveness of different interventions.

Effectiveness

Effectiveness could be assessed for all completed interventions that were already complete. At the time of the research, NT6 was missing as some data were still under analysis before finalising this report. Those that measured their effects on self-reported amounts of food waste (NT1, NT2, NT3, NT9, NT10, NT12, NT13, NT14) reported a decrease in its quantity. Reductions ranged from 30 % to 46 %. NT14, NT9 and NT13 reported the greatest reductions, which occurred specifically for fruit waste. In addition, NT14 reported a significant reduction in vegetable and meat waste. NT11 achieved a 44 % reduction in avoidable food waste, NT12 reported a 44.9 % reduction in plate waste by using meal boxes, NT3 saw positive results with shared recipes targeting the use of leftovers and NT12's gamification intervention reduced food waste per capita by 30 %.

Interventions aimed at inducing behavioural change (NT4, NT5, NT7, NT9, NT10, NT12) indicated that they were effectively altering participants' self-reported behaviour. However, it is not clear if self-reported behavioural change generated a reduction in food waste. Only NT12 suggests there is a correlation between self-reported behavioural change and food waste reduction. NT5 and NT7 reported increased awareness of participants regarding storage techniques but food waste reductions were not measured. NT4 provided multiple aids to participants and found the recipe booklet for using leftovers to be most effective tools among the provided. However, the effectiveness of each element of the aid box was not analysed.

Self-reported changes in behaviour or behavioural intentions must be interpreted with caution. While assessments of the effectiveness of interventions relying on self-reports are easier to conduct and less costly, they rely on data that is less accurate than objective measurements of food waste reductions. Self-reported measures can severely compromise the reliability of the results. According to Spang et al. (2019), self-reporting methods understate waste production by approximately 40 % compared with direct measurement. These measures also raise the challenge of social desirability bias: the reported behaviour changes may simply reflect how people would like to change their behaviour, potentially in the light of what they think the researchers or their social environment expects of them, rather than real behaviour change (Blondin and Attwood, 2022). Furthermore, when evaluating information campaigns, it is hard to distinguish between the impact of the campaign itself and parallel influences in society. It is recommended, therefore, that these caveats are borne in mind when evaluating self-reported changes.

Efficiency

To calculate the efficiency of an intervention, the effort, the time and costs invested should be calculated and considered in relation to the results. This is, however, difficult to assess for the interventions reviewed, as this information is rarely available. Five did not provide information on the resources invested, the social benefits or the outreach achieved. The remaining interventions provided some information on the economic costs, with all but NT14 keeping the more detailed breakdown confidential. However, none provided enough information to evaluate the efficiency in terms of economic benefits and environmental savings: information on either the outreach or the prevented waste was missing (at least from the information available when writing this report). For instance, NT14 reported a 440 g reduction per household, at a total cost of AUD 205 000. However, no information on the number of households reached was provided. In the case of NT11, it was known that the intervention reached 37 households and cost JPY 1 027 000, but information regarding the saved food was given only in percentages. In the case of NT12, we have data on the outreach and saved food, but not on the economic resources invested. Going forward, it would really help in understanding the impact of interventions if data on efficiency was captured. Some information on this has been published by Champions 12.3 as a business case (Hanson and Mitchell, 2017).

Sustainability over time

To know the degree to which an intervention is effective, it is also important to assess the sustainability of the intervention in the long term. Many interventions that provide consumers with tools and skills do not result in economic return for the actors implementing them (Caldeira et al., 2019). Thus, they rely on the implementer's ability to secure funding to maintain them. That is the case for most of the interventions included here. In the case of those that provide apps to consumers, funding to maintain the software is required. Interventions using tools such as tapes, fridge tabs and aid boxes rely on ongoing media campaigns supporting the product to keep the public aware of them. They also rely on ongoing partnerships with supermarkets and retail shops to sell these tools once their utility is sufficiently known by the public. Partnerships are an important way of maintaining the long-term sustainability of many interventions. This is the case with NT13, a social marketing pilot in partnership with Redland City Council (Australia) as part of the city's waste reduction and recycling plan.

It is also important to consider the human resources, the infrastructure, training for staff implementing the interventions and the necessary strategic plans to evaluate the interventions' sustainability. These aspects, however, are not present in the interventions assessed. According to the information provided, no plans were designed to sustain the interventions over a long period, although some cases will be disseminated through a series of activities such as publications and workshops (NT1, NT2, NT10, NT13) or information campaigns (NT10).

Transferability and scalability

In most cases, interventions have been neither upscaled nor transferred to a different context since they started, nor had this possibility been considered before their implementation. Nevertheless, four interventions have already been implemented at the national level (NT1, NT7, NT8, NT14) and could be transferable to other countries. NT3 has already been transferred from Canada to the United States and launched in the United Kingdom; it has also been scaled up as an e-book uploaded to the company's website. Mobile-app-based interventions could also be transferred nationally and to other countries if they are translated into local languages and made available on multiple devices and this is permitted by the owners or creators of the apps and tools. For instance, NT2 (the mobile app), which successfully reduced the quantity of food waste of participating students, will be tested in Greece and Finland. In addition to transferring the intervention to other countries, it could also be scaled up and tested in larger and more heterogeneous samples. A barrier for scaling up apps, however, would be the technological literacy of the target users and their inclinations to download and use the app.

For interventions requiring the cooperation of local authorities, such as NT14, the extent to which they can be extrapolated and/or scaled up is more complicated. In these cases, cooperation between local authorities and garbage collection systems would be needed. These groups might differ in significant ways, potentially making cooperation more cumbersome.

Finally, in experiments, there is a need to set up a control group to better test the effectiveness of the interventions. If such a group is not included, we cannot assess if the changes found are due to the intervention or to external factors (e.g. there may be a local authority campaign to reduce food waste while the intervention is being implemented).

Systemic effects

The evaluation of systemic effects was inconsistent for the data collection exercise. Despite this, some key insights can be gathered from those interventions that allow for the evaluation of the effects on the broader food system. In a potentially negative trade-off, NT10 could generate food waste when the manufacturer prepares the meal boxes, thus shifting the waste upstream in the food supply chain. Other potential trade-offs to investigate include the packaging waste deriving from the subscriptions. Unexpected positive effects have been recorded by consumers participating in NT11, who witnessed a decrease in food expenditure coupled with the reduction in waste due to using the food available more efficiently. Intervention NT10, on push notifications reminding consumers to use up leftovers, discovered that providing a cognitive input about food waste is beneficial.

Most of the KPIs refer to quantities or attitudes and self-assessed behavioural change. For attitudes and self-assessed behavioural change, systemic effects are rather difficult to determine. For quantities, even if the nudges include environmental information (NT8), no attempt was made to provide a holistic assessment approach to quantify the results in a way that considers the three pillars of sustainability (economic, social and environmental).

Box 1 presents the challenges identified for these interventions.

Box 1. Identified challenges in tools and prompts for food storage and preparation

Although all interventions considered in this section contribute to a better understanding of potential tools to prevent/reduce food waste at the household level, some messages should be considered to improve future interventions and inform future research.

All but one of the interventions (NT14) were designed from the top down. That is, all interventions were designed by researchers or other stakeholders without considering how consumers are going to use them. There might be benefits of co-creating together with end users.

To reliably test the effectiveness and efficiency of interventions, samples must be representative of the target population (convenient samples or well-motivated participants should only be used for pretesting interventions, for example).

In all except three cases, there was a lack of sound theoretical bases for the intervention tests. Consumer behaviour can be rather complex and depend on many different factors. Several of these factors must be considered when designing an experiment and the intervention itself. There is room for future research to extend existing models of consumer behaviour with specific constructs dealing with food waste. Furthermore, future research should assess whether theoretically grounded interventions are more effective than interventions without theoretical grounds.

Moving from self-reported methods to more objective ones to measure food waste is a real challenge. Even objective methods are mere approximations and subject to measurement errors. However, objective measuring techniques allow reliable tests of differences in food waste, which is the main concern of most of the interventions (the total wasted quantity is less important than the change in the quantity wasted).

If experiments are used, their designs should consider and account for potential impacts of uncontrolled factors, such as the influence of seasons affecting food availability, holiday periods such as Easter or national holidays and specific household events. These and other similar factors might be mixed up with the treatment effects and thus render the comparison of impacts from different interventions difficult or lead to less generalisable results.

Interventions used to modify attitudes are relevant but, as mentioned before, they must be based on a sound theoretical background, validated constructs and scales. To some extent, they should try to allow the assessment of how awareness influences food waste behaviour. Last, the relevance of tested interventions to modifying attitudes should be acknowledged – which includes a behavioural science approach in the design stage – but they should be grounded on solid theoretical bases and validated constructs to give reliable insights on how awareness influences food waste behaviour.

The key takeaway messages are as follows.

- Tools and prompts for food storage and preparation appear to be a prominent type of nudge.
- These interventions appear effective, even though the real impact on food waste (as opposed to intentions or self-reported behaviour) is rarely apparent.
- Thorough evaluation of the considered interventions was not possible due to a lack of reported data and theoretical basis for the testing.

4.1.2. Other nudges for household food waste

Four interventions were categorised as other nudges for household food waste. They included nudging tools such as social influence and leverage of social norms (NH1, NH4) and feedback (NH3) as well as other tools such as awareness-raising campaigns (NH1, NH3). In one case (NH4), a wider-ranging and diversified strategy was adopted, including a bundle of nudging techniques such as social influence, simplification, pre-commitment and feedback, coupled with awareness-raising campaigns and education and training solutions. Interestingly, NH2 adopted an idiosyncratic strategy based on induced hypocrisy and information pamphlets.

The four interventions were implemented at the national and subnational levels. NH1 and NH4 focused on the national dimension in Finland and in the United Kingdom, respectively. NH2 was conducted at the regional level in France and NH3 at the local level in Canada.

The interventions had a range of target audiences: some had a single target – addressing students (NH3), supermarket customers (NH4) or individual housing units (NH2) – and one was a more overarching study (NH1). However, all of them focused on the household level. The duration of the interventions varied from a few days to multiple months.

The studies targeted different phases of food management routines: while all of them focused on the consumption phase, most of them (NH1, NH2, and NH4) adopted a wider perspective by including at least the storage phase as well. Among these, NH1 and NH2 were the most encompassing, with more than three phases considered. Researchers were involved in all interventions. NH1 and NH4 also included business operators.

Quality of intervention design

All studies clearly stated their aim to tackle household food waste. However, they adopted different strategies to frame the topic and implement their interventions. For instance, NH1 developed a strategy to influence household behaviour by informing households about the amount, drivers and economical and climate impacts of food waste through a specific tool (i.e. the food waste calculator). Similarly, NH4 leveraged households' awareness of food waste through social media. Researchers focused on providing information on how to deal with leftover food and on household food waste drivers. NH2 tested a specific behavioural mechanism, namely cognitive dissonance, by asking participants to engage in the

development of a future public food waste reduction campaign. Participants had to propose food waste reduction measures and report anonymously on their transgressive past behaviours. Finally, NH3 developed a physical tool to support the sharing of information: a smart bin (Ecomate) was used to capture and provide a wide set of data on food waste levels that households can easily share and exploit without much cognitive effort.

All interventions recognised awareness as the main driver of food waste to be addressed. As shown above, they employed different levers to reach this aim, for example induced hypocrisy (NH2), self-reflection (NH3) and social influence (NH4).

Three out of four studies (NH2, NH3, NH4) tested their intervention against a control group. Two of them (NH2, NH4) implemented a randomisation strategy and hence had a full experimental approach. Only two studies adopted a defined theoretical framework: NH3 used the technologically enhanced feedback theory and NH4 employed social influence theory. In three interventions (NH2, NH3, NH4), a baseline was defined from previous measurements and some relevant KPIs connected to the main studies' targets were defined. For instance, NH2 and NH3 used food waste mass as a KPI. NH2 defined the KPI as the food waste in grams per week, while NH1 chose number of users of the food waste calculator as the KPI. Monitoring occurred in three phases (before, during and after the intervention) for all the interventions. Monitoring methods included weighting, visual observation, reporting in diaries and surveys.

Effectiveness

Three out of four studies (NH2, NH3, NH4) reported achieving their objectives. NH1 stated that the tool required further refinement to reach its goals. Despite that, some degree of behavioural change was observed in all studies. More specifically, the main results obtained due to the interventions were a partial overcoming of cognitive dissonance for NH2 and the raised awareness of food waste via different tools: the trigger of the smart bin for NH3, the support of social media for NH4 and the use of the food waste calculator for NH1. The impact on food waste was quantified for NH3 (almost 32 % decrease in edible food waste), a reduction in food waste ranging from 66 g per person in NH2 to 243 g per person in NH4. The outreach of the interventions ranged from a few households (around 60 for NH2) to larger groups (around 1500 for NH3) and to a wider population (70 000 for NH1). As hinted above, outcomes were measured mainly through weighting and visual analysis, supported by statistical or text analysis tools.

Efficiency

The available data does not enable evaluation of the efficiency of the interventions. Interventions were funded by public bodies and did not have precise strategies for adapting the resources to the goals of the interventions.

Sustainability over time

NH1 reported that it is still delivering its expected impact. Even though the intervention has ended, the tool is still currently in use. NH2 could not present any information in terms of the long-term effects of its intervention, while NH2 and NH3 performed an evaluation only 5 weeks after the end of the activities. However, NH3 developed a strong dissemination strategy for its results, with five scientific publications already, and more planned; NH2 adopted a similar approach. Similarly, NH1 engaged in a wide communication campaign on the efficacy of the food waste calculator, targeting young people, with the support of influencers and schools.

Systemic effects

The lack of granular data limited the understanding of systemic effects. However, NH1, NH2 and NH3 emphasised that the lack of awareness, the general lack of information and the absence of systemic reduction strategies can be considered limitations that drive food waste in any food management phase. NH2 also pointed out the lack of consumers' responsibility and the risk of burden shifting (i.e. instead of preventing or reducing food waste, it is simply moved from one part of the supply chain to another).

Transferability and scalability

The interventions are deemed to be transferable and scalable in the case of NH1, NH2 and NH3. NH1 would require adjustments in food waste data for it to be transferred to different contexts. The reason for this is that its functioning hinges on actual food waste data from the country where it is implemented. NH1 has a strategy to extend its outreach and impact. NH1 and NH2 would need more support from the local

government. NH4 would leverage more brand loyalty to team up with retailers to boost the impact of the project. Similarly, NH3 would require a commercial partner to scale up and promote its smart bin.

Box 2 presents the challenges identified for these interventions.

Box 2. Identified challenges in other nudges for household food waste

NH3 was confronted with the general difficulty of measuring food waste and, more specifically, the real cost of its smart bin, as it was a prototype. In addition, the quality of collected data hampered the possibility of performing fine-grained analyses. NH1 obtained high-quality local data through the food waste calculator, but could not adequately monitor food waste reduction. In the future, scalability would require access to granular national data from other countries, which could be difficult to achieve. Another barrier that was recognised by NH4 was the conflict with marketing campaigns of retailers in an extremely competitive environment. Difficulties in reporting and in measuring impact were also observed in this study. NH2 pointed to the emergence of potential methodological impasses in the experimental design, in the definition of a control group and when upscaling to larger communities.

The key takeaway messages are as follows.

- All interventions recognised awareness as the main driver of food waste to be addressed. They employed different levers to reach this aim, for example induced hypocrisy, self-reflection and social influence.
- Scalability relies on the possibility of accessing granular national food waste data from other countries where the intervention could be implemented.
- All interventions were limited by data availability and quality. Moreover, difficulties in reporting and in measuring impact were observed.
- There is a general need for better data and systemic approaches to ensure that the interventions are delivering real reductions of food waste. Simply shifting the burden to a different phase (i.e. from purchase to storage) must be avoided.

4.1.3. Labelling and visual cues on food packaging

Seven nudge interventions providing labels and visual cues on packaging were reviewed. Six of the studies focused on the issue of (mis)understanding best before and use-by labels (NL1, NL3, NL4, NL5, NL6, NL7). Two studies investigated using stickers near the best before date to encourage consumers to use their senses to decide if food needs to be thrown out or can still be consumed safely (NL2, NL7). NL5 and NL6 applied time-temperature indicators to meal boxes. One intervention (NL4) used stickers on product packaging and during TV spots to give consumers specific advice on how to avoid bread waste. Another study gave advice on the correct storage of products (NL3). NL1 is an experiment testing a different date format to help consumers better understand expiration dates.

Geographically, the interventions covered exclusively Europe. In most cases, the interventions have been implemented in one or two countries (NL1, NL4, NL5, NL6, NL7), with the two exceptions being NL3, which was implemented in four countries, and NL2, which has been implemented in 13 countries. Notably, five of the seven interventions were implemented in the Netherlands.

One intervention targeted a broad range of actors (NL5), while the others focused on families with children (NL4, NL6), single people (NL6) and representative samples of the population (NL3, NL7). NL1 focuses on the customers of a specific retail chain.

The interventions mostly addressed the storage stage of food production (NL2, NL3, NL4, NL5, NL6), followed by the preparation stage (NL2, NL4, NL5, NL7), consumption stage (NL1, NL2, NL4) and purchasing stage (NL2).

Only one intervention has been implemented on a large scale and included a vast variety of products (NL2: 12 countries, 483 brands). The others focused on either one food product (i.e. minced meat (NL1), bread (NL4) or salmon (NL5, NL6)) or several products (NL3, NL7).

Four of them have been implemented at least at the pilot level (NL2, NL4, NL5, NL6). Two were tested in an online survey that showed participants pictures of products with the corresponding information (NL3, NL7).

It should be mentioned that the only large-scale and international intervention (NL2) is being implemented by business operators. In four cases, the main actors implementing the interventions were researchers (NL3, NL4, NL6, NL7). In two of these, the researchers cooperated with NGOs (NL4, NL5) and for one they cooperated with food businesses (NL6). NL1 is being implemented by an NGO and NL5 was implemented by a food business.

Quality of intervention design

In general, the quality of the reviewed interventions was sufficient. However, some limitations have been recognised. All interventions on labelling and visual cues fulfilled the main quality criteria in terms of problem identification and definition of objectives. However, no interventions followed a theoretical framework, and five interventions carried out the evaluation of the effect against a control group (NL1, NL2, NL3, NL6, NL7). As one intervention (NL1) is still ongoing and no detailed information on evaluation is available, only six interventions will be included in the rest of this section.

Five of the six interventions explicitly mentioned the reduction of food waste as their main or overall aim. The only exception was NL3, which aimed to improve storage decisions made by consumers. Measurable KPIs were explicitly defined for very few interventions (although sometimes they were implicit), so the evaluation of effects appears to have been decided while the interventions were running rather than in the design phases. The defined KPIs ranged from rather unspecific expectations such as changes in consumer choices/behaviour (NL4, NL7) to concrete measurable figures such as the number of entities (e.g. brands, participants or consumers) noticing the intervention (NL4, NL5).

All interventions used consumer surveys for the evaluation of their success. The number of participants per country ranged between 544 and 1 589, and the lowest total number of participants was 1 485. In three interventions (NL4, NL6, NL7), a control group was used and sufficiently described. Only one intervention has tested its results for statistical significance (NL3).

Assessing the performance of interventions relied mainly on evaluating outcome objectives. Outcomes were assessed in terms of the general perception of an intervention, a percentage score indicating planned behaviour change or reported food handling. In one intervention, an attempt was made to use this percentage value to express the potential avoidance of food waste as a mass (NL6). Real impact objectives in terms of actual change in behaviour or actual food waste savings were not measured and could not be measured because of limitations in the intervention designs.

Main drivers and reasons for the labels and visual cues on food packaging were the consumers' lack of understanding of best before and use-by dates.

Effectiveness

For almost all labelling interventions (i.e. except NL1, for which findings are not yet available), effectiveness can be assumed but not demonstrated. For these interventions, only the number of participants reached or self-reported intentions to change behaviour can give an indication of their effectiveness.

Of the two date-labelling campaigns (NL2, NL7), only NL7 included a comparison with a control group. However, the impact of visual cues turned out to be ambiguous. For products with best before dates, respondents were less likely to discard the food in the presence of a (visual) cue, showing that adding a cue may help reduce food waste. For products with use-by dates, the cue triggered respondents to eat (instead of inspect, smell and taste) the product on the date of expiry. However, as intended, for products past their use-by date, the visual cue triggered discarding of the products instead of inspecting, tasting and smelling them. NL2 uses the involvement of 483 brands as one KPI. As a result of an online survey with 12 077 participants, it was concluded that 16 % of consumers have noticed the awareness label on products and, of those that have noticed the label, 71 % intend to change their behaviours (meaning they intend to inspect, smell and taste the product before throwing it away).

Although investigations of the time-temperature indicator (NL5, NL6) concluded that most respondents expected that the indicator would result in them throwing away less food, the actual success of the indicator was difficult to assess. Of the 289 people who saw the indicator, 36 % reported still eating the fish when the Keep-it indicator showed that the fish was good for consumption for 2 days after the static date

(which was also included on the packaging). Assuming that 50 % of those who reported that they would still eat the fish actually ate the fish, a waste reduction potential of 15 % was estimated ⁽⁴⁾.

In the campaign aimed at the consumption of bread (NL4), which also included TV ads, flyers and posters in addition to the stickers on the product, no direct measurement of effects on food waste prevention was possible. In addition, it is unclear to what extent the effects were due to the labels or any of the other interventions. In general, 40 % of the respondents noticed the campaign. Furthermore, 40 % of respondents who noticed a sticker on a bread bag said it caused them eat their (old) bread and waste less. The study concluded that stickers are more recognisable to consumers than flyers and posters.

Finally, NL3 confronted participants in an online survey with two types of on-pack information (date labelling and storage advice) on selected products. Only the effects on storage behaviour, and not those on food waste, were measured. There was no evidence that adding the day to the date had an effect on storage behaviour. An increased intention to store optimally was attributed to the provided storage advice. An additional outcome was that guidance given in a directive tone using sticker-effect labels was significantly more effective than that given in an advisory tone using non-sticker labels and both were more effective than no guidance at all.

Importantly, none of the studies could prove effects on waste reduction. Nevertheless, insofar as effects can be suspected, further research in this direction would be insightful.

Efficiency

It was not possible to calculate the efficiency of the labelling interventions, as two were in the experimental stage (NL1, NL3) at the time of reporting and the companies running the others (NL2, NL4, NL5, NL6, NL7) did not disclose cost information.

Sustainability over time

As mentioned, only four interventions were beyond the experimental stage (NL2, NL4, NL5, NL6). Three of them were pilots that were not expected to continue beyond the pilot stage. Therefore, no strategic plans regarding their longevity exist.

Only NL3 was implemented on a large scale and accompanied by appropriate communication activities. Sustainability is made possible not least by the fact that the application of the labels to the products is left to the businesses themselves, which pay for the application. Additional funding is only required for the acquisition of new brands and the corresponding promotion of the campaign.

Transferability and scalability

In principle, each of the labels and visual cues can be implemented in another place and for many other products. Similarly, upscaling to reach more consumers is possible, in principle. Regarding the time-temperature indicators (NL5, NL6), currently, European law requires static dates on food packaging. Time-temperature indicators could thus only complement, not replace, static labels.

Systemic effects

As mentioned earlier in this report, the evaluation of systemic effects was inconsistent for the whole data collection. Data on the drivers linking label misunderstanding and food waste or on the levers and drivers linked to risk perception of food safety concerns could be collected to better understand the systemic effects of interventions.

Box 3 presents the challenges identified for these interventions.

Box 3. Identified challenges in labelling and visual cues on food packaging

One of the main challenges is that there is no concrete evidence of consumers noticing or paying much attention to on-packaging labels (Obersteiner et al., 2021). Furthermore, even if the information on the package is noticed, it does not necessarily translate into behaviour change. In fact, it is often difficult to

⁽⁴⁾ It should be noted that the prerequisites are that the Keep-it indicator shows a longer shelf life than the static date and that consumers want to eat the fish within the extended period. The actual effectiveness is therefore probably even lower than that calculated here.

measure the success of packaging interventions, as this usually depends on surveys and self-reporting. Direct waste measurements in realistic contexts can be technically challenging and prohibitively expensive.

The key takeaway messages are as follows.

- For labelling and visual cues on packaging, it is difficult to demonstrate effectiveness and efficiency.
- The actual food waste avoidance effect is not directly measurable because it is difficult to follow the products to the consumer and/or because only planned behavioural change can be queried.
- Nevertheless, the direct link between food and food waste can best be established on product packaging and a wider audience can be reached.
- Importantly, consumers often tend not to notice information on labels.

4.1.4. Nudges out of the home

Ten nudging interventions were labelled according to their focus on behaviour out of the home. Four interventions (NOOH1, NOOH3, NOOH5, NOOH7) leveraged the power of social influence or social norms, with NOOH1 also including awareness campaigns. NOOH2 uses nudges in school canteens by providing the side dish at the beginning of the meal, instead of with the first main course. NOOH8 involved financial incentives, NOOH6 and NOOH9 focus on food waste prevention interventions and NOOH3 consisted of visual, participatory and educational measures.

NOOH5 was implemented at the national level in France. NOOH7 was implemented at the regional level in Gran Canaria (Spain). NOOH3, NOOH8 and NOOH9 focused on the local level. NOOH8 was implemented in five restaurants in São Paulo (Brazil), NOOH6 and NOOH9 in several municipalities / metropolitan areas in Portugal and NOOH3 in schools of the metropolitan region of Barcelona. NOOH4 did not indicate its geographic coverage.

Hotel employees (NOOH1, NOOH6, NOOH10) and hotel customers more generally (NOOH4) were the primary target groups, in addition to restaurant owners (NOOH1, NOOH6, NOOH9). NOOH1 and NOOH3 mentioned families with children, students, and single-person households as target groups. Fittingly, all the interventions took place in the serving and consumption stages, except for NOOH4, which focused on the retail stage. NOOH4 specifically focused on takeaway using doggy bags.

Half of the included interventions have now ended (NOOH3, NOOH4, NOOH7, NOOH10, NOOH8), whereas the others are ongoing (NOOH1, NOOH2, NOOH5, NOOH6, NOOH9). Two interventions were implemented by local authorities (NOOH4, NOOH6) and four interventions involved researchers (NOOH3, NOOH6, NOOH7, NOOH10). Three interventions included control groups (NOOH2, NOOH7, NOOH10) and two were implemented in restaurants (NOOH6, NOOH9). Five interventions targeted restaurants and/or hotel customers (NOOH4, NOOH5, NOOH6, NOOH7).

Quality of intervention design

On the one hand, all the reviewed interventions adequately reported the problem of food waste and defined objectives and aims. On the other hand, most of the interventions did not define specific targets and only 5 interventions out of the 10 (NOOH5, NOOH6, NOOH7, NOOH8, NOOH9) identified a baseline for the monitoring of intervention implementation. A theoretical framework was adopted by four interventions: NOOH7 was based on the attitude-behaviour-context theory, NOOH10 relies on informational feedback and environmental framing, NOOH5 followed a dynamic social norms approach (how other people's behaviour and attitudes change over time) and NOOH1 applies a weighting method to food waste, separating edible and non-edible parts. All the interventions relied on an experimental approach, except for NOOH1, NOOH5, NOOH6, NOOH8 and NOOH9.

Effectiveness

Overall, the observed interventions showed varying degrees of effectiveness and challenges to demonstrate effectiveness. In the case of NOOH6 and NOOH9, which were tested in pilot restaurants, the accomplishment of targets depends on each specific restaurant within each intervention. However, several interventions evidenced a certain reduction in food waste, expressed in kilograms (NOOH1, NOOH3, NOOH6, NOOH10) or as percentages. In three cases the quantification of the food waste amount was not provided (NOOH2, NOOH4, NOOH8). The outreach of the reviewed interventions ranges from 5 to

15 people per meal (NOOH6) to 11 000 meals per day or a total of 1 536 600 meals (NOOH9). NOOH1 is an exception, as it indicates no significant accomplishment in terms of food waste reduction and outreach for its intervention on posters displaying social norms, thus concluding that the communication strategy envisaged was ineffective.

Efficiency

The reviewed initiatives were experimental; therefore, it was not possible to perform a real efficiency evaluation, as the costs for experiments can differ widely from the costs of implemented initiatives. Three initiatives did not disclose any cost evaluation (NOOH4, NOOH6, NOOH10); costs for the other interventions ranged from EUR 400 in total for NOOH7 to EUR 48 000 in total for NOOH3.

Sustainability over time

NOOH1 and NOOH3 envisage monitoring plans to keep track of their sustainability objectives, based on which they could communicate with the public. NOOH6 provided its monitoring and improvement strategies through an annual checklist of good practices. NOOH9 uses a monitoring spreadsheet, which is analysed by technical staff to adapt practices when needed. Rest of interventions under this category do not envisage any monitoring or communication and dissemination plan.

Transferability and scalability

There was remarkable variety regarding evaluations of transferability and scalability. Several interventions considered these parameters in the description of their outcomes and suggested high potential. This evidence emerged in schools in NOOH3, corporate restaurants in NOOH5, other consumption contexts in NOOH7 and commercial restaurants in NOOH9. NOOH7 declared that it was an easily scalable intervention if there are professional printing facilities. NOOH10 could be replicable if sites had the capacity to measure plate waste daily. NOOH1 could be transferable through disseminating the intervention and results at specific events such as festivals or other gatherings where sustainability (i.e. reducing food waste or running the event with low-emission transport) is a shared goal. NOOH3 highlighted the need for legislation fostering food waste prevention in school canteens. Transferability and scalability were not clearly detailed for interventions NOOH4, NOOH8 and NOOH10.

Systemic effects

The reviewed initiatives revealed several potential systemic effects on the food system in terms of food waste, new food waste drivers and the levers identified, which were assessed qualitatively. This included helping guests tackle overserving (NOOH7) and therefore potentially encouraging healthier consumption. Other aspects related to education and training were, for example, the positive impact helping reduce food waste had on staff (NOOH3).

Exceptions are NOOH1, NOOH4 and NOOH6, which did not report any systemic effects.

Box 4 presents the challenges identified for these interventions.

Box 4. Identified challenges in nudges out of the home

NOOH7 highlighted the difficulty of analysing individual behaviours and of understanding all control variables considered. NOOH10 faced difficulties in evaluating the specific impacts of the communication strategy used. NOOH3 encountered biases in children's behaviours, while NOOH5 recognised biases in people's self-perceptions, possibly affecting the quality of the respondents' declarations. NOOH5 faced obstacles in catching people's attention due to busy environments. Finally, NOOH3 noticed the lack of long-term perspectives in the results. The main challenge identified by NOOH4 was transforming cultural barriers by changing the negative social perception associated with social norms, while for NOOH6 the main challenge is convincing partners about the benefits of creating more sustainable menus.

The key takeaway messages are as follows.

- Emotional and psychological drivers related to out-of-the-home nudges deserve further research.
- A monitoring plan to keep track of sustainability goals can be used as a basis for communicating with the public.
- Educational activities and training for staff might improve food management and communication with customers.

4.2. Education and training interventions

These interventions specifically focus on improving the food-related knowledge and skills of their targets so that the targets are able to reduce food waste in their homes (education interventions) or in their place of work (training interventions). These interventions are recognised as different from awareness raising, as they can have a pedagogical component. The category of education and training interventions is subdivided into school programmes, training for food business workers and coaching for households. School programmes target children or teenagers in their learning environments. Associated interventions sometimes have a broader scope than food waste prevention and incorporate other elements related to food, such as nutrition. Training for food business workers encompasses interventions that provide training for food business workers, including retail employees and those in zero-waste restaurants. Coaching for households includes interventions aiming to improve the skills and knowledge of consumers in the context of their homes (including personalised coaching and community programmes).

4.2.1. School programmes

Under the category of education and training, eight interventions, covering a wide range of activities, have been labelled as school programmes. Six activities focused directly on food waste (ES1, ES3, ES4, ES5, ES7, ES8), while two only touched on the topic (ES2, ES6). Among these focusing on food waste, involving children in food selection and preparation (ES1) and providing general information about food (ES2) are expected to reduce food waste, among other effects. In one case, the topic of food waste was just one of many included in a national, school-based nutrition education programme (ES2).

Half of these interventions (ES2, ES5, ES7, ES8) reported providing information and teaching materials (for teachers and students) of various kinds, mostly free of charge. Other interventions reported providing information and teaching materials to kitchen staff or parents (ES5, ES6). Overall, the aim of these interventions was to raise awareness about food waste. ES1 aims to avoid food waste at a school by involving the children in processes of food selection and preparation at home⁽⁵⁾. One intervention encouraged pupils to submit creative videos in which they showed the cooking of a recipe made from food leftovers (ES4). Another intervention involves food waste battles (ES3), where pupils receive leftover food from local supermarkets and grocery stores and then plan and prepare a two-course meal.

All interventions except one were implemented in Europe, specifically in France (ES8), Italy (ES6), the Netherlands (ES2), Portugal (ES4, ES7) and Finland (ES3); one intervention (ES5) was implemented in several European countries (Belgium, England, France, Italy). One was conducted in Australia (ES1). For half of the interventions, the focus was on food waste prevention in schools (ES1, ES5, ES6, ES7). The remaining interventions provide more general knowledge on food waste prevention at the household level (ES2, ES3, ES4, ES8).

Most interventions that provided information on the targeted food management stage addressed all stages (ES2, ES3, ES8), with ES3 indicating a focus on only the preparation and consumption stages. Except for one initiative, which is more experimental in nature (ES1), the rest are ongoing. One intervention is in the start-up phase and has not yet been completed (ES7). Two interventions were implemented in the framework of the respective national education programmes (ES1, ES5), while four others are run by national (ES2, ES3, ES4, ES6) or international (ES5) organisations. Either they are launched annually or the material is freely available on an ongoing basis and can be accessed at any time. Most interventions target pupils from elementary to secondary school (ages 5–12). However, the age is not always clear due to different school systems or missing information. Intervention ES3 explicitly focuses on teenagers.

Quality of intervention design

The focus of the included interventions was to raise awareness of food-waste-related issues. Therefore, these interventions frequently lack both a clear definition of targets and measurement of impact variables (e.g. food waste reduction). Only experimental study ES6 provided and clearly defined the targets of the investigated intervention, measured KPIs and evaluated the results according to statistical

⁽⁵⁾ Australian schoolchildren typically bring food from home to eat at school. Children who are more actively involved in food choice and decision-making were assumed to be more likely to try a greater range of foods, to eat more and to waste less.

criteria. However, the purpose of this intervention was not to prevent food waste, but rather to provide information on nutrition. In addition, the loss rates were not calculated on the basis of the actual quantities delivered but on the basis of weights of a standard portion, which could lead to massive misjudgements of the quantities and mean that the results (no impact of the educational intervention on the amount of waste produced in school canteens) are not reliable.

Four interventions did not specify targets (ES1, ES2, ES4, ES5). For those interventions that monitored their activities, four used the number of schools and the number of participating pupils as KPIs (ES1, ES2, ES4, ES8). In one intervention (ES7), the target was to reduce the food waste generated by the school by up to 50 %, but this study is still ongoing and no details were provided on the implementation of the intervention. Although in most cases no measurable KPIs were defined, most at least implemented smaller experimental studies to evaluate the interventions. ES1 performed pre- and post-intervention measurements through visual audits and by counting wasted items. In ES5, food waste was weighed before and after the implementation of the intervention. ES2 included several measurements, but none focused on food waste. For interventions ES3 and ES4, no information on the detailed measurements was provided.

The drivers for most of the interventions were identified as being a general lack of awareness (ES1, ES2, ES3, ES8), lack of education (ES3) and lack of attention, especially in the communication between pupils and kitchen staff (ES5). Four interventions did not mention drivers explicitly (ES2, ES3, ES7, ES8).

Effectiveness

For five interventions, no data was collected that would allow an evaluation of their effectiveness. One experimental study (ES6) found no effect of the intervention, but, as mentioned, this might be because of a bad study design. The Australian intervention involving pupils in food choices at home (ES1) led to a 35 % reduction in avoidable food waste items ⁽⁶⁾. Finally, intervention ES5 compared the baseline with a post-intervention measurement of food waste and found a 15 % average reduction in waste over the 2 years of the pilot phase. No details are provided on the sample size of the pilot or the measurement.

Efficiency

Because of a lack of information on the effectiveness of the interventions, efficiency can be assessed for only two studies, and only partially. The costs of the Australian intervention involving children (ES1) are quantified at AUD 22 250 for the running and evaluation of the pilot and at AUD 1000 for the yearly maintenance of the project. For the 15 % reduction of food waste in ES5, a cost of EUR 18 400 was calculated. Interestingly, it was estimated in ES3 (food waste battle) that about EUR 1.7 was spent for each pupil reached by the intervention.

Sustainability over time

Except for experimental study ES6, all the interventions are ongoing and the further implementation or availability of the materials is ensured. ES7 started recently and was scheduled to end in June 2023.

Transferability and scalability

In principle, transferability for all interventions is achievable. However, ES1 would be applicable only in contexts where children bring food from home to school, not contexts in which children eat food from school canteens. In one intervention, the involvement of ambassadors is required (ES5). In all other interventions, the concepts should be easily transferable and scalable.

Systemic effects

In principle, raising awareness of food waste in a household and family setting can positively affect the appreciation of food. The interventions address the general problem of lack of cooking skills in schools. In ES4 and ES7, it is emphasised that more attention is paid to a healthy diet and nutrition. Food-waste-related environmental impacts and impacts on canteens' and households' budgets are also pointed out.

In school programme interventions, it can generally be stated that the drivers of food waste identified are the lack of cooking skills and the lack of knowledge about food and its management. As these

⁽⁶⁾ It must be mentioned that the figures relate only to food that was prepared at home to be eaten in the school. The same effects should not be expected for meals provided in schools.

interventions apply a pedagogical approach, the topic of food waste is often paired with other topics, such as home economics (ES3), nutrition and health (ES4) and food literacy in general (ES5). In addition, for interventions entailing the quantification of waste in school canteens, the portion sizes and the type of kitchen seemed to determine the amount of waste. Interestingly, a lever for action identified was the inclusion of children in food preparation activities, thus underlining how children should be considered not only the targets of the intervention but active agents in food waste prevention, including beyond the school's walls (Kansal et al., 2022).

Box 5 presents the challenges identified for these interventions.

Box 5. Identified challenges in school programmes

There are three major challenges connected to the success and quality assessment of school programmes. First, most programmes rely on the involvement and support of teachers. The failure of teachers to fully engage will decrease the potential impact of these interventions.

Second, most activities considered here focus on school interventions that aim to have an impact on food waste generation in households. Activities in school should raise the awareness of children, and this will influence their general behaviour, including at home. However, this means that the effect of these interventions cannot be measured at the school level, as they do not focus on school catering or the food that is provided in schools. A direct measurement of food waste in households is expensive and a large sample size would probably be required to enable a reliable assessment of the effects of these interventions on household food waste.

Finally, most of these interventions can have an impact only on the level of plate waste in school canteens, as they focus on the behaviour of pupils. In the worst case scenario, this can result in a shift of waste from the plate to the buffet, where strict rules on the amount of food and the nutritional content of food are predefined for children's nutrition in most countries. This happens when the cooking is done not at school, but by a company supplying schools with food through a fixed framework contract. Often caterers must follow strict guidelines regarding the composition and quantity of portions and menus.

The key takeaway messages are as follows.

- Interventions in schools have the added value that children mostly pass the information on to their parents, which widens the interventions' reach.
- If the intervention focuses on school catering, it must be considered that there may also be a shift of food leftovers from the plate to the serving area.
- If the intervention focuses more generally on food waste prevention, rather than reducing food waste in the school canteen, it is likely that no measurable effects can be achieved in the school and it would be difficult to estimate the effects of the intervention at the household level.

4.2.2. Training for food business workers

Two case studies were labelled as training for food business workers. ET1 focused on training for supermarket employees at a supermarket chain in Germany. It lasted 1 year. ET2 was part of a more overarching project on the promotion of food literacy and plant-based diets in Lisbon, Portugal. Specifically, it was a zero-waste restaurant project promoting local sourcing, food waste and packaging waste reduction and circularity.

The types of intervention implemented in the two case studies differed. Both ET1 and ET2 provided some form of education and training to workers, but ET2 implemented a more wide-ranging strategy that was also based on social influence, simplification, warnings and pre-commitment strategies.

The two initiatives focused on training for food business workers, specifically on the purchase and storage phases. Again, ET2 employed a more overarching strategy that tackled all the stages of the food chain, including the supply and preparation of food. While ET2 relied on the sole efforts of the restaurant's owners, ET1 featured researchers, food business operators and retailers teaming up to reach its goals. The target audience of ET1 was quite narrow, specifically supermarket workers, while ET2 extended its outreach to families with or without children, students, people living on their own and those in other types of households.

Quality of intervention design

The aims of the two initiatives converged to some extent, with both stating that their overall objectives were to raise awareness of food waste and to train personnel. However, ET2 has shaped a more encompassing strategy to connect producers, consumers and researchers, while promoting circularity; plant-based diets; local, organic and seasonal food; and a strong role for circularity in operating their business.

The interventions' targets were quite ambitious: ET1 aimed to achieve 100 % awareness among its newly hired personnel, while ET2 strived to achieve zero food wasted. However, ET2 did not implement any monitoring strategy to verify that no food waste was generated. ET1 relied on feedback questionnaires, which were administered just after the intervention and again after 6 months to monitor the intervention's impact. Neither relied on a theoretical or experimental approach.

The food waste drivers recognised in ET1 and ET2 differed. While ET1 found that the main issue was a lack of awareness, the emphasis of ET2 was on menu design, improving the efficiency of food preparation and increasing knowledge of how to repurpose leftovers. Interestingly, the levers for behavioural change had some similarities. Both cases stress the need to communicate information to consumers on how to manage food scraps and leftovers and on how to manage and store food. ET2 also adds ideas of clever menu design, portioning and sourcing strategies.

Effectiveness

Targets were met in both interventions. ET1 reported 100 % success in training its employees in Germany, and ET2 claimed to have reached its zero-waste goal in its activities; however, as the monitoring strategy for ET2 was not clear, it is not possible to ascertain whether this was actually achieved. Generally, ET2 stated that, through its zero-waste management, it was able to reduce the production of waste on its premises by an average of 75–95 % compared with the average restaurant in Portugal. The most effective tool, according to ET2's results, is a smart seasonal menu that changes every day, thus inverting the commonplace tendency to adapt sourcing to the menu.

ET1 reached 800 supermarket apprentices, while ET2 had 3 000 direct beneficiaries and reached 300 000 people through its communications on social media.

Efficiency

ET1 did not provide cost data, while ET2 indicated costs but did not provide measurable outcomes on the amount of waste reduced to put these costs into context. Therefore, from the data provided, it is not possible to determine whether or not the interventions were efficient (where efficiency is understood to mean the evaluation of the results achieved in relation to the resources or inputs used, which are unknown).

Sustainability over time

No sustainability information was available for ET1, while ET2 has a strategy to disseminate its work through communication channels (website, newsletter, social media and other related projects) targeting a young population and food chain professionals.

Transferability and scalability

ET1 deemed that the intervention could be easily transferred and scaled up, even if it would require adaptation because it was tailored to the supermarket's specific structure and needs. ET2 claimed the same, but it stressed that compliance with strict rules would be necessary to make the system work and that a strong effort of community building at the local level would be needed for an impact to materialise.

Systemic effects

Data on training interventions is quite limited. However, ET1 recognised the positive synergies that could be found between food waste awareness and work-related issues (support to customers and employers) to trigger personal engagement. ET2 evidenced a ripple effect on farmers, who adjusted their practices towards sustainability based on the experience of working with the intervention group.

Box 6 presents the challenges identified for these interventions.

Box 6. Identified challenges in training for food business workers

ET1 identified the lack of a theoretical framework as the main weakness of the intervention. A theoretical basis would have supported the design of the intervention and the collection of quantitative insights on food waste reduction. ET2 faced difficulties in making farmers understand the principles of the restaurant. They also experienced hardships in data collection.

The key takeaway messages are as follows.

- Linking or basing the design of an intervention on a theoretical framework might contribute to a better design and a better understanding of the intervention's effects.
- Depending on the context, the transferability of an intervention might require significant adaptations.
- Monitoring strategies need to be implemented to verify the effects of the interventions. The absence of monitoring strategies hampers the credibility of the entire work.

4.2.3. Coaching for households

Eight interventions have been assessed under the subcategory of coaching for households. During their implementation, some of the interventions highlighted the financial and environmental benefits of food waste reduction. They employed kitchen laboratories to teach practices in a controlled environment (EC2), citizen communities to encourage behaviours and cascade down the information through a community network (EC8), information workshops for interested households (EC4, EC5), training with thematic challenges for households (EC1, EC4), household panels with different intervention schemes (EC8) and personalised coaching (EC7). All interventions aimed to achieve household food waste reduction by improving people's food management skills.

Six interventions were implemented in Europe, more specifically Germany (EC2, EC3), Scotland (EC5, EC8), Portugal (EC1) or Belgium (EC4). Two interventions (EC6, EC7) were implemented in the United States.

Messages generally covered all food management aspects, including planning, shopping, cooking and storing. Online and offline tools were applied to attract participants and facilitate the uptake of new practices. The most common tools were podcasts, infographics, videos, flyers, a mobile app to register food items, shopping list templates, portion measures and thermometers.

Half of the interventions lasted 1 year or more (EC2, EC4, EC5, EC8). EC3 lasted nearly 10 months, EC1 lasted 4 months, EC6 included 5 weeks of intervention within a time frame of 5 months, and the shortest, at 1 week, was EC7. EC4 was conducted in 2020 and reported difficulties due to the COVID-19 pandemic. EC5 was launched in 2017 and is ongoing; all the others have finished.

In terms of the type of organisation, universities and NGOs were the main providers of the coaching interventions investigated here. Cooperation was common between universities, between universities and local authorities and between NGOs and universities.

Quality of intervention design

All interventions had some kind of objective, KPI, monitoring system and baseline value. However, the degree to which these were clearly defined or implicit varied strongly. In fact, a detailed description of these values or the methods used was generally lacking. For most interventions, the main KPI was defined as food waste reduction (EC2, EC3, EC4, EC5, EC6, EC7, EC8). EC7 also measured participants' awareness of the negative effects of discarding food, based on self-reports, while EC1 measured the number of people reached through the media. Thus, an assessment of the quality of all interventions overall is challenging, as they followed different intervention logics.

Examples of food waste drivers were excessive food purchasing (EC6), food capabilities and knowledge (EC8), lack of awareness (EC7, EC8), food literacy (EC6) and time pressure (EC7). None of the interventions were explicitly based on a theoretical model or framework. Experiments were conducted in EC2, EC7 and EC8. Of these, EC2 included two groups that used different food waste measurement tools. More specifically, one group used an offline self-reporting system, while the other group used a web-based online platform to document and report data.

There was remarkable overlap between the examined interventions in terms of their targeted drivers and the developed materials. This suggests a high level of consistency in the practices applied by researchers and practitioners.

Effectiveness

Indicators of the effectiveness included reduction in food waste (as a percentage or in terms of mass per day and person, mass per household and person or total mass of avoided food waste), number of people engaged, financial savings associated with food waste prevention, media outreach, number of readers, number of views and amount of CO₂ avoided. This broad spectrum of monitoring indicators prevents a direct comparison of the interventions. Reduction of food waste varied between 16 % and 67 %.

Efficiency

The efficiency of most of the included interventions cannot be evaluated. In some cases, there was not enough data available to assess efficiency (EC6, EC7, EC8). For two, efficiency was connected to the aim of reaching out to many people (EC3, EUR 15.70 per person expressing interest in the workshops; EC5, EUR 3.61 per person reached). EC4 demonstrated the most transparent and understandable efficiency indicator. According to their results, the total budget of the 2-year project was EUR 94 540, while the money saved through prevented food waste was EUR 188 684 over a year.

Sustainability over time

None of the interventions had a well-defined sustainability strategy. Therefore, they do not provide information on the future of the interventions, the associated human and financial resource needs or partnerships that would be maintained after the project. In addition, the interventions did not provide evidence regarding their sustainability.

Transferability and scalability

Translation and publication of the created materials is a general way to ensure the transferability of interventions (at least if they rely on providing textual or similar information). Most interventions did not include an action plan for transferring the results to other contexts or for scaling them up. Though most of the interventions' concepts could be easily adopted by other stakeholders and in different contexts, the following barriers were identified: the necessity to adapt online materials and questionnaires to new contexts (EC2, EC4); securing financial resources for implementation (EC4, EC8); the need to consider local priorities, opportunities and barriers (EC8); difficulties in funding local organisations or networks to mobilise local communities, especially in volunteering projects (EC8); and the time and resource intensity of personalised coaching (EC7).

Systemic effects

Interventions in this subcategory primarily focus on multiple drivers and levers. This implies a broad spectrum of practical information that can be used to equip individuals or households with comprehensive management skills. Besides teaching practical skills, several interventions aimed to improve understanding of food waste issues, such as the connection between food waste and the environment, and the financial savings that consumers can achieve if they avoid food waste. Food waste messages can also be linked effectively to healthy eating and sustainable or local food messages (EC8). Another identified systemic effect is the link between food safety and food waste messages (EC6). Food waste prevention measures must align with food safety requirements and messages must be formulated in accordance with the safety-first principle.

Box 7 presents the challenges identified for these interventions.

Box 7. Identified challenges in coaching for households

A major challenge of interventions in this area that aim to change behaviour is overcoming consumers' routines and habits. The sustainability of the intervention is also a challenge from two perspectives. On the one hand, delivering and evidencing a long-term effect is challenging, as there is frequently a lack of data available for the measurement of effectiveness on a longer time scale. On the other hand, it is challenging to maintain project activities after funding ends. Therefore, action plans for sustainability should be drawn up before implementing an intervention and it is recommended that, after a campaign ends, certain activities developed in the project should become an integral part of the organisation. Another challenge linked to the evaluation of the interventions is the lack of tangible, unified efficiency

indicators. This suggests that the definition of a unit that can be used as a common efficiency indicator in interventions (e.g. euro per kilogram of food waste avoided, euro per consumer reached) and detailed descriptions of the related monitoring methodologies can be beneficial. In addition, with respect to the actors involved, it appears that universities were frequently involved in the interventions outlined here. Some challenges might be overcome by boosting interactions between different actors and universities. Finally, scaling up a collaborative intervention, though often effective, may prove to be prohibitively expensive and resource intensive.

The key takeaway messages are as follows.

- Coaching for households can break consumer routines in planning, shopping, cooking and storing food. It could be very effective when combined with nudging.
- Household coaching requires money, time and effort, but good results can be achieved in a few sessions.
- Interventions to coach households can be recommended for local communities.
- Universities can motivate students to engage in household coaching with different methodologies, including pre- and post-intervention measurements of food waste, as parts of projects and theses.

4.3. Awareness-raising interventions

This section includes interventions that raise awareness of food waste. We subdivided these interventions not by subtopic, but rather according to their scale. Thus, we differentiate between local and large-scale initiatives.

4.3.1. Local initiatives

In total, seven awareness-raising food waste reduction interventions were labelled as local initiatives. Of these, two distributed communication materials to homes, displayed awareness-raising materials in the locality and organised community or neighbourhood cooking workshops (AL3, AL7). In addition, AL6 focused on awareness raising in schools and hospitality businesses, while AL3 included door-to-door visits. Two interventions focused solely on awareness-raising communication and prompts provided directly to the home or apartment building (AL2, AL5), while another utilised communication such as radio advertising, social media and digital adverts, alongside roadshow events and talks (AL7).

AL4 focused solely on the fridge by posting information to participants and instructing them on how they could reduce food waste by managing the food in their refrigerators effectively. AL1 focused on overexploitation of marine resources and discards to raise awareness of food waste in the fishing supply chain. In doing so, they also aimed to encourage an increase in consumer demand for neglected (i.e. rarely consumed) fish species.

Most interventions addressed multiple stages of food management, specifically purchase (AL1, AL2, AL3, AL4, AL5), storage (AL2, AL3, AL4, AL5, AL7), preparation (AL1, AL2, AL3, AL4, AL5, AL7) and consumption (AL1, AL2, AL3, AL5, AL7).

While AL9 reported a focus on a wide range of target groups, the other interventions that provided information focused on families with and without children (AL3, AL4), students (AL7) and single people (AL3, AL4). Three included representative samples (AL3, AL4, AL5) and two indicated other target groups (AL6, AL7).

Quality of intervention design

Overall, the information provided was sufficient for analysis and demonstrated a satisfactory quality of intervention design. The aims and specific objectives were clear: to reduce food waste by raising awareness and encouraging change in relation to specific behaviours.

In the majority of cases, the driver leading to food waste was identified as a lack of awareness of food waste and its impact (AL3, AL4, AL6, AL7). Other drivers were a lack of knowledge on the diversity of fish species (AL1), poor food literacy (AL5) and concerns about food safety (AL2).

One intervention included some form of baseline measurement. A method for monitoring the effects of the intervention was not typically in place and, with one exception (AL3), a theoretical framework was not

used in designing the interventions. Similarly, the implementation of an experimental approach, including a control group, was rare.

Effectiveness

For four interventions (AL3, AL5, AL6, AL7), measurement of their effectiveness included a pre- and post-intervention food waste composition analysis. The remaining interventions employed interviews and surveys. Most interventions reported a reduction in food waste or an increase in awareness. In-person interaction in the form of door-to-door activities, in combination with awareness-raising campaigns on the impact of food waste, was shown to be effective. More specifically, this interaction resulted in a 30 % reduction in avoidable food waste, while communication on its own showed no significant change (AL3). A 31% reduction in food waste was also reported as a result of communication and tools provided to homes, supported by a dedicated website (AL5). A combination of communication activities, cooking workshops, events, training and awareness raising in schools and businesses resulted in a reported 9 % reduction in avoidable food waste generated per household per week after a 2-year period of activity (AL6). However, the lack of actual food waste measurement in many of the interventions echoes the challenges surrounding reliable methods of measuring the results of awareness-raising activities.

Efficiency

To calculate the efficiency of an intervention, its results need to be compared with the resources invested. Gaining sufficient information proved problematic here. Cost breakdowns and data required to calculate cost per person reached was unavailable for all interventions. It was therefore not possible to assess the efficiency of the interventions.

Sustainability over time

For an intervention to be sustainable, it usually requires ongoing funding. This is problematic in most instances. However, where food waste levels were monitored through waste collection data in the 2 years following the original intervention (AL5), these levels suggest a long-term, sustained 30 % reduction in food waste.

Transferability

AL6 reported that aspects of the Trifocal project – a pilot project aiming to prevent food waste by changing planning, shopping, storage and meal preparation behaviours, by promoting healthy and sustainable eating through changing purchasing and preparation practices and by recycling unavoidable food waste – had been transferred to a total of 11 cities across Europe. Although no other interventions were transferred to other locations, most were seen to be suitable for delivery elsewhere, while acknowledging the possible need for adjustment to local contexts and audiences.

Scalability

The cost of scaling up certain aspects, such as the door-to-door activity that proved effective in one intervention (AL3), was highlighted and identified as a challenge. Activities centred around one-to-many communication activities, such as those utilising leaflets, tools and web information, were generally seen to be suitable for scaling up.

Systemic effects

As mentioned earlier in this report, the evaluation of systemic effects was inconsistent for the whole data collection exercise. Despite this, some key insights can be provided for awareness campaigns. Specifically, AL1, a campaign to drive interest in neglected and usually discarded fish species, revealed the power of consumer choice in reducing food waste in other parts of the supply chain. In addition, delivering a bundle of interventions on sustainable food-related behaviour (food waste reduction, consumption of sustainable food, recycling behaviour) was also found to be beneficial (AL6) not only to encourage food waste reduction, but also to elicit other changes in consumers. Interestingly, an intervention attempting to raise awareness in a public housing complex highlighted the difficulty of engaging consumer groups homogeneously (AL2). In many interventions (AL1, AL3, AL4, AL6), the implementation relied on the cooperation of diverse stakeholders (researchers, local councils, NGOs) active in the territory.

Box 8 presents the challenges identified for these interventions.

Box 8. Identified challenges in local initiatives

The difficulties in engaging those deemed hard to reach was highlighted, and it was suggested that it may not be a worthwhile strategy to target this group to drive household food waste reduction. Generally, it was found that men were more difficult to engage, with women being more willing to participate and learn. This was seen to indicate that traditional gender roles regarding shopping and cooking remain and that it may therefore be more effective to target women (AL2). The difficulty in getting sufficient survey responses for an effective evaluation was also highlighted (AL2), especially when facing strict budgets. Overall, analysis of the interventions highlighted the challenge of measuring the effectiveness of interventions when food waste data is not available.

The key takeaway messages are as follows.

- The lack of awareness of food waste and its impact was identified as a key driver of food waste.
- In-person interaction in the form of events, training, workshops or door-to-door activities, in combination with awareness-raising campaigns on the impact of food waste, was shown to be effective.
- Linking various interventions on sustainable food-related behaviour (food waste reduction, sustainable food, recycling) was found to be beneficial.
- It is challenging to measure the impacts of awareness-raising activities for those interventions where food waste is not measured.

4.3.2. Large-scale initiatives

Four awareness-raising interventions were labelled as large-scale initiatives. One was a national food waste week, which utilised media and the distribution of tools such as measuring cups to raise awareness and inspire behaviour change (AS3). Two involved a more place-based approach and highlighted the impact of food waste by focusing on storage and expiry dates through an exhibition at a national natural history museum (AS1) and a series of photography exhibits on the streets in a major city, alongside a national social and traditional media campaign (AS2). Another intervention was carried out in partnership with a major discount food retail chain and encouraged planning behaviour to bring about food waste reduction by providing weekly 'waste-free' shopping lists, meal plans and recipes (AS4).

All interventions where information was available targeted the purchasing and consumption phases. The storage phase was targeted by AS1 and AS3 and the preparation phase was targeted by AS3 and AS4. AS3 addressed a wide range of actors, while AS1 focused on families without children and on students and AS4 focused solely on families with children.

Quality of intervention design

All the interventions included clear aims and objectives and KPIs. These were related to reach and engagement and in all but one intervention (AS2) were also related to inspiring food waste reduction as a result of increased awareness. Lack of awareness was consistently identified as the main driver of food waste. In one intervention, demographics were highlighted as a driver. More specifically, the desire to be a good provider for one's family could cause people to overbuy food, and time pressure could cause them to plan meals poorly. Both were seen to have an impact on food waste behaviour (AS4).

A pre-intervention survey was carried out in three of the four interventions; however, only one targeted the same audience with the pre- and post-intervention measurements (AS1). In the two interventions that applied the pre- and post-intervention surveys to different samples (AS2, AS4), it is not possible to reliably attribute results to the intervention.

Two interventions involved monitoring from the start, thus allowing for assessment throughout (AS1, AS3). Only AS3 used a theoretical framework: the motivation-opportunity-ability model. An experimental approach was not used in any of the interventions.

Effectiveness

In all interventions, effectiveness was assessed not based on measured quantities of food waste reduction but by assessing outreach and awareness of self-reported behaviour change. In relation to self-reported behaviour change, in all but one intervention (AS3), evaluation relied on post-intervention surveys of a representative sample, rather than a specific target audience. The survey samples made it

difficult to assess the reduction achieved by interventions aiming to reduce food waste. However, all interventions demonstrated impressive results in relation to reach and self-reported action. For example, the national food waste week (AS3) reported that 49 % of the population was reached, with 55 % of those surveyed saying that they took action to reduce food waste during the week. The food waste exhibition (AS1) results stated that 59 % of visitors reported increased knowledge and the effect of the exhibition on visitors was also shown through test questions in the survey.

Efficiency

The three communication campaigns (AS2, AS3, AS4) could provide details of costs for each person reached. Due to the high outreach achieved through public relations (PR), social media and digital media, costs were reported to be as low as EUR 0.01 per person reached for the national food waste week activity (AS3), EUR 0.016 per person reached for the food waste photography exhibition and national media campaign (AS2) and EUR 0.21 per person reached for the waste-free planning campaign in partnership with a national retailer (AS4).

Sustainability over time

None of the analysed interventions was implemented over a longer time frame.

Transferability

Although transferability had not been considered for any of the interventions, all were seen to be suitable for delivery elsewhere.

Scalability

Scalability had been considered in the waste-free planning campaign with the national retailer, but this had not been followed up at the time of reporting (AS4). In all interventions, activities were seen to be scalable; however, the cost of scaling up provision of tools, such as measuring cups, was identified as a barrier.

Systemic effects

Improved stakeholder community cohesion was seen as having a major impact on success (AS3), as partnerships and joint messaging by many players were crucial to creating a national movement and thus enabling improved awareness among citizens. Unintended consequences of awareness-raising activities on food waste on another food policy area were identified as part of the waste-free food planning intervention (AS4). Specifically, sticking to the maximum cost for the weekly shopping lists set by the partner retailer (GBP 40 for a family of four) meant trade-offs in relation to food sustainability and nutrition in the recipes used.

Box 9 presents the challenges identified for these interventions.

Box 9. Identified challenges in large-scale initiatives

All interventions shared the challenge of a lack of evaluation against their overall aim, which was to reduce household food waste. It was generally not possible to attribute the reported increase in awareness to the intervention activity, as targeted evaluations were not carried out, except for one intervention. Therefore, a key challenge is encouraging and evaluating behaviour change induced by large-scale awareness-raising interventions, rather than simply relying on measures of outreach or self-reported attitudes or behaviours.

The key takeaway messages are as follows.

- Lack of awareness was consistently identified as the key driver of food waste.
- Raising awareness does not automatically change a consumer's behaviour.
- All large-scale interventions demonstrated impressive results in relation to outreach and self-reported action and could therefore be seen as effective in raising awareness.
- Community cohesion, partnerships and joint messaging were seen to contribute to the greater impact of awareness-raising activities.
- Evaluation practices could be improved by strengthening the quality of the intervention design.

— Awareness-raising activities related to food waste risk having unintended consequences on other food policy areas.

4.4. Other interventions

This section includes interventions that did not fit into any of the other categories. These include interventions uncovering new drivers and large-scale national programmes. Interventions uncovering new drivers highlight drivers and causes of food waste and food waste reduction / behaviour change. Large-scale national programmes include two interventions that are umbrella initiatives for many subinterventions. Both are at a national scale and co-funded by the EU through the LIFE (financial instrument for the environment) programme. Moreover, other interventions outside the scope of the ECFWF project were also evaluated under the categories of measurement and redistribution. These can be found in Annex 1.

4.4.1. Interventions uncovering new drivers

Three interventions were labelled as interventions uncovering new drivers. Each addressed a new driver or tested novel hypotheses aimed at understanding how to best reduce food waste. Two of the three included a focus on children (O1, O2). More specifically, O2 addressed the overprovision of food leading to waste during the religious celebrations of Ramadan and Eid. In this intervention, children acted as messengers who, together with their parents, do good by fighting food waste during the holidays. O1 focused on the role of social influence (by peers and families and the participants' own perceptions of popularity) and education for food waste in a school setting (in the short and long terms). O3 investigated what kind of intervention technique could best help households reduce their food waste by improving meal planning.

O3 addressed all stages of food management, O2 addressed all except the purchasing stage and O1 addressed only the consumption stage. O2 and O3 targeted families with children, while O1 targeted children specifically.

Quality of intervention design

In all cases, the quality of the intervention design was high. Food waste drivers were identified as poor meal planning (O3) and overprovision of food, incorrect leftover storage and lack of motivation and skill to use up leftovers (O2).

Two interventions (O1, O3) were research projects delivered by academics and students. Therefore, they included baseline measurements on behaviours; O1 also used data from pre-intervention food waste diaries. O1 was concerned with testing how receiving information and guidance on meal planning would reduce food waste in households including at least one child and featured an experimental design. This enabled measurement of the effectiveness of different engagement techniques. For the Ramadan and Eid intervention (O2), a control group was used. The capability–opportunity–motivation–behaviour model^(?) was utilised as a theoretical framework for development of this intervention. Ajzen's theory of planned behaviour, and Stern's value–belief–norm theory inspired the intervention on food planning (O3).

Effectiveness

In the case of the experimental intervention to improve meal planning (O1), the most effective technique was found to be the combination of a one-week food waste diary followed by an article on the topic to read, followed by another one-week food waste diary. The materials that participants needed were delivered personally by the students involved in the project. The students also spent time with the participants and explained the diaries and the article. This group reduced their food waste per person by 737.7 g, from a pre-intervention baseline of 1553.9 g to 816.2 g at the post-intervention measurement 2 weeks later. In the second group, where the two diaries were used without the informational article, food waste reduction was found to be around half that of the first group, at 370.6 g.

^(?) The model suggests that capability, opportunity and motivation are essential for any behaviour to change. The three components interact with each other.

The intervention addressing food waste during the religious celebrations of Ramadan and Eid (O2) also showed positive results. Although precise values for the frequency and quantity of food waste could not be calculated due to the limitations and constraints of the study, most participants (67 %) reported wasting less food as a result of using the good deeds calendar; by comparison, only 32 % of the control group reported this. Encouraging use of the calendar every day was found to be particularly effective, with 60 % saying that they dealt with leftovers differently, compared with only 32 % of those who did not use the calendar every day.

O1 found that receiving education on the environmental impacts of food waste reduced self-reported food waste only in the short term. Furthermore, children's food waste was found to be unrelated to the food waste of their friends and to their assessments of whether they were considered popular or not. Neither parents' views on food waste nor their strictness in relation to their children wasting food was found to correlate with children's food waste. Generation of food waste was also found to be unrelated to a child's perceived contribution to the public good. The study, which included 420 children, did, however, show a link between peers and behaviour change in one respect: when sitting together in the school canteen, social interactions were found to influence behaviours. Food waste behaviours at school and home were found to be unrelated.

Efficiency

It was not possible to calculate efficiency, as data on costs was missing. However, based on the resources produced for the Ramadan and Eid intervention (O2), it appears this was an activity delivered at relatively low cost, as the only expenses incurred related to the design and printing of some communication materials.

Sustainability over time

O1 was found to be not sustainable over time. A survey showed that the effect of the food waste education campaign vanished 4 months after the intervention. Post-intervention research to establish sustainability over time was not included in the other interventions.

Transferability

The successful intervention utilising food waste diaries and information on food waste (O3) was seen to be easily transferable. The good deeds calendar (O2) was seen to have uncovered some transferable principles, such as placing a focus on preventing food waste or eating leftovers to offset the overprovision of food at special occasions and dispelling the idea that, to be a good host, it is necessary to provide abundance. Making the good deeds social by involving the community or family in the activity and making the deed part of daily life to overcome the barrier of time constraints were also recommended.

Scalability

For the good deeds calendar (O2), it was suggested that the activity could be scaled up by distributing the calendars through mosques and local authorities or by selling the calendar through local retailers. The other two interventions were scientific studies aimed at discovering household practices or how children respond to education; therefore, scalability was less important.

Systemic effects

Social influence from family members and school friends was identified as a possible driver to further investigate when conducting school programmes. The effect of direct observation of food consumption behaviours between peers seems to be a promising approach to acknowledge in the design of school-based interventions, once again showing the crucial role of the school canteen as a potential learning environment. In addition, intervention O2 highlights how festivities (Christmas, Easter, Eid) can be leveraged to share good practices regarding food waste prevention, as they usually revolve around food as part of broader cultural and religious contexts. O2 specifically also acts as a reminder of the diverse nature of Europe's population.

Box 10 presents the challenges identified for these interventions.

Box 10. Identified challenges in interventions uncovering new drivers

A challenge highlighted by the meal planning intervention (O1) was the difficulty in understanding how people's sociodemographic and psychographic characteristics affected the effectiveness of an

intervention. Furthermore, relying on the school setting alone to influence future food waste behaviour was seen as challenging (O1).

The key takeaway messages are as follows.

- A combination of activities, rather than individual activities, was found to be more effective at reducing food waste.
- Encouraging food waste reduction through community and family activities during religious holidays was shown to be effective.
- The effects of food waste education in schools were found to be time limited.
- It was noted that social influence has an impact on behaviours in the school canteen; thus, this is a setting where sustainable behaviours could be fostered.

4.4.2. Large-scale national programmes

Two interventions were labelled as large-scale national programmes. G1, project wasteless in Hungary, and G2, the foodprint project in Cyprus, share common approaches to public awareness raising based on an intensive media presence. Both projects cover a variety of stakeholders, from consumers to food business operators. G1 has published educational materials on food waste prevention for students and teachers and four guidelines for good practices for the food industry, the catering industry, the retail industry and NGOs.

Quality of intervention design

G1 demonstrated a good quality of intervention design. School materials were co-created with teachers and pretested before the national roll-out. The surveys and measurement reflected a sound scientific approach and were published in good-quality academic papers. Transparency was ensured through various media and social media channels, reports and events. G2 is a very transparent, multiactor programme, frequent live events and regularly implemented measures.

Both interventions defined indicators (due to the financial support from the LIFE programme, which made this compulsory), and monitoring was applied consistently.

Effectiveness

G1 started in 2016 and is still maintained by the Hungarian National Food Chain Safety Office, while G2 started in 2020. These durations are also reflected in their achievements so far. G1 has become a data provider for the European Commission's obligatory measurement of household food waste. In addition, G1 reached 300 000 students in 1 500 schools. G2 reported a reach of 500 000 consumers.

In terms of food waste quantity, G1 reported a 24 % reduction in household waste since 2016, based on regular waste measurement studies. The questionnaire-based consumer surveys demonstrated improvements in attitudes and practice. G2 also utilised consumer studies and reported improving habits related to the purchase, preservation and consumption of food.

Efficiency

Both programmes reported financial figures. G1 was launched with a budget of over EUR 960 000, including almost EUR 580 000 of funding from the EU LIFE programme, which is being maintained by the Hungarian National Food Chain Safety Office. The budget for G2 is almost EUR 1 020 000 and it was also supported by the LIFE programme until April 2023.

Defining the efficiency indicators was difficult because of the complexity of the achievements. However, if only consumer numbers are considered, the cost of reaching one consumer is about EUR 0.1 in G1 and about EUR 2 in G2.

For G1, annual food waste quantities are available, based on which the cost per tonne of food waste avoided can be estimated as EUR 2.5. (However, it should be noted that food waste reduction in a country is possibly the result of several factors, not just one intervention.)

Sustainability over time

The sustainability of G1 has been ensured by the Hungarian National Food Chain Safety Office and a group of stakeholders in government offices and food businesses and charities. Project wasteless collaborates

with various international organisations and projects. The impact in Hungarian schools is already tangible, thus granting sustainability for project materials used in practice all over the country.

There is no indication of the sustainability of G2, albeit the project team seems to be seeking synergies with other LIFE programme projects. The organisers mentioned that maintaining the programme required a lot of support from individuals, thus indicating that the chances of sustainability might be low.

Transferability

G1 is well documented and a major part of the project-related materials (e.g. the education materials, the good practices and the research reports) are available in English as well as Hungarian. Transferring project results is known to be highly supported by the organisers. Based on G1, several local-level initiatives have begun already, and international collaborations are in progress. The project structure and the know-how are ready to be transferred to other countries.

G2 invests significant energy into knowledge sharing, especially with other LIFE programme projects and local initiatives. Both interventions G1 and G2 were well documented, and several of the materials are also available in English.

Scalability

Both interventions could be scaled down (i.e. project results could be easily transferred to the regional or local level). Upscaling is not really possible for national programmes, but their results could be disseminated at the EU level through networks and websites (e.g. the EU Food Loss and Waste Prevention Hub).

Systemic effects

G1 achieved systemic effects at the national level, being the most prominent voice in the country in relation to food waste prevention. Besides awareness raising and motivation for consumers, it encouraged food business operators and attracted the attention of policymakers. Given the large reach of G2, this intervention is a potential game changer and, considering that its participants and stakeholders included many business organisations, the systemic effect could be ensured.

Box 11 presents the challenges identified for these interventions.

Box 11. Identified challenges in large-scale national programmes

Both interventions used consumer surveys to monitor some of the indicators. The research design of G2 lacks scientific scrutiny. G1 collected representative data and followed scientifically designed methodologies. However, the self-reported data has to be interpreted accordingly, especially for questions that relate to sensitive issues such as food waste. G1 collected data on household food waste quantities, also providing a breakdown of food categories and according to edibility, while G2 dealt only with questionnaire-based studies. Importantly, food waste is often a hidden problem in households, as its extent is sometimes not perceived realistically. Consumers tend to under-report the amounts of food waste generated when asked to self-report.

It is important to note that implementation of a scientifically proven theoretical model (such as the theory of planned behaviour) for behavioural change could and should be considered in similar national programmes.

The key takeaway messages are as follows.

- National programmes are umbrella initiatives to many subprogrammes. Their main responsibility is raising awareness of, collecting and disseminating good practices. They can deliver a cluster effect by triggering many local- and regional-level interventions.
- National programmes should seek partnerships with stakeholders and ensure the active participation of policymakers in discussions.
- Collecting food waste data, following professional literature and food-waste-related news and conducting primary research offers an opportunity for interventions to become primary, credible information sources for stakeholders, influencers and journalists. This can amplify the impact of communication activities.

— Schools and representatives of the media are especially important partners, as they efficiently contribute to high levels of consumer outreach and the sustainability of effects over time.

4.5. Net economic and nutritional benefits and environmental savings of interventions

Twelve interventions provided enough data to calculate the net economic benefits and environmental savings (NOOH1, NOOH3, NOOH9, EC3, EC7, EC8, ES5, AL6, AL7, G1, NT10, NT15), while the information on food category was detailed enough to carry out an environmental analysis depending on the food type (e.g. meat versus fruit) for only two of them (NT10, NT15). Table 2 indicates the key information on economic, environmental and nutritional benefits from these 12 interventions. It includes the cost savings and environmental impacts from avoided food production as well as waste reduction. The calculations were done using the food waste prevention calculator described in the evaluation framework of the ECFWF (García-Herrero et al., 2023).

The interventions considered had different reference times (e.g. one intervention lasted a few months, but the reported information covered only a few weeks, while others were running for years and they reported on the whole period), scales (varying from pilot scale to the national or international level) and time frames of implementation (i.e. in which year the intervention information was reported). Therefore, it is not possible to compare the results systematically to indicate that one intervention is more efficient than the other. Moreover, of these 12 interventions, some were experiments (e.g. NOOH3, NT10) and first-time interventions (EC7), which might have been allocated higher costs due to the initial design and implementation. At the same time, if they were to be transferred in the future, the cost of their implementation could be lower, as only the conceptualisation and first implementation of the intervention would face these higher costs.

The interventions with the highest costs per tonne of food waste avoided were two EU-funded projects – a national awareness-raising programme (G1) and a city-level programme (AL6) – and a local awareness campaign carried out at the neighbourhood level (AL7). It should be added that these three interventions reported cost data for the whole funding of the projects, which also contains many subactivities whose outcomes might not be immediately visible in terms of food waste reduction (i.e. education activities for younger generations). These interventions also have the largest economic, nutritional and environmental savings. Remarkably, G1 started investing in setting up a national plan in 2016 and, in the last few years, the cost of the intervention has reduced by one quarter per year (as it has only a maintenance cost).

With NOOH1 being the pilot test of an intervention, the measurement period for food waste reduction was limited to a few weeks, but it showed promising results and the total cost of the design and testing will most likely be abated when the intervention is transferred or upscaled. Comparison between interventions is remarkably difficult due to a lack of data harmonisation in reporting and in the target audience sample sizes. Cost information is rarely broken down in detail, thus making it difficult to understand the costs of the actual implementation and the running of an intervention. The different nature of the interventions (e.g. nudges versus awareness campaigns) also hinders a straightforward comparison of their efficiency. Some interventions included assumptions in the reporting of their effectiveness (EC7, EC8), while for others assumptions were made by the JRC (indicated in the column 'Assumption for calculation at scale'). This was done in order to use the calculator and involved either upscaling the effects reported over a short period to cover the whole run of the intervention or upscaling the effects to cover the population size when the measurement referred to a representative sample. It is noted that this process leads to further uncertainties; however, this exercise was carried out for illustrative purposes and to remind the food waste prevention community to report data more exhaustively.

Unfortunately, none of the interventions provided enough details to calculate the emissions due to setting up the interventions, such as the number of leaflets printed and kilometres carried out to run the intervention in case transport was needed in any stage of the implementation. At the same time, it is also acknowledged that the calculator currently does not allow for the evaluation of the environmental impact of all types of promotional materials, such as electricity or processes for online campaigns or, in the case of other interventions, the delivery of fridge magnets or measuring cups.

Further details on each intervention can be found in Annex 1.

Table 2. Information on economic, nutritional and environmental benefits from selected interventions

Code	Country	Stage of the supply chain	Cost of setting up the intervention (EUR)	Total food waste avoided (tonnes)	Assumption for calculation at scale	Environmental impact of avoided food waste production and waste treatment (climate change impact in Kg CO ₂ eq)	Economic savings of avoided food waste production and waste treatment (EUR)	Nutrition savings
NOOH1	Portugal	Food service	5 664	< 0.1	NA	119	73	29 222 kcal, 44 meals
NOOH3	Spain	Food service	48 000	< 0.1	Daily reduction multiplied for 2 weeks of measurement in one school	350	215	9 619 kcal, 14 meals
NOOH9	Portugal	Food service	123 750	76	EUR 760/restaurant/year (multiplied by 181 participating restaurants)	365 874	229 033	91 320 128 kcal, 136 980 meals
EC3	Germany	Households	7 850	3	Average 158 g reduction, assumed constant for all participants over the period	16 010	9 622	3 896 325 kcal, 5 844 meals
EC7	United States	Households	94 540 ^(a)	45	Reduction assumed to be constant over the period	222 377	8 504 406	54 792 077 kcal, 82 188 meals
EC8	United Kingdom (Scotland)	Households	1 141 000 ^(b)	156	Estimated in the evaluation from Zero Waste Scotland	771 579	473 061	189 945 866 kcal, 284 919 meals
ES5	International	Food service	18 000	3	NA	14 815	9 083	3 652 805 kcal, 5 479 meals
AL6	United Kingdom	Households	3 200 000	66 560	Assumptions of number of households that live in the neighbourhood, amount reduced and approximate	328 686 615	201 520 439	81 043 569 483 kcal, 121 565 354

Code	Country	Stage of the supply chain	Cost of setting up the intervention (EUR)	Total food waste avoided (tonnes)	Assumption for calculation at scale	Environmental impact of avoided food waste production and waste treatment (climate change impact in Kg CO ₂ eq)	Economic savings of avoided food waste production and waste treatment (EUR)	Nutrition savings
					number of weeks of duration of the campaign			
AL7	United Kingdom	Households	192 058 ^(b)	11 635	601 000 households in west London multiplied by 11 months of campaign multiplied by weekly food waste reduction	57 457 739	35 227 807	14 167 234 174 kcal, 21 250 851 meals
G1	Hungary	Households	40 000	9 436	Assuming that all households in Hungary reduced their total food waste by 4 %	46 596 858	28 568 913	11 489 289 688 kcal, 17 233 935 meals
NT10	United Kingdom	Households	52 027 ^(b)	0.1	Average reduction of 108 g/week for 6 weeks, considering 154 participants	187	182	121 760 kcal, 183 meals
NT15	Australia	Households	125 052 ^(c)	7	In the impact reports from OzHarvest, they mention a survey for 1 600 households; the assumption here is that it was the same sample	31 085	19 223	8 571 916 kcal, 12 858 meals ^(d)

^(a) Investment for 2-year project.

^(b) GBP 1 = EUR 0.88.

^(c) AUD 1 = EUR 0.61.

^(d) Used generic and multinational reference values for calculations.

NA= NOT APPLICABLE

5. Key lessons learned and recommendations

This chapter presents the key lessons learned from the interventions’ analysis (Section 4). The aim is to inspire food system actors around the world and provide them with tangible and actionable examples to support citizens in reducing food waste. Reflections are provided on the effectiveness of interventions, on what worked and what did not and on how to improve the evaluation of interventions. Best practices are exemplified and ideas are presented on how to create synergies between consumer food waste prevention interventions and other (ongoing) processes, such as recycling and healthy nutrition.

5.1. Interventions

Table 3 provides the overview of key lessons learned and recommendations from the evaluated interventions.

Table 3. Overview of key lessons learned and recommendations from the evaluated interventions

<p>Awareness raising is not enough</p>	<p>Prior systematic literature reviews of interventions to reduce food waste indicate that the simple provision of information is the most widespread approach used for raising consumer awareness of the impacts of food waste (Simões et al., 2022); however, it is now acknowledged that, as an intervention, it is not actually successful in delivering concrete impacts in terms of behaviour change. Consequently, new approaches, such as the nudges and training contained in this report, are being designed to deliver more impactful interventions. The evaluations conducted by the ECFWF gathered only a few interventions that focused on awareness raising, thus indicating that alternative approaches are being developed more and more often.</p>
<p>Combining intervention elements is suggested</p>	<p>A key lesson learned is that combining nudges, education and awareness raising seems an appropriate approach to reducing food waste. Particularly effective examples evaluated in this report included a combination of awareness-raising campaigns on the impacts of food waste with in-person interaction in a door-to-door approach (AL3); communication and tools provided to homes, supported by a dedicated website (AL5, NT1, EC6); and the iterative use of a 1-week food waste diary and the provision of interesting articles, with material delivered in-person (O3). Notably, these combinations are best administered in a concerted manner, as exemplified by the two large-scale national programmes (G1, G2). These programmes represent umbrella initiatives: they contain many subinterventions – such as awareness-raising campaigns combined with, for example, school programmes – measuring household food waste or food redistribution. The same lessons can be drawn from the success of city-wide interventions (in Seika, NT12; in Bruges, EC4; in west London, AL7), which combine many different elements, thus covering awareness raising, education and nudging. This shows that, at both the national and the local levels, a combination of approaches implemented through coordinated efforts is effective.</p>
<p>Education programmes and coaching can be effective, but require a long-term outlook</p>	<p>School programmes tend to have a moderate to large effect, according to a recent meta-analysis of food-waste-related interventions (Tian et al., 2022). The effectiveness of the school programmes assessed by the ECFWF cannot be fully judged, as the data did not allow such an evaluation and only two out of eight interventions show a proven reduction in food waste (ES1, 35 % food waste reduction; ES5, 15 % food waste reduction on average per school). The challenge with educational programmes is delivering them cost-effectively at scale, as they are resource intensive.</p> <p>In this analysis, household coaching – that is, supporting people by increasing their knowledge and skills in the context of their homes through personalised coaching and community programmes – was effective in reducing food waste</p>

	(by 16 % to 67 %). However, the indicators proposed to assess the performance of the interventions varied and therefore an accurate comparison is not possible.
Management of leftovers is a starting point from which to develop new food related skills	Many household interventions aim to prevent leftovers (e.g. through correct planning, correct portioning). Others target the recovery of leftovers and show that this can be a viable strategy as well (NT3, NT5). In line with this, interventions that include recipes that reuse leftovers are welcomed by consumers and are generally successful (NT1, NT3, NT4). As households may be more likely to put such recipes into practice when these are demonstrated and experienced, cooking workshops can be helpful (AL3, EC3).
Financial incentives work in some contexts	Providing financial incentives in out-of-the-home settings, related to how much food is served or the amount of plate waste, has been shown to be an effective intervention in prior research (Tian et al., 2022). This is also reflected in the ECFWF review: in an out-of-the-home setting such as a restaurant, price incentives such as a variable price buffet resulted in a lower level of food waste. However, this type of intervention would be difficult to translate for use in the home setting.

5.2. Why certain interventions worked better than others

The measurement of food waste is a key element of a strategic food waste reduction intervention, and it supports the assessment of the effectiveness of interventions and/or progress made in reducing food waste. It can serve as an important starting point and can inform broader action plans in view of targets set by governments, as exemplified by the national consumer intervention conducted in Hungary (G1). By contrast, isolated measures would not set target values for waste reduction, nor would they be able to build systematically on the results to provide a persistent effect. Measurement is also a noteworthy way to deliver tangible information to consumers about the quantity, composition and cost of the food – data that can be easily applied to their everyday lives. Measurement results are also widely used by journalists and influencers, thus contributing significantly to awareness-raising interventions. Table 4 provides a summary of the main elements identified in successful interventions.

Table 4. Identified success factors for interventions

Adaptation to local context	<p>One intervention leveraged locally sourced information on the impacts of food waste (AL5). Others took advantage of already existing networks of communities to support their implementation (EC8, ES5, AL7).</p> <p>Household-coaching interventions seemed to have worked best when they were adapted to the local contexts and cultures. The success of these interventions (as shown by EC6 and EC7) was also due to the motivation for change covering three perspectives (social, economic and environmental impacts) and, if possible, also being linked to local food contexts (EC8). By contrast, difficulties might arise when target audiences' interests do not fully match organisational priorities (EC8). Although prior research has indicated that coaching can be done effectively online (EC2), another intervention found that only those households that were subject to door-to-door visits made significant reductions in the food waste they produced (AL3).</p> <p>In general, coaching interventions seemed to be very attractive and reached a wider audience faster when linked to existing networks and community initiatives – such as individuals acting as ambassadors or an advocacy group – to generate a larger base of households that either lead by example or are moved by social norms or challenges.</p>
Connection with stakeholders	Key success factors for large-scale programmes – in the form of public awareness and communication campaigns – seem to be, on the one hand, being able to connect and engage with a wide range of stakeholders, including schools and representatives of the media (G1), and, on the other hand, having

	<p>access to professional support on demand for improved execution of the intervention (e.g. through the production of engaging online videos). Connection with stakeholders is a crucial element for all types of interventions. Some of the interventions benefited from collaborations with individual manufacturers (NT3) or retailers (NH4), while others were more proactive in approaching existing community groups and delivering personalised materials to them (EC4). These types of collaborations could set an example for future intervention implementation.</p>
Disruptions in daily routine	<p>More interventions are being developed that include nudging. Interventions that have a continuous presence in the consumers' kitchen appear remarkably effective in reducing food waste. Most likely this is because they intervene in consumers' everyday routines. For instance, the Use It Up Tape intervention (NT15) was designed to make food that needs to be eaten soon more prominent in the fridge. However, when consumers were interviewed, it appeared that it also acted as a communication device between household members, thus affecting multiple routines. Visual cues in household kitchens, such as fridge and freezer stickers (N1), may act as prompts reminding consumers of the goal of diminishing food waste. When it comes to stickers, a directive tone telling people how to treat products appears to be more effective than an advisory tone. A key success factor for visual prompts and cues on packaging or on posters is that these need to stand out and be noticeable for consumers. Thus, interventions are ineffective when they are not noticed by consumers (e.g. N00H5), while the use of simple demonstrations (N00H3) draws more attention and seems effective. Having said that, most nudging interventions could benefit from integrating a behavioural science approach into their design phase, rather than simply assuming that providing additional information will result in changing consumer behaviour.</p>
Personal involvement	<p>When it comes to nudges, another tendency is that these work better when consumers are personally involved, for example through gamification (NT13), personal food waste logs (NT10) or tools to promote the use of leftovers in recipes (NT1, NT3, NT4). Interventions also worked better when they targeted consumers who willingly signed up for the intervention.</p>

5.3. Scalability and transferability

Interventions have a higher chance of success when they are first applied to a small group of interested consumers for initial testing and evaluation. If an intervention works and achieves its objectives, then it can be scaled up or transferred. Table 5 provides the key elements that emerged when analysing the scalability and transferability criterion.

Table 5. Key elements identified when analysing the scalability and transferability criterion

Scalability	Opportunities	<p>Large-scale interventions are mostly conducted by governments, municipalities, large retailers (NH4) or manufacturers (NT3), whereas small-scale ones are implemented by researchers, sometimes in collaboration with other stakeholders. Interventions that require the intensive involvement of households may be successfully applied only when participants show an already high baseline level of awareness and interest. This makes these interventions more difficult to scale up (NT12), because consumers who are interested and willing to devote their time and attention to food waste interventions might not be prevalent in the general population.</p> <p>Non-personalised interventions, for example those that communicate messages or apply educational materials, are</p>
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		<p>easier to scale up (NT9, NT10, NT12). Considering that communications by restaurants (ET2) can reach many local consumers, rolling out an intervention across a restaurant chain could be promising.</p>
	<p>Challenges</p>	<p>Nudges for labelling have the potential for scalability in terms of both increased product ranges and geographical scaling. However, regulatory barriers need to be kept in mind to ensure that specific labels / visual cues are allowed (NL5, NL6), as the food information provided to consumers is regulated at the EU level. Some visual cues aim to improve the understanding of best before and use-by date labels. Language is another barrier for the scalability of nudges, as they may require linguistic tailoring. This may prevent a one-size-fits-all approach to the execution of a labelling nudge. Yet another barrier to scaling up nudge interventions relates to the tools (e.g. measuring cups, apps) that were designed with support from external parties and/or are under copyright (NT1). For some of these tools, budget considerations may prevent their widespread application (AL4).</p> <p>Interventions with personalisation and a high level of personal contact (e.g. household coaching) appear effective and several tools have shown their effectiveness in reducing household food waste. However, the cost of these interventions can be a barrier to scaling them up (EC7, AL3). Therefore, ensuring that the intervention is adequately financed is an important issue for the mobilisation of communities by local organisations or adaptation of educational materials to local contexts or cultures (e.g. EC6, EC8).</p>
<p>Transferability</p>	<p>Opportunities</p>	<p>Transferability can only be accomplished when the implementation procedure is well documented, materials are available in the appropriate language(s) and organisers / knowledge owners proactively support the intervention. For example, in G1, several local-level initiatives are ready to be transferred and international collaborations are in progress.</p> <p>In the case of household coaching, municipalities might help transferability by preparing roadmaps (EC3) with other cities' municipalities. EC8 suggested an improved intervention design, including an action plan, KPIs and evaluation protocols. By design, AL7 included a replication exercise that implemented the same interventions in various European cities.</p> <p>To successfully transfer school programmes, a collaboration network of appropriate committed people, including ambassadors at the city level and a project coordinator at the school level, is needed. The lack of a proper network may limit transferability, such as in the case of ES5. However, ES5 shows the potential for transferring education programmes to different countries, while using the same educational material as a basis. The organisational support from supranational organisations (the Food and Agriculture Organization, in ES5) is a success factor for transferability. ES5 also mentions the requirement of having ambassadors.</p> <p>In all other interventions, the concepts should be easily transferable. Two measurement interventions that dealt with</p>

		<p>institutional catering (M1, M2) made the transferability of the experience to other municipalities, even in other European countries, possible. M1 expects the implementation of an automatised food waste data collection procedure (e.g. during lunch buffets) in different countries' institutional caring institutions to be straightforward.</p> <p>In interventions that communicate messages to reduce food waste (NT9, NT10, NT12), transferability to different consumer groups and contexts is relatively easy. The same holds for nudges that use labelling information, where this information could be placed on product packaging by manufacturers.</p>
	Challenges	<p>The transferability of school programmes is achievable between schools, although this might depend on contexts at the local, regional and national levels. There might be strong institutional barriers to including food waste education in school curricula, which might depend on how education is governed in each country or region.</p> <p>Mobile apps (e.g. R1, R2, NT2, NT10) are transferable, but need to be adapted to different cultures, languages and regulatory settings, especially for food-sharing initiatives. Difficulties in transferability may also arise due to the effort required to persuade people to download the apps and actively use them.</p>

5.4. Quality of the intervention evaluation

A review of interventions regarding the reduction of food waste published less than 5 years ago (Reynolds et al., 2019) found 17 interventions, of which only five took place in a household setting and many were reported with little or no robust evidence regarding their effectiveness. Less than 5 years later, the situation is changing. Not only are there many more interventions to report on, but the evaluation of effectiveness has become more common. Still, we find large differences in the quality of this evaluation, ranging from no formal evaluation to a structured field study with a control group and baseline measurement. Table 6 indicates some common characteristics that surfaced when assessing the quality of the intervention evaluation.

Table 6. Key elements when analysing the quality of the evaluations

Definition of targets and measurement of outcomes	<p>The lack of systematic evaluations of interventions can be attributed to the difficulty in setting up these evaluations in practice. For instance, the evaluation of large-scale campaigns, such as retailer campaigns, nationwide campaigns and special themed exhibitions in museums (NH4, AS1, AS2, AS3, AS4) can be challenging. It may be difficult to find and include a proper control group when interventions have a large reach.</p> <p>However, in more controlled settings, such as with school programmes, interventions also frequently lack both a clear definition of targets and the measurement of outcome variables. Moreover, when intervention evaluations were provided (e.g. the household interventions), these were difficult to compare in terms of effectiveness because different indicators were used. A lack of a sound theoretical basis for the intervention tests was identified. This basis should be included when setting the targets and running the measurements.</p>
Evidence of good practices in design monitoring	<p>Most of the collected 78 interventions were generally well-designed, reported a baseline and appropriate data gathering (e.g. M2, O3) and included control groups (e.g. NT1, NT5, NT9, NT10, NT14). Both large-scale national programmes reviewed (G1, G2) defined indicators and provided consistent monitoring, which is evidence of good practice. It is worth mentioning that both projects were started under EU funding programmes, which require a</p>

	<p>high level of detail in reporting and monitoring – including a clear set-up of KPIs. Monitoring was also undertaken in a few other interventions (e.g. NT10) or it was planned for (NT2), which could inspire future intervention testing, as continuous monitoring is needed to assess the impacts of interventions over time.</p> <p>Many evaluations were undertaken using self-reported data (e.g. NT1, NT3, NT11), but there were exceptions. Several interventions classified as local initiatives (AL3, AL4, AL5, AL6, AL7) included a pre- and post-intervention measurement using waste-sorting analysis. This technique results in reliable food waste quantities and can be more easily operated at the local level. However, measurement for control and experimental groups using waste sorting rarely took place.</p>
Efficiency of interventions	<p>Efficiency is estimated as a ratio between the outcome of the intervention and the costs. This implies that information about costs needs to be taken into consideration, but this information is generally lacking. There are a few exceptions where estimates of efficiency were possible (e.g. R2, NT15, NH1, EC8), but it mostly appears as though this information is unavailable or stakeholders are keeping the more detailed breakdowns confidential. At times, not all costs have been included (e.g. labour costs for teachers' efforts not included in school programmes). Information is generally insufficient to evaluate economic benefits or environmental savings. Still, it appears that large-scale interventions can be undertaken with relatively low costs, but for these interventions it is often difficult to ascertain the effectiveness of the intervention on each household, as also explained in Section 4.5.</p>
Theoretical foundation	<p>A few of the interventions, such as NT14, were based on theoretical frameworks. However, many were not. While the academic literature initially started from an extended theory of planned behaviour framework (Graham-Rowe et al., 2015; Soorani and Ahmadvand, 2019; Stefan et al., 2013; van der Werf et al., 2021), more recently the focus seems to have shifted towards taking the motivation–opportunity–ability framework (Soma et al., 2021; van Geffen et al., 2020, 2017) or the capability–opportunity–motivation–behaviour model and related behavioural change wheel (Manika et al., 2022) as starting points. These may provide insights on how to fine-tune or further develop interventions and should be taken into account when new interventions are set up.</p>

5.5. Potential improvement of evaluation

Several good practices that can improve evaluations of interventions could be suggested. In general, designs with pre- and post-intervention measurements are recommended, and use of a control group is advisable. Several interventions follow these general guidelines for good intervention measurement. Table 7 illustrates some areas of potential improvement when evaluating interventions.

Table 7. Areas of improvement when evaluating interventions.

Less reliance on self-reports of food waste	<p>Self-reported changes in behaviour or behavioural intentions must be interpreted with caution. While assessments of the effectiveness of interventions that rely on self-reports are easier to conduct and less costly, they rely on data that is less accurate than objective measurements of food waste reduction. These measures can severely compromise the reliability of the results. According to Spang et al. (2019), self-reporting methods understate waste production by approximately 40 % compared with direct measurement. The use of self-reporting methods also raises the challenge also raises the challenge of social desirability bias: the reported behaviour changes may simply reflect how people would like to change their behaviour, potentially in the light of what they think the researchers or their social</p>
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	environment expects of them, rather than real behaviour change (Blondin and Attwood, 2022). The extent to which these issues are present needs further examination.
Adoption of uniform indicators to communicate impact	Even interventions that use similar methods, for instance household coaching, can use different indicators for assessment. This makes it difficult to compare their performance. The definition of a uniform and comparable measurement unit (e.g. weight of food waste) to assess effectiveness is needed to compare interventions. So too are descriptions of the related monitoring methodologies. Experience suggests that even experts can be prone to different interpretations, so clear communication and transparency are key.
Monitoring of long-term effects	Another important omission is the lack of data assessing the effectiveness of interventions on a longer time scale. Only a few interventions have incorporated longer-term measurement or monitoring (AL5, G1, NT3, O1), despite this being essential in order to conclude that behaviour change was not only temporarily achieved. Longer-term evaluations must be taken into consideration more often, as must action plans for maintaining project activities after initial funding has stopped.
Participant compensation	Participants who provide (often detailed) information about their levels of food waste are often compensated for their time and effort. However, the amount of compensation varies significantly between studies. While academic studies often use little or even no compensation, studies supported by industry may be capable of providing participants with compensation that is in line with commercial market research approaches. This compensation appears generous and ranges from free meal boxes (NT3) to grocery cards (NT13). The extent to which the level of compensation may affect reporting accuracy and whether it could lead to behavioural reactivity, where (reported) behavioural change may be (partly) triggered not by the intervention but by the incentive, remains an open question.

5.6. Gaps in knowledge

A few gaps in knowledge and research needs arose from the data collection. Table 8 indicates gaps in knowledge identified when conducting the evaluation task.

Table 8. Gaps in knowledge

Segmentation and targeting	<p>Segmentation and targeting of interventions appeared mostly absent in the interventions assessed, or at least were not well developed. Segmentation implies categorising the overall population into groups of people who are similar regarding certain characteristics or traits and differ from other groups. Targeting involves the tailoring of an intervention to specifically address one of these segments. It is important to note that, in practice, even when a segment is well identified, it might be difficult to reach it with an intervention.</p> <p>The evaluation showed that, although sometimes certain groups are singled out (e.g. the Netherlands Nutrition Centre aims to address families with young children), interventions can be applied to and have been tested more broadly on the general population (NT1; van Dooren et al., 2020). An exception is the Bonus meal mission (NT3), which was developed to address households with busy and irregular schedules and aimed to reduce food waste by promoting the use of leftovers. However, although this intervention is targeted towards a predefined segment, it could be applied more broadly as well. Overall, whether segmentation and targeting would increase effectiveness and efficiency of interventions remains an open question.</p>
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	<p>Certain groups of consumers are also missing from interventions. These include single-person and young households, those in non-traditional families and living arrangements, tourists (especially in all-inclusive settings) and patients in the healthcare sector. Especially when life-changing events occur (e.g. the first time living on one's own, starting a family, moving house), people are open to changing their habits and establishing new ones, so targeting people who are going through these events may be fruitful to examine.</p>
Under-researched intervention elements	<p>Collected interventions rarely use financial incentives, regulation or social norms. Therefore, relatively little is known about their potential effectiveness. Obtaining more insights about potential interventions using these elements is important, as assumptions about what may or may not be effective can be mistaken.</p> <p>As an example, a recent systematic study on the effects of multibuy offers (such as the 'buy-one-get-one-free' deal) found that consumers do not waste more of the products bought on such multibuy offers, but rather waste less of these (van Lin et al., 2023). Although these deals have been criticised as a potential cause of food waste, consumers who actually bought products on a deal reported consuming and freezing more of these products. Retailer efforts to help consumers reduce food waste may be better spent on communicating ways to reduce food waste (Zhang et al., 2023) and other interventions that have proved to be effective. Price promotions should be accompanied by appropriate messages to remind consumers about the need to plan and store food and the risk of wasting food.</p> <p>Furthermore, there is initial evidence that gamification may be effective (NT13): in this intervention, food waste was about 30 % lower in the group that was provided with a game than in any of the other groups, for which information-based campaigns and community workshops were used. Thus, it may be valuable to further look into the use of games in interventions to reduce food waste.</p>
Potential rebound effects	<p>Better understanding of potential rebound effects would also be beneficial. For instance, waste prevention communication efforts that blame consumers for waste can backfire when not accompanied with information about how to easily reduce waste (Birau and Faure, 2018). In terms of rebound effects, when consumers save money by wasting less, the environmental benefits could be partly offset if this stimulates additional demand for products and services (Meshulam et al., 2022; Sundin et al., 2022). A thorough sustainability assessment such as the one applied in the framework of reduction measures in Germany between 2020 and 2022 could allow assessments across the three sustainability dimensions (economic, environmental and social) (Goossens et al., 2019).</p>
Potential spillover effects	<p>In contrast to these rebound effects, there may also be spillover effects, where an intervention in one context or setting could spill over to another context. For example, an intervention in schools could spill over to change behaviour in the home setting or sustainable food choices could lead to food waste reduction. These aspects were often not considered and the interventions that did consider them showed mixed findings. In one intervention (O1), it was observed that food waste behaviours at school and at home were unrelated, while in another intervention (ES1) education at school affected behaviours at home. Therefore, the extent to which or how food waste reduction in one context can spill over to another context remains an open question.</p>
Combination of intervention elements	<p>The outcome of this analysis emphasises that there is no one best intervention. In fact – as stated above – a combination of key elements from various successful interventions could potentially improve effectiveness</p>

	<p>(Simões et al., 2022). Future research is advised to investigate different combinations of interventions to determine which combinations deliver behaviour change most rapidly and cost-effectively. For example, among the nudge interventions that used tools and prompts for food storage and preparation, recipes for reusing leftovers could be combined with apps and games.</p>
<p>Interventions embedded in a broader programme</p>	<p>Finally, a general trend seen in the household-coaching interventions assessed in this work is that they promote several practices and embed food waste reduction in a broader food management programme. The combination of practical food waste skills with, for example, knowledge on financial savings, healthy eating, local food messages and food safety may help equip individuals or households with comprehensive food management skills and future research could examine how these elements interact. Some initial evidence is shown in AL7, where food waste reduction messages and skill training were coupled with recycling behaviour and a shift towards plant-based eating. This is an important finding, as it points the way to approaches that could help not only halve food waste, but also deliver on the carbon and health objectives that the EU has under the European Green Deal.</p>

6. Discussion and conclusion

The ECFWF collected 78 interventions, 74 of which were found to be suitable for detailed evaluation of their impact on food waste levels. Table 9 presents the challenges that emerged in reducing consumer food waste at scale and the findings that can be built on to design the most effective interventions.

Table 9. Main challenges to address in tackling food waste and insights to help deliver reductions in consumer food waste

<p>Diverse mechanisms can influence behavioural change</p>	<p>While only 10 of the evaluated interventions focused solely on awareness raising, most interventions covered simultaneously several dimensions to trigger behavioural change (e.g. motivation, opportunity and ability) by, for example, informing participants of food waste, providing them with tools and skills or nudging consumers to change their behaviour. Other dimensions that could further influence behaviours but which were less often considered include:</p> <ul style="list-style-type: none"> — building a clear understanding of behavioural mechanisms that can influence consumer change and the identification of effective ‘routes to persuasion’ (e.g. gamification was found to be successful in NT13); — influencing and creating synergies with other initiatives not intentionally targeting food waste reduction but affecting it, such as those that focus on food sustainability, healthy eating or economic considerations.
<p>Consumer segmentation and the tailoring of interventions should be further explored</p>	<p>Around 53 % of the total food waste in Europe occurs at the household level, and more granular information about groups of consumers or segments of the population (indicating who is wasting the most, what might motivate them to act, which media channels might be the most effective) is surprisingly scarce. Hence, it is not surprising that the interventions evaluated by the ECFWF mostly apply to various types of households indifferently, rather than being targeted at those that waste the most and are most interested in reducing waste. Segmentation research by academics and public organisations to accurately map what types of households and out-of-the-home contexts generate the most waste should be encouraged to help practitioners and policymakers develop better-targeted interventions. An additional challenge later on will be to reach these segments in a cost-effective way.</p> <p>Partnerships between practitioners and researchers, who work hand in hand to tailor interventions to specific types of consumers, could also be encouraged, to assess if they can improve interventions’ effectiveness. Giving simple guidance to practitioners would also be useful to facilitate assessing the trade-off between the costs of segmentation and tailoring and the potential benefits from more targeted, tailored and cost-effective interventions.</p>
<p>Using a more consistent evaluation methodology will help assess interventions more effectively</p>	<p>The present work has shown that the number and diversity of interventions to reduce consumer food waste have increased substantially, but not all are assessed consistently or comprehensively. A new methodology is proposed to drive more consistent evaluation, which would allow simple comparisons between interventions and would encourage researchers to capture valuable data. This methodology would help practitioners to select impactful combinations of approaches, thus encouraging rapid and cost-effective household food waste reduction. This report has found that, for example, simple and practical measurement techniques should be prioritised for households, while automatised food waste data collection devices seem promising in food service environments.</p> <p>The design stage of the intervention influences the quality of the intervention’s evaluation. This report highlighted that the evaluation quality could be</p>

	<p>improved by using control groups and preferring waste-sorting analysis and direct measurement over participants' self-reported data.</p> <p>NGOs and multistakeholder partnerships implemented most of the interventions evaluated by the ECFWF. Therefore, this audience should be prioritised when offering practical tools and guidance to support evaluation. The advice should also consider that practitioners often have limited time and resources.</p>
<p>Synergies between interventions may drive more rapid and cost-effective change</p>	<p>There is immense benefit to be gained from synergies between food waste reduction interventions. However, that potential still needs to be fulfilled. Synergies between interventions could be achieved on several scales of intervention. Synergy between local multiactor networks and partnerships should be a priority for local community-based interventions. As an example, the engagement of local schools can be used to develop and promote learning activities related to food waste. The synergies of large-scale national programmes facilitating partnerships between actors and identifying fertile ground for action can stimulate interventions. The evaluation of interventions within these large-scale national programmes can also serve as means to offer valuable data when countries fulfil their reporting obligations to the European Commission.</p>
<p>Tackling food waste brings systemic benefits and can be integrated with other food chain transformation interventions</p>	<p>The ECFWF evaluation framework suggests that the synergies created by integrating food waste interventions with other initiatives not intentionally targeting food waste reduction might lead to greater food waste reduction. On top of that, food waste reduction contributes to multiple benefits, such as the efficient use of natural resources, the reduction of pressure on land and water resources, the mitigation of climate change and support for food security and nutrition. When so many people in the world are food insecure and the price of food is increasing, reducing food waste is not only a question of saving money and natural resources, but also an ethical question. Therefore, these multiple and cross-sectoral benefits should be considered when designing the interventions in order to trigger action from other stakeholders and increase their impact. Annex 3 shows the EU food waste quantification collected for the year 2020. It quantifies food waste across the food supply chain and Member State.</p>
<p>Different types of interventions are available to facilitate action in schools</p>	<p>Some interventions in school settings aim to prevent food waste in canteens; others use education in classrooms through specific teaching materials or target the families of pupils through the provision of information about food waste reduction. The last two types of interventions raise awareness about food waste among young people and potentially among their families.</p> <p>Generally, in society, schools and educational policymaking, there is broad acceptance of the idea of education for sustainable development, in which learning about food waste could fit well. Some methodologies and educational technologies could be instrumental in achieving this (Mikkelsen, 2022). For example, gamification and other experience learning approaches could be used to develop smarter learning approaches. Furthermore, since evaluating interventions targeting young people at school is imperative, there is also a need to develop proxies and evaluation methods, such as a food waste literacy score, thus building on the existing research on food literacy. Current programmes under education for sustainable development might cover food waste, but often do so superficially.</p>
<p>Some types of interventions appear particularly promising</p>	<p>Personalised coaching, which supports households by increasing their knowledge and skills in the context of their homes, showed the highest level of effectiveness among interventions (up to 67% reduction). The only problems are that these interventions are costly and hard to scale up. Research could investigate if specific types of households are more</p>

	<p>responsive and identify key success factors for these interventions so that they can be more effectively targeted, thus potentially reducing the cost.</p> <p>Two large-scale national programmes (G1, G2), representing umbrella initiatives of many subinterventions, showed benefits associated with activating multistakeholder partnerships. These interventions:</p> <ul style="list-style-type: none"> — facilitated the reach of diverse consumer groups (e.g. primary schools, households); — coordinated measures to test various interventions at scale (e.g. education, awareness); — encouraged a wider stakeholder group to amplify the messages and help change behaviour. <p>This approach has been used with success in a number of European countries, for example the Netherlands and the United Kingdom, to drive reductions at scale in homes.</p> <p>Interventions rarely use financial incentives, regulation or social norms to influence behaviours, although the literature shows that these levers can change consumers' behaviours. This may indicate that these levers are not easy to use and complementary research on how they could be employed would be beneficial. It has been highlighted in Section 5.2 that the interventions that worked in household contexts were those that targeted consumers who willingly signed up for the intervention. Research could aim to create pathways to better engage households in interventions.</p>
<p>The scope of the interventions evaluated by the ECFWF is limited</p>	<p>Among all existing types of interventions to reduce consumer food waste, the ECFWF focused on those:</p> <ul style="list-style-type: none"> — to educate children (because they will shape the future); — to raise awareness (because it is a prerequisite to motivate action); — to nudge behavioural changes (because consumers need to be stimulated to change their habits). <p>Some interventions excluded from the scope of the ECFWF were nonetheless included in the analysis: redistribution apps, measurement apps and interventions uncovering new drivers. Other types of interventions, such as social influences, economic incentives or regulations, can also be considered while formulating recommendations. The scope was narrowed to ease the data collection, but the ECFWF recognises the importance of all other approaches.</p>

Overall, the systematic evaluation of household food waste interventions has only recently started and more progress can (and needs to) be made. Stöckli et al. (2018) and Caldeira et al. (2019) indicate that a framework would help systematic evaluation by providing standardised definitions and measurement methods. Particularly for consumer food waste, it is necessary to have an evaluation framework that addresses specific behaviours and change processes and that provides definitions to distinguish between short- and long-term effects. It is also necessary to keep in mind that a direct comparison of the effectiveness of interventions (i.e. the decreases in household food waste) can be misleading when there are differences in target groups and/or measurement methods. For example, when an intervention is aimed at mainstream consumers (including those with little interest in food waste), its effectiveness is usually lower than when a similar intervention is tested in a setting in which consumers can choose to participate (and the intervention is thus tested with consumers who are already interested and motivated to change their behaviour).

Food has embedded environmental, nutritional and economic consequences because of the energy, natural resource use and associated emissions generated throughout its life cycle. When food is discarded, all the embedded environmental impacts occur without achieving the final goal: benefiting human nutrition. This report uses the food waste prevention calculator to reflect this life cycle thinking.

The calculator allows the user to assess the environmental, economic and nutritional benefits of food waste prevention measures and consider all impacts or avoided impacts along the food supply chain. This comprehensive and holistic thinking should be considered when evaluating the impact of food waste, as it provides a more detailed picture of the real impacts of food waste beyond people developing the habit of treating food as waste more often than necessary.

Interventions to reduce consumer food waste happen in a context where practitioners constantly leverage new lessons learned from growing evidence-based best practices. The ECFWF evaluated 74 interventions within a limited scope; compared with the number available to an overview carried out a few years ago, which fully analysed only 15 interventions, this number shows the extraordinary expansion in efforts to reduce consumer food waste.

Box 12 presents the main conclusions of this research.

Box 12. Main conclusions of this work

Consumer food waste can be reduced. Although some interventions did not evaluate their impact on reducing food waste consistently, many showed excellent results. The key message to convey is straightforward: significantly reducing consumer food waste is essential and possible.

There is no one solution to reducing consumer food waste. Instead, a combination of essential interventions is required to act at scale. At home, where the greatest share of consumer food waste occurs, the evaluation suggests that combining messages or interventions on practical food waste skills with knowledge on financial savings, healthy eating and local food messages can help equip households with comprehensive food management skills and the motivation to change. Interventions to reduce consumer food waste in out-of-the-home settings can be more specific, depending on the type of establishment and context.

Multicomponent and multilevel interventions seem more effective in changing food behaviours. Developing these interventions could involve multiple actors/institutions, such as schools, local governments, NGOs and the private sector. Reducing food waste requires society to invest in effective and efficient initiatives. To that effect, we have identified a key aspect that has thus far been underutilised when designing interventions – that is, capitalising on the potential synergies between food waste prevention and other topics related to welfare (strongly connected with diet and health) and the environment. These synergies can be achieved for several scales of intervention, from local or multiactor networks to large-scale programmes. The outcomes from those synergies should give us a direction for a future comprehensive framework for action.

Using standard evaluation methods can accelerate the implementation of evidence-based best practices. Consistent evaluation protocols also improve the overall intervention design. Hence, scientific work to improve evaluation should be translated into user-friendly versions of tools for practitioners, as we acknowledge the central role that NGOs (and other actors with limited resources) play in supporting food waste reduction.

Developing data-sharing platforms where different actors can share and compare relevant data on food waste interventions would allow those responsible to develop and maintain measures and interventions based on data-driven decisions.

To coordinate interventions on a large scale, the role of governments is key in many aspects.

- It increases both the outreach and the sustainability of the interventions. More actors will be engaged and contribute when political will is strong (through increased visibility, funding, overcoming legal constraints and operational frameworks). The role of governments is also crucial to achieving lasting effects, as many interventions are still experimental and can disappear if not sustained, which can slow down learning, sharing and the continuous improvement process.
- Governments are best placed to create a network of actors dealing with food waste and other areas of synergy and to adjust their needs depending on national contexts. Multistakeholder collaborations leverage more funding, creativity, knowledge, tools and implementation capacity, which are key to unlocking the potential reduction of consumer food waste in complex settings.

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Abbreviations

AL	local initiatives
AS	large-scale initiatives
app	application
CSCP	Collaborating Centre on Sustainable Consumption and Production
DECO	Portuguese Association for Consumer Protection
DG SANTE	Directorate General for Health and Food Safety
EC	coaching for households
ECFWF	European Consumer Food Waste Forum
ES	school programmes
ET	training for food business workers
G	national programmes
JRC	Joint Research Centre
KPI	key performance indicator
LIFE	financial instrument for the environment
M	measurement
NA	not applicable
NGO	non-governmental organisation
NH	other nudges for household food waste
NL	labelling and visual cues on food packaging
NOOH	nudges out of the home
NT	tools and prompts for household food waste
O	interventions uncovering new drivers
PR	public relations
R	redistribution
WRAP	Waste and Resources Action Programme

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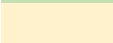
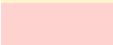
Annex 1. Food waste prevention intervention factsheets

The overview table below lists the interventions evaluated by the ECFWF according to the typologies indicated in Section 2 of the report. The code column contains hyperlinks to the factsheets on the interventions.

Type	Subtype	Code	Intervention name
Nudges	Tools and prompts for food storage and preparation	NT1	Behaviour change tool package
		NT2	Cozzo mobile app
		NT3	Effect of sharing recipes to use up leftovers
		NT4	First aid box against food waste
		NT5	Food trainer app test
		NT6	Kitsain – app trial for food management
		NT7	<i>Koelkastklem</i> (refrigerator tab to use leftovers in the fridge)
		NT8	Online experiment on effects of different messages
		NT9	PUSH notification reminders to use up food in the fridge
		NT10	Reducing food waste by cooking meals from a meal box versus from scratch
		NT11	Seika social experiment
		NT12	Study on effect of gamification
		NT13	Study on use of social marketing for food waste reduction
		NT14	Use It Up Tape – visual prompt for leftover consumption
	Other nudges for household food waste	NH1	Food waste calculator
		NH2	Study leveraging cognitive dissonance to reduce household food waste
		NH3	Study on eco-feedback device
		NH4	Study on social media use for awareness
	Labelling and visual cues on food packaging	NL1	Day on date label
		NL2	Evaluation of date labelling campaign encouraging consumers to look–smell–taste
		NL3	On-pack storage and consumption guidance (Refresh)
		NL4	Stickers on bread packaging and communication campaign
		NL5	Time–temperature indicator – Germany
		NL6	Time–temperature indicator – the Netherlands
		NL7	Visual cue study on labels - effects on consumers
	Nudges out of the home	NOOH1	Food waste reduction at music and arts festival
		NOOH2	Lariso
		NOOH3	Nudging strategies in school canteens
		NOOH4	Online experiment in retailers
		NOOH5	Posters displaying social norms
		NOOH6	Prompts encouraging right portion consumption
		NOOH7	Study investigating effect of context manipulation
		NOOH8	Study on types of restaurants and food waste production
NOOH9		Take away doggy bags	
NOOH10		Use of anthropomorphic food in messages	

Type	Subtype	Code	Intervention name
Education and training	School programmes	ES1	Intervention targeting children's and parents' food-related behaviours by encouraging them to make lunch
		ES2	Food and nutrition education programme – the Netherlands
		ES3	Food waste battle for teenagers (<i>Hävikki-battle</i>)
		ES4	Green Chef – youth-targeted competition
		ES5	'Do good, save food' campaign
		ES6	Study on food and nutrition education – Italy
		ES7	<i>Programa Z(h)ero</i> – zero-waste schools
		ES8	<i>Mon École Anti Gaspi</i> (my school against food waste)
	Training for food business workers	ET1	PENNY apprenticeship programme
		ET2	Zero-waste restaurant
	Coaching for households	EC1	<i>Alimentar Sem Desperdicar</i>
		EC2	Coaching methods and measurement
		EC3	Cooking classes and workshops – Germany
		EC4	FoodWIN Brugge
		EC5	'Love food, hate waste' Scotland cascade training
		EC6	Study on comprehensive intervention/coaching for households – the United States
		EC7	Tailored intervention with personalised coaching
		EC8	Volunteer and community advocate programme
Awareness raising	Local initiatives	AL1	Fish scale
		AL2	Food waste prevention campaign in public housing areas
		AL3	Keep your refrigerator tidy
		AL4	Maizuru city food waste reduction pilot project
		AL5	Reduce food waste, save money
		AL6	Trifocal project
		AL7	West London food waste prevention campaign
	Large-scale initiatives	AS1	Best before exhibition
		AS2	COP26 campaign with Rankin
		AS3	Food waste-free week
		AS4	Great taste, no waste
		National programmes	
		G2	Life foodprint
Interventions uncovering new drivers		O1	Education and leveraging social influence in school environments
		O2	Good deeds calendar
		O3	Study on domestic food practices
Out of scope	Measurement	M1	Gladsaxe measurement
		M2	Copenhagen municipality
	Redistribution	R1	Olío app
		R2	Munch app
		R3	Food saving event catering

The following sections provide a summary of each intervention, its implementation and the data that enabled the evaluation. The introductory table for each section shows the quality of the data provided for each intervention, based on the evaluation criteria introduced in Section 2. To provide an initial analysis of each intervention and select best practices, the quality and quantity of information presented in the data collection protocols were assessed and are indicated as follows:

-  Information provided was satisfactory and clear
-  Information provided was enough but not clear
-  Information incomplete or not applicable

Nudges

Action code	Action name	Sub-type	Quality of intervention design	Effectiveness	Efficiency	Sustainability over time	Transferability	Scalability	Systemic Effects
NT1	Behaviour change tool package	Tools and prompts for food storing/preparation							
NT2	Cozzo mobile app	Tools and prompts for food storing/preparation							
NT3	Effect of sharing recipes to use up leftovers	Tools and prompts for food storing/preparation							
NT4	First aid box against food waste	Tools and prompts for food storing/preparation							
NT5	Food trainer app test	Tools and prompts for food storing/preparation							
NT6	Kitsain – app trial for food management	Tools and prompts for food storing/preparation							
NT7	Koelkastkiem (refrigerator tab to use leftovers in the fridge)	Tools and prompts for food storing/preparation							
NT8	Online experiment on effects of different messages	Tools and prompts for food storing/preparation							
NT9	PUSH notification reminders to use up food in the fridge	Tools and prompts for food storing/preparation							
NT10	Reducing food waste by cooking meals from a meal box versus from scratch	Tools and prompts for food storing/preparation							
NT11	Seika social experiment	Tools and prompts for food storing/preparation							
NT12	Study on effect of gamification	Tools and prompts for food storing/preparation							
NT13	Study on use of social marketing for food waste reduction	Tools and prompts for food storing/preparation							
NT14	Use It Up Tape – visual prompt for leftover consumption	Tools and prompts for food storing/preparation							
NH1	Food waste calculator	Other nudges for household food waste							
NH2	Study leveraging cognitive dissonance to reduce household food waste	Other nudges for household food waste							
NH3	Study on eco-feedback device	Other nudges for household food waste							
NH4	Study on social media use for awareness	Other nudges for household food waste							
NL1	Day on date label	Labelling and visual cues on food packaging							
NL2	Evaluation of date labelling campaign encouraging consumers to look-smell-taste	Labelling and visual cues on food packaging							
NL3	On-pack storage and consumption guidance (Refresh)	Labelling and visual cues on food packaging							
NL4	Stickers on bread packaging and communication campaign	Labelling and visual cues on food packaging							
NL5	Time-temperature indicator – Germany	Labelling and visual cues on food packaging							
NL6	Time-temperature indicator – the Netherlands	Labelling and visual cues on food packaging							
NL7	Visual cue study on labels – effects on consumers	Labelling and visual cues on food packaging							
NOOH1	Food waste reduction at music and arts festival	Nudges out of home							
NOOH2	Lariso	Nudges out of home							
NOOH3	Nudging strategies in school canteens	Nudges out of home							
NOOH4	Online experiment in retailers	Nudges out of home							
NOOH5	Posters displaying social norms	Nudges out of home							
NOOH6	Prompts encouraging right portion consumption	Nudges out of home							
NOOH7	Study investigating effect of context manipulation	Nudges out of home							
NOOH8	Study on types of restaurants and food waste production	Nudges out of home							
NOOH9	Take away doggy bags	Nudges out of home							
NOOH10	Use of anthropomorphic food in messages	Nudges out of home							

Tools and prompts for food storage and preparation

NT1: Behaviour change tool package

ID	Title: Tool package provided by Netherlands Nutrition Centre, consisting of existing tools that help consumers diminish food waste
	Country: the Netherlands
	Implemented by: Samen Tegen Voedselverspilling-led partnership (with Wageningen University & Research and Netherlands Nutrition Centre)
	Experiment: no
	Intervention period: ongoing (started 2020 – evaluation of effects covers up to 2021)
Intervention design	<p>Goal. The goal is to provide households with a package, including tools and skills development resources, to reduce food waste in homes. The objective of the tool package is to increase people's skills and thus diminish household food waste.</p> <p>The package contains:</p> <ul style="list-style-type: none"> — a shopping list notepad; — a sticker and information on how food should be stored; — a sticker that indicates how long bread, leftovers, meat and fish, vegetables and fruit can be kept in the freezer; — an app providing information on the shelf life of products; — a measuring cup for various types of carbohydrates; — information on best before versus use-by dates; — an app with recipes for leftovers. <p>Implementation. To evaluate the intervention, which ran on a national scale, three evaluation studies were conducted. Participating households were asked to self-report their food waste over 2 weeks.</p> <p>In two studies, participating households signed up knowing the topic and were motivated to use the tools.</p>

	<ul style="list-style-type: none"> — Study 1 tested the effect of the package when supplemented with a motivational message to boost participants' willingness to reduce food waste. — Study 2 tested a control condition and the effect of self-measurement alone. <p>The households that participated in study 3 were not volunteers; rather they received the package out of the blue and their waste was measured through waste compositional analysis.</p> <p>Baseline. In all three studies, baseline measurements were obtained in the week before the tool package was sent to participants.</p> <p>Monitoring. Monitoring was through self-reported food and survey questions on behaviours and skills in studies 1 and 2. In study 3, waste was collected in garbage bags and underwent waste sorting.</p>
Effectiveness	<p>Study 1. About 220 g of food waste was avoided, which equals a 39 % food waste reduction with the package (study 1) - this is statistically significant. No significant supplementary reduction was seen with the complementary motivational message. However, participants reported performing more waste-reducing behaviours after receiving the tool package. This effect was more pronounced when they also received a social norm message. Participants also perceived themselves as having greater skills in food management after receiving the tool package.</p> <p>Study 2. There was a 29 % food waste reduction, which is a marginally significant reduction when comparing pre- versus post-intervention measurements. Participants perceived themselves as having greater skills in food management after receiving the tool package.</p> <p>Study 3. No significant effect of the tool package was reported in this study. The fact that the tools were provided without explanation was suggest as a reason for the lack of effect.</p>
Efficiency	The production costs of single units of the tools range from EUR 0.12 to EUR 2.50, excluding value added tax.
Sustainability over time	NA. An academic paper is being written about the studies. The Netherlands Nutrition Centre is providing communications about the tools in the package.
Transferability and scalability	<p>Some of the tools (the measuring cup and others) have been developed together with an external party and are under copyright – this might limit the intervention's transferability to different contexts. The other tools were developed by the Netherlands Nutrition Centre; these can be used by other parties after permission is granted.</p> <p>Intervention is already implemented at scale, as it runs on a national scale.</p>
Key features for replicability	The tool package has increased people's skills regarding food management and reduced food waste when participants signed up knowing the topic and were motivated to use the tools. We did not find these effects in study 3, in which participants received the package out of the blue and were not motivated to use the tools.
Notes	<p>No information was available on systemic effects.</p> <p>For more information, see the Netherlands Nutrition Centre web pages on the measuring cup, the yes/no fridge stickers, the cool stickers and the best storage tips.</p> <p>For more information, also see Van Dooren et al. (2020).</p>

NT2: Cozzo mobile app

ID	Title: Cozzo mobile app
	Country: Austria

	Implemented by: Institute of Waste Management and Circularity, University of Natural Resources and Life Sciences
	Experiment: yes
	Intervention period: 1 March 2022 to 30 June 2022
Intervention design	<p>Goal. The goal was to test a food management app developed within an EU-funded project. The overall aim of the intervention was to better manage food at home. The app helped consumers keep track of their purchased and cooked food, thus enabling more accurate food purchasing and leading to less food being wasted as a consequence of overpurchasing, overcooking or spoilage. The content of the app was based on raising awareness of efficient food management at home.</p> <p>The features of the mobile app that supported this process were:</p> <ul style="list-style-type: none"> — 8 a.m. summary notifications on expired / about to expire items; — individual product expiry notifications on the best by / best before date; — an inventory list sorted by expiry date (calendar icon); — an automatic estimation of product shelf life according to storage conditions (sub-zero, cold, normal); — a 'cook expiring products' recipe list on the 'boards' page. <p>Monitoring and evaluation. The app was tested among students who participated in a lecture at the university: 11 students tested the target app (the Cozzo app), 36 students tested a similar app (the Nosh app) and 48 students did not test an app but took pictures of their daily food waste. Food waste levels were monitored by waste audits conducted by the students themselves for 1 week before and at the end of the intervention; only the avoidable fraction of food waste was monitored (and only specific food categories).</p> <p>Drivers. Drivers were a lack of knowledge about products in stock that are close to their expiry dates, a lack of cooking ideas for ingredients that are in stock, forgetting about food that is stored at home and overpurchasing.</p>
Effectiveness	The group using the Cozzo app reduced the quantity (mean value) of food waste produced more than the other two groups. It is not clear whether the reduction can be entirely attributed to the intervention or there are possibly other influencing factors.
Sustainability over time	There was 1 month of observation, but the objective of the app's development is long-term use. The app will also be tested in Greece and Finland. Scientific publications will be issued and, with the intervention being part of the outputs of an EU-funded project, the dissemination of the results is likely.
Transferability and scalability	The mobile app runs only on iOS and not on Android yet; it is available through the app store. Scalability will entail making the app available on all devices.
Notes	No information was available on efficiency or systemic effects. For more information on the app, see the Cozzo app website .

NT3: Effect of sharing recipes to use up leftovers

ID	Title: Bonus meal mission / Fridge night
	Countries: Canada and the United States
	Implemented by: Hellmann's and researchers from a behavioural science consultancy firm
	Experiment: yes
	Intervention period: Canada, 16 October 2020 to 1 December 2020; United States, 4 October 2021 to 23 November 2021

Intervention design	<p>Goal. The goal was to get participants (households) to pick one day a week on which they would prepare a meal with food they already had. Households were provided with (1) tools aimed at increasing the salience of foods that are at risk of being thrown away (inside and outside the fridge) and (2) flexible recipes ('flexipes') to prepare bonus meals using these foods. The recipes were shared through Hellman's website and an app and tools were sent to households.</p> <p>Implementation. A baseline measurement of self-reported food waste was established by participants in the first week. Then households received a behavioural intervention ('Bonus meal mission') for the remaining 4 weeks. Participants were asked to select a 'use-up day' (Canada) or a 'fridge night' (United States) each week to make a meal from available food. Finally, they filled out a weekly food management survey to report results.</p> <ul style="list-style-type: none"> — The intervention was first tested in Canada, where 1 475 people committed to the study, but only 909 completed the full study. Participants also received one of three salience tools – a magnetic dry erase board, a yellow plastic basket or clips. They were asked to use the tool to collect fruit and vegetables they wanted to remember to eat. — It was then tested in the United States, where 1 047 people committed to the study, but only 484 completed the full study. The US test had some adjustments. Some participants received only online instructions, while others received online and printed versions. Some received instruction materials for 5 weeks while others received them for just 3 weeks, but with reminder emails encouraging them to keep up with their fridge nights. <p>Drivers. Drivers were feeling tired, a lack of time, forgetting and a lack of cooking skills.</p> <p>Levers. Levers were information about social and environmental consequences, material incentives, goal setting / action planning, instructions on how to perform the behaviour and prompts/cues.</p>
Effectiveness	<p>Overall, 62 % of participants in Canada and 46 % of participants in the United States completed the intervention.</p> <p>In Canada, those in the intervention group reduced their waste by 33 % (148 g) from baseline or by 27 % (106 g) compared with those in the control group. In the United States, those in the intervention group reduced their waste by 46 % (317 g) from baseline or by 33 % (182 g) compared with those in the control group.</p> <p>The motivation–opportunity–ability component results were as follows.</p> <ul style="list-style-type: none"> — Ability. Participants considered themselves to be more confident and resourceful following the intervention. They also indicated that the flexible recipes made them see more meal options and incorporate fruit and vegetables into their meals. — Motivation. Participants in both countries enjoyed participating in the intervention and indicated they were likely to use the flexible recipes again. — Opportunity. The majority of participants in both countries indicated that the intervention did not take too much effort.
Efficiency	NA.
Sustainability over time	The effect on consumers continued 3 weeks after the intervention. No information was available for a longer period.
Transferability and scalability	When creating the intervention for Canada, a review of available information on food waste determinants indicated that there were no major differences in food waste drivers and barriers between Australia, Canada, New Zealand, the United States and most western European countries. Therefore, the expectation was that the programme could be transferred to other countries, with some changes in wording.

	<p>The intervention has already been transferred from Canada to the United States and was also launched in the United Kingdom in 2022.</p> <p>Barriers to scalability. Barriers are getting potential users to download the app, keeping participants within the programme when there is no formal monitoring of their participation and ensuring the smooth functioning of the app. The intervention has been scaled up through Hellmann's websites, where an e-book can be downloaded, along with the intervention, the flexible recipes and the mobile phone app (Android and iOS). A smooth user interface is key and so is getting new users to download and start using the app.</p>
Systemic effects	<p>While the advantages of the flexible recipes are that they stimulate people to cook with their leftover ingredients and indicate that they do not need to stick to predefined ingredients, care should be taken that the flexible recipes lead to healthy meals. Before expanding on the intervention, a critical look at the nutritional content of the flexible recipes would be advisable. The list of recipes could be limited to the more healthy ones and/or health indications could be added (e.g. not only mentioning that 'any veggies left in the fridge will do' but also provide an indication of the amount of vegetables to add per person).</p>
Notes	<p>No information was available on efficiency.</p> <p>For more information, see Hellman's flexipes web page.</p>

NT4: First aid box against food waste

ID	Title: First aid box against food waste
	Country: Austria
	Implemented by: Institute of Waste Management and Circularity, University of Natural Resources and Life Sciences
	Experiment: no
	Intervention period: 1 March 2018 to 31 March 2018, reporting 1 May 2018 to 31 June 2018
Intervention design	<p>Goal. The goal was to develop a first aid box for food, which would attempt to address as many different consumer's needs as possible. Specific objectives were to inspire concrete options for action, show possible solutions for households, educate consumers on the meaning of expiry dates, educate consumers on correct storage, educate consumers on options for preservation, educate consumers on what to do with leftovers and contribute to reducing food waste.</p> <p>The box contained:</p> <ul style="list-style-type: none"> — 10 food waste prevention tips; — an express jam recipe; — a freezing card with information on what and how long to freeze food; — a storage circle; — recipes for leftovers; — 'don't forget about me' cards; — information on best before dates and their correct interpretation. <p>The boxes were handed out to 2 000 consumers over 6 days in March 2018 at three Spar retail stores in Vienna. The stores are located in different Viennese districts that include consumers of different social classes and with different purchasing power. Furthermore, the times of distribution varied: boxes were handed out on weekends and weekdays to reach different types of consumers and age groups.</p> <p>Drivers. Drivers were a lack of knowledge about expiring dates, a lack of knowledge about correct food storage, a lack of cooking ideas for leftovers and forgetting about food that is stored in the fridge.</p>

	Levers. Levers were imparting knowledge about best before dates and storage and creating problem awareness.
Effectiveness	The most popular aid that found application in consumers' daily life was the booklet of recipes for leftovers. In addition, more than 30 % of participants would use the freezing card and the storage circle again. The 10 food waste prevention tips that can be pinned to the fridge, for example, were appreciated by 21 % of participating consumers. Unlike the other aids, the 'don't forget me cards' received very little support.
Transferability and scalability	The box can be distributed as is in other supermarkets and food retail stores.
Notes	No information was available on systemic effects or efficiency. Data refers to only 1 month, so the sustainability of the intervention over time is difficult to evaluate.

NT5: Food trainer app test

ID	Title: Food trainer
	Country: United Kingdom
	Implemented by: Waste and Resources Action Programme (WRAP)
	Experiment: yes
	Intervention period: 1 May 2020 to 22 June 2021
Intervention design	<p>Food trainer is an app developed by a team of psychologists. It trains users to choose healthy food and resist unhealthy food. It works on the unconscious level by making positive or negative associations with behaviours. WRAP trialled the concept to try and make positive and negative associations between good and bad food waste behaviours. Specific objectives were to test if pairing negative and positive associations with incorrect and correct food storage and 'compleating' (eating all of the food) behaviours would change these behaviours and/or change knowledge or attitudes.</p> <p>The app focused on two kinds of behaviour:</p> <ul style="list-style-type: none"> — compleating (not peeling potatoes, apples and carrots and eating bread crusts), — storage (correct storage of tomatoes, carrots, apples, lemons and oranges). <p>Driver. The driver was a lack of knowledge on food storage and eating.</p> <p>Levers. Levers were creating negative unconscious associations with unwanted behaviours and creating positive unconscious associations with desired behaviours.</p> <p>Monitoring. Monitoring involved the comparison of the control and treatment groups (which used the app a minimum of 10 times over 4 weeks) in terms of self-reported attitudes, knowledge and behaviour change (storing food correctly or compleating).</p>
Effectiveness	<p>Mixed results were found for an effect on the compleating (eating all of the food) behaviour of the intervention group compared with the control group. In the case of carrots and apples, the app showed a greater reduction in people reporting peeling these items than in the control group. For potatoes, there was no significant difference in the results of those in the intervention and control groups. The results were very inconsistent for bread.</p> <p>The relatively small sample size for compleating meant that strong conclusions could not be drawn from the data. In addition, participants were exposed to fewer images of bread crusts and ends in the app, which may have affected the ability to draw conclusions.</p>

	<p>Note that the instances where the group using the app did not perform better than the control group do not mean that the app was not successful; it means the app was not more successful than giving people the same factual information without the app.</p> <p>Mixed results were found for an effect on storage behaviour, when comparing the intervention and control groups. There was a greater percentage increase in participants' behaviour change after app use (compared with the control group) for carrots and tomatoes than there was for oranges and apples. This may indicate that using the app successfully reinforced knowledge people already had.</p> <p>A number of foods showed continued improvement in the intervention group from post-survey to follow-up (compared with deteriorating performance in the control group). The app therefore tended to lead to greater sustained behaviour change.</p> <p>The Food trainer app does appear to be effective in changing some food-waste-related behaviours; however, its effectiveness varies depending on the type of behaviour and food being tested. For both storage and completing, mixed results were found.</p> <p>The post-intervention behaviour changes were not significantly different to those of the control group. Over time, this behaviour change was sustained by the (storage) intervention group but, in the main, the difference between the intervention and control groups was not significant.</p>
Sustainability over time	<p>The intervention effects were sustained up to 8 weeks later; however, as participants kept using the app voluntarily, the repeated exposure to the intervention is likely to have sustained any behaviour or knowledge change.</p> <p>No dissemination activity is expected at the moment.</p>
Transferability and scalability	<p>Transferability. If the brain training worked, the barrier to transferability would be people's motivation to download and use the app. The knowledge that positive and negative associations regarding behaviours could be trained through repeated exposure could be applied to other contexts.</p> <p>Scalability. It was challenging to create images for indicating 'good' and bad' behaviours. Storage and completing behaviours were considered the easiest to portray in images. The main barrier to use, if scaled up, would be motivation to download and use the apps. If successful, the app was to be gamified to increase use. Further testing is required, as the images could be made more intuitive.</p>
Systemic effects	<p>Lever. Repeated exposure to the same information increased knowledge.</p>
Key features for replicability	<p>This intervention found that repeated exposure is more likely to increase knowledge (than behaviour) and that knowledge has an effect on behaviour. This lesson can be applied to scenarios in which information is given, with the recommendation that knowledge be given repeatedly (i.e. multiple exposures to the same information).</p> <p>The app did not prove to be more successful than providing the same factual information. A knowledge intervention may be just as effective in prompting positive behaviour change, especially if information is provided repeatedly.</p>
Notes	<p>No information was available on efficiency.</p> <p>For more information, see the University of Exeter's web page on FoodT (the Food trainer app).</p>

NT6: Kitsain – app trial for food management

ID	Title: Kitsain – open-source software concept for consumers to manage their groceries and prevent food waste
	Country: Finland
	Implemented by: Kitsain (non-profit open-source software service)

	Experiment: no, but initial phase of testing
	Intervention period: 1 March 2023 to 30 June 2023
Intervention design	<p>Kitsain is an open-source-based service concept helping people manage groceries and motivating it's users to enhance their food-related consumption habits in their homes, for example preventing food waste and nudging users into healthier and more ethical diets. The aims of the software are food waste prevention in home kitchens, increased home food inventory cognition through habit nudging motivated by gamification, cost savings and easier food-related processes at home.</p> <p>Drivers. The driver was targeting specifically students in the first phase, as students are keen for cost savings and are tech savvy.</p> <p>Levers. Levers were costs, ecological considerations, ethics, gamification, health and personal and social empowerment.</p>
Transferability and scalability	Open-source software is widely proven as a scalable (business) concept, for example Linux (e.g. Red Hat) and the Android operating system by Google.
Notes	<p>No precise information was available on effectiveness. Some was available on costs but without effectiveness information it might not be meaningful. No information was available on transferability.</p> <p>For more information, see the Kitsain website.</p>

NT7: *Koelkastklem* (refrigerator tab to use leftovers in the fridge)

ID	Title: <i>Koelkastklem</i> / Refrigerator tab
	Country: Netherlands
	Implemented by: Netherlands Nutrition Centre
	Experiment: no
	Intervention period: 2017–2019
Intervention design	<p>Goal. The goal was to reduce households' food waste by increasing the salience of leftovers and food that is near its expiration date in the fridge by attaching a tab on one shelf of the fridge.</p> <p>Implementation. From November 2017 to February 2018, 100 000 tabs were distributed via the web shop or directly to customers in supermarket. Surveys were conducted to gather self-reported behavioural change associated with usage of the tab.</p>
Effectiveness	<ul style="list-style-type: none"> — Effects on actual food waste have not been studied. — 91.3 % of respondents have placed the clamp on a shelf in their fridge. — Around 40 % self-report that they are more aware of food waste in their household as a result of using the clamp and that they have tried to reduce food waste because of using it. — 80 % find that the clamp is salient in the fridge and 58 % indicate that they plan to continue using it. — 43.2 % think that the clamp has helped them waste less food. — The clamp has the largest effect on remembering leftovers (working as a prompt), less of an effect on actually cooking products at the limit of their expiration date and the smallest effect on cooking the right amounts.
Key features for replicability	The refrigerator clamp is not currently in use (it is not for sale). The survey indicates it works as a prompt for the issue of food waste for households but would benefit from being complemented by other interventions to help consumers implement solutions to reduce food waste.
Notes	No specific information was available on efficiency, sustainability over time, transferability and scalability or systemic effects.

NT8: Online experiment on effects of different messages

ID	Title: Effectiveness of environmental messages to reduce consumer food waste
	Country: United Kingdom
	Implemented by: University of Leeds, in partnership with WRAP and with funding from UK Economic and Social Research Council
	Experiment: yes
	Intervention period: December 2021 to February 2022, reporting December to October 2022
Intervention design	<p>Objective. The intervention was in the form of a series of online experiments, with participants recruited through an online platform.</p> <ul style="list-style-type: none"> — Experiment 1. There were two intervention groups and one control group. Participants received messages and images linking meal planning with climate change and tasty food. — Experiment 2. There were two intervention groups and one control group. Participants received messages and images linking wasting food with climate change and financial burden. <p>Aim. The aim was to examine how environmental and taste-oriented messages affect behavioural intentions to reduce food waste and to plan meals (experiment 1) and how environmental and financially oriented messages affect interest in food waste reduction efforts (experiment 2).</p> <p>The intervention were based on the theory of planned behaviour.</p> <p>Monitoring. Monitoring involved surveys on meal planning habits.</p> <p>Drivers. Drivers were a lack of intention to reduce food waste, a lack of intention to plan meals in advance and interest in food waste reduction efforts.</p> <p>Levers. Sharing messages (and images) linking meal planning with climate change and tasty food or financial burden will change consumers' intentions regarding food waste.</p>
Effectiveness	<p>An environmental message promoted higher interest in food waste reduction efforts than when there was no message. In addition, an environmental message was as effective as a message that conveys the financial burden of food waste.</p> <p>Results suggest that messages that associate food waste with its impact on the environment are:</p> <ul style="list-style-type: none"> — more effective than no message at affecting intentions regarding food waste and meal-planning behaviour. — at least as effective as taste-oriented messages at affecting intentions regarding food waste reduction and meal-planning behaviour. — at least as effective as financially motivated messages at influencing citizens' interest in food waste reduction efforts.
Efficiency	<p>Approximately GBP 33 120.6 was spent. (This figure was estimated based on 3 months of work out of an 18-month project with a larger budget – the actual intervention's implementation was less costly, but the costs were mostly allocated to labour.)</p> <p>Incentives paid to the participants equalled approximately GBP 4 500.</p>
Transferability and scalability	<p>Transferability. The intervention was conducted before the cost-of-living crisis hit the United Kingdom and the financial lever for food waste reduction might have been less relevant at that point. It would be helpful to conduct a similar intervention in the United Kingdom and Europe, as the financial consequences of COVID-19/Brexit directly affect citizens. Follow-up work on the intervention is also needed to examine its long-term effects.</p>

	<p>Scalability. This was a sufficiently big intervention. The next step should be updating the intervention or sample composition, rather than increasing the sample size.</p> <p>Although the sample was big and diverse enough, and the biospheric values of the participants were controlled for in all analyses, we cannot conclude that linking food waste to the environment in communications and interventions will work in different contexts. Rather, messages of information-based intervention campaigns may need to be aligned with the values of the target audience. This suggests a need for further research to examine which groups of individuals would respond positively to environment, taste and finance-oriented messages.</p>
Notes	<p>No information was available on systemic effects or sustainability over time. See Bretter et al. (2023).</p>

NT9: Push notification reminders to use up food in the fridge

ID	Title: Push notification reminders to use up food in the fridge
	Country: United Kingdom
	Implemented by: WRAP
	Experiment: yes
	Intervention period: June 2021 to February 2022
Intervention design	<p>The intervention was in the form of an experiment, which was done at participants' homes by asking them to complete food waste diaries and food waste logs.</p> <p>Aim. The aims were to understand how people can be encouraged to reduce their waste of fresh fruit and vegetables and to decrease the amount of effort required during cooking times by using a chart that will simply remind people what needs to be used next. The chart eased the burden of going through expiration dates and digging through the fridge every time people went to cook.</p> <p>The participants were divided into four groups (two control groups and two treatment groups).</p> <ul style="list-style-type: none"> — One control group and one treatment group were asked to record their fresh produce waste using a waste diary. — The other two groups were asked to use a food waste log. <p>The intervention groups were asked to use a simple mapping chart to log purchased produce and by when it should be consumed. There were 127 participants that completed the entire monitoring period across all conditions and a total of 154 participants completed the entire first 6 weeks (the intervention period) and part of the monitoring period.</p> <p>Drivers. Drivers were the theory of planned behaviour variables: attitude, intention and perceived behavioural control.</p> <p>Levers. The lever was an electronic purchase log for participants to fill in when fresh food was delivered. Attached to the chart were recommendations for when to consume fruit and vegetables safely and whether the items could be frozen, if they are not used by their use-by date.</p>
Effectiveness	<p>On the whole, participants wasted approximately 108 g less per week after the 6 weeks of the intervention (more than a quarter of which they wasted at the beginning of the 6 weeks).</p> <p>The first 6 weeks of the main study revealed a discrepancy between the reductions in fruit and vegetables wasted: participants overall wasted more vegetables than fruit. Wastage of both fruit and vegetables was reduced over the 6 weeks, but the reduction was found to be significant only for fruit.</p>
Efficiency	<p>The total budget for the intervention was GBP 59 122. No breakdown of costs was available.</p>

Sustainability over time	The participants were monitored for 24 weeks after the intervention. There was an upkeep of food waste reduction in the monitoring period.
Transferability and scalability	A similar experimental study can be conducted by focusing on fresh fruit because it was found that reduction in fruit waste was much higher than the one in vegetables in this intervention. As the study was conducted during the COVID-19 pandemic, replicating the experimental intervention in the post-COVID-19 environment should be helpful.
Systemic effects	Levers. Levers were positive attitudes regarding the environment, ethics, not being influenced by the expiration date and cognitive input (being reminded and thinking about food waste through the food waste and purchase logs).

NT10: Reducing food waste by cooking meals from a meal box versus from scratch

ID	Title: Meal planning boxes
	Countries: Belgium, Canada, Germany, the Netherlands, the United Kingdom and the United States
	Implemented by: HelloFresh
	Experiment: the data refers to a monitoring experiments of the effects, but HelloFresh has been on the market since 2011
	Intervention period: 4 November 2019 to 16 December 2019, reporting 2020
Intervention design	<p>Goal. The goal was to test whether cooking with a meal box helps to diminish food waste related to the dinner. Specific goals were to quantify the differences in reported food waste for different meal types (convenience meals, traditional meals cooked from scratch, meals cooked from a box), including food waste breakdown by stage of the meal (storage, preparation, leftovers and plate waste).</p> <p>Implementation. In total, 914 households from six countries self-reported the level of food waste (in grams) from the dinner meal (made with or without a meal box) on 3–7 days through a daily questionnaire (total meals covered: 8 788). The total amount of waste generated by meal boxes and other types of meals was compared, including a breakdown by stage (preparation, cooking, storage and leftover waste). Households provided information at multiple points using a self-reported survey.</p> <p>Drivers. Drivers were people’s skills and knowledge and creating a context (opportunity) in which planning is simplified and standard portion sizes are provided.</p> <p>Levers. Cooking from meal boxes simplifies planning and portion size estimation.</p>
Effectiveness	<ul style="list-style-type: none"> — Overall, an average of 213 g of food waste was reported as the total leftovers. — Meal boxes reduced meal waste from 20 % to 29 % compared with traditionally cooked meals. — Cooking waste in particular was much lower for meal boxes than for traditional meals (36.0 % reduction). However, meal boxes lead to a higher occurrence of plate waste. — Plate waste was significantly lower for convenience meals than traditional meals (44.9 % reduction).
Efficiency	No relevant costs were reported. Households used their own scales to measure waste and incentives for households were covered by HelloFresh itself (after finalisation, households received a meal box worth EUR 50).
Sustainability over time	HelloFresh has launched an information campaign based on the results with reference to food waste prevention in private households.
Transferability and scalability	Providing meal boxes is a business practice that can be taken up in different markets and by different providers.

Systemic effects	<p>The study has indicated that differences between types of meals (the composition of the boxes) have a large impact on the amount of food waste from that meal and should be taken into consideration in future studies.</p> <p>Provision of standardised portion sizes appears to be very helpful in reducing cooking waste but could lead to a shift of waste to the preparation stage.</p>
Key features for replicability	<p>It seems that meal boxes save food at the preparation stage but do not prevent plate waste. Hence, the effect on portion control is not clear; however, recipes to use up leftovers could be provided.</p>

NT11: Seika social experiment

ID	Title: Social experiment on food waste reduction
	Country: Japan
	Implemented by: Kyoto Prefectural University and Seika Town Council's Environment Department
	Experiment: yes
	Intervention period: intervention period, 3–23 December 2018; pre-intervention measurement period, 27 November to 2 December 2018; reporting period, 27 November to 23 December 2018
Intervention design	<p>Implementation. Households were recruited for monitoring of the effect of the intervention. Overall, 37 households were gathered: 13 households of town hall officers, 15 from local environmental groups and nine of those who responded to the call for volunteers. Households were asked to put into practice the following three things.</p> <ul style="list-style-type: none"> — In the preparation of every meal, the use of items that have shorter shelf lives must be prioritised. — When going shopping for food, a shopping list is to be made and only the items on the list should be purchased. — The refrigerator is to be kept tidy and priority items are to be placed in a designated visible area. <p>Households were to separate avoidable food waste into plate residue (items that were placed on the dining table and discarded after the meal) and other avoidable food waste (items that had not been prepared and ready-to-eat items stored in containers or packaging).</p> <p>Both types of avoidable food waste were to be weighed with the provided scales and recorded, along with a description of the items and the reasons why they went to waste. Recording of waste took place for 1 week before the intervention and for 2 weeks while the intervention took place.</p> <p>Volunteer households were recruited and given a manual (instruction sheets) on the intervention and measurement/recording. Before the intervention, households were invited to a briefing session. In total, 22 out of the 37 volunteer households attended the briefing session.</p> <p>Monitoring. Monitoring concerned the differences in self-reported weights and reports of the amount of food waste between the pre-intervention and intervention periods. After the intervention, participants completed a questionnaire/survey on changes in their behaviour during the intervention.</p> <p>Drivers. Drivers were skills relating to food planning, shopping, preparation and storage.</p>
Effectiveness	<p>Three measures (regarding shopping, storage in refrigerators and preparation of meals) on food waste reduction were suggested to volunteer households that recorded their daily amounts of food waste. During the intervention period, a 44 % reduction in avoidable food waste was observed.</p>

	<ul style="list-style-type: none"> — The majority of households reported that they checked the content of the refrigerator more often during the intervention. Similarly, they made more efforts to place items that were a priority to consume in a visible position in the refrigerator. — Plate residue waste was reduced by more than 31.6 %, while there was a 50.7 % decrease in other avoidable food waste (items that had not been prepared and packaged ready-to-eat items). — However, the majority of participants reported that there was no change in making a shopping list or in replacing items in the recipe book with items that were a priority to consume. — For all behavioural items, households that changed their behaviour recorded a larger reduction in the amount of food waste during the intervention. — Regarding the ease of practising the suggested measures, replacing items in recipes and only purchasing what is on the shopping list were perceived to be more difficult than other measures.
Efficiency	The total budget was JPY 1 027 000.
Sustainability over time	No observation was made to assess the continuity of effects. Academic papers, conference presentations, workshops for municipal officers and researchers and PR materials for the promotion of food waste reduction were created utilising the results. The results were presented to the residents of Seika through regular newsletters and a public lecture.
Transferability and scalability	The local authority's (and neighbourhood association's) cooperation is essential. The project involved volunteer households that were interested in the topic and were very cooperative. That level of interest and cooperation cannot be expected from all other residents in the town.
Systemic effects	Some households reported that, through the intervention, they have realised that the reduction of avoidable food waste results in the reduction of expenditure on food.

NT12: Study on effect of gamification

ID	Title: Food waste reduction: a test of three consumer awareness interventions
	Country: Canada
	Implemented by: university
	Experiment: yes
	Intervention period: 12 weeks (2018)
Intervention design	<p>Objective. The study focused on comparing the effects of three strategies on household food waste reduction. The three strategies tested were:</p> <ul style="list-style-type: none"> — an information-based campaign using passive approaches (newsletters with background information, tips to reduce waste); — information plus community workshops (group discussions, activities, quizzes with small prizes); — an information campaign augmented by an online game and five trivia questions per week, with a reward of a CAD 20 grocery card if a certain number of points was reached. <p>Pre intervention. Waste audit samples were collected from 164 single-family homes. Edible food waste was 37 % of the combined garbage and green bin waste and 64 % of all food waste: 1.1 kg to 1.5 kg per week per person. Participants completed sociodemographic information surveys.</p> <p>Post intervention. Waste audit samples were collected from 146 single-family homes. Participants completed a survey about information material and</p>

	<p>perception of changes. Focus groups were held 3 months after the intervention (focusing on barriers to food waste reduction despite increasing awareness).</p> <p>Drivers. The driver was a lack of knowledge of food waste.</p> <p>Levers. Gamification can be an effective strategy compared with provision of information alone.</p>
Effectiveness	<p>After the intervention, the range of edible food waste recorded was 0.9 kg to 1.3 kg per week per person, which was lower than the baseline amount.</p> <p>Awareness of food waste increased more in the two campaign groups than in the control group.</p> <p>The amount of food waste per capita per week produced by the game group was about 30 % lower than that produced by any of the other groups by the end of the campaign. There was no statistically significant difference in food waste changes between the groups (marginally significant decrease in the game group compared with the control and information groups). Further study of gamification effects is suggested.</p>
Sustainability over time	<p>A follow-up publication covered the evaluation of the intervention specifically in terms of motivation, opportunity and ability (through focus groups 3 months after the intervention).</p> <p>Motivation. Motivations were the gift card prize associated with participation in the intervention, the booklet with information, the workshops for communities and the game.</p> <p>Opportunity. Opportunities were workshop invitations, game reminders, newsletters and fridge magnets.</p> <p>Ability. Abilities were game reminders, workshops, the game, newsletters and fridge magnets.</p>
Systemic effects	<p>Levers. Repeated playing and engagement with the game is necessary to sustain food waste reduction.</p> <p>Drivers. Competing goals may negatively impact motivations to reduce food waste.</p>
Notes	<p>No information was available on efficiency or transferability and scalability. See Soma et al. (2020).</p>

NT13: Study on use of social marketing for food waste reduction

ID	Title: Food waste social marketing pilot 'waste not, want not'
	Country: Australia
	Implemented by: university
	Experiment: yes
	Intervention period: NA
Intervention design	<p>Implementation. The experiment was based on social marketing theory.</p> <p>Hypothesis. Evidence indicates that behaviour change is more likely when more social marketing benchmark principles are applied.</p> <p>Research questions/objectives. (1) Can a social marketing programme designed with consumers reduce household food waste behaviour? (2) How are social marketing benchmarks applied to reduce food waste?</p> <p>The consumer insight-driven social marketing programme called 'waste not, want not' was designed following the social marketing process and delivered to Redland City Council residents located within the pilot area. Over 2 weeks, the programme delivered an interactive shopping centre display consisting of daily food demonstrations delivered by a chef, community engagement with volunteers who offered food to taste, free recipe cards and discussions about what could be made from the food available in the display fridges. The programme culminated</p>

	<p>with a cook-off event featuring two local chefs. The programme group received a package of intervention materials that consisted of a shopping bag, chopping board, a set of 16 recipe cards, an invitation flyer and a shopping list.</p> <p>Monitoring. Participants self-reported food waste through a telephone survey.</p>
Effectiveness	<p>Outcome evaluation indicated that the pilot study reduced self-reported household food waste and increased perceived levels of self-efficacy in cooking for the programme group, but not the control group. The 'waste not, want not' programme successfully applied five of the eight social marketing benchmark criteria, namely consumer orientation, insight, competition, marketing mix and behaviour change.</p> <p>The proportion of respondents reporting throwing out hardly any fruit and vegetables in the programme group increased by 41 %, with 44.5 % reporting throwing out hardly any fruit and vegetables at baseline, compared with 62.6 % reporting throwing out hardly any fruit and vegetables after the intervention; no significant change was observed in the control group.</p> <p>Statistical tests showed a significant increase in cooking self-efficacy for the programme group.</p> <p>Intervention was co-created with consumers. Indications that it was successful, but rather crude measurement.</p>
Transferability and scalability	<p>Given that the use of more benchmarks increases the likelihood of behaviour change, future research must advocate for complete application of the eight major social marketing benchmark criteria in programme design. Clear operational definitions are required to improve practice and behavioural change outcomes.</p>
Notes	<p>No information was available on efficiency, sustainability over time or systemic effects.</p>

NT14: Use It Up Tape – visual prompt for leftover consumption

ID	Title: Use It Up Tape – visual prompt for leftover consumption
	Country: Australia
	Implemented by: OzHarvest (NGO)
	Experiment: no
	Intervention period: ongoing (started late 2021)
Intervention design	<p>Goal. The goal is to reduce food waste at home using a visual prompt (tape) to promote a key target behaviour: 'Once a week make a meal that combines food in fridge or pantry that needs to be used up.' The tape is used to mark out a place in the fridge or pantry where food that needs to be used can be placed as a reminder. The tape can also be used on individual food items.</p> <p>Implementation. This is a field experiment in households, with pre- and post-intervention food waste measurements being taken. The consumers targeted are families, students, people living on their own and those living communally.</p> <p>Drivers. The driver is breaking habitual behaviours with food use at home.</p> <p>Levers. The lever is providing a visual prompt to encourage citizens to use the food that needs to be used.</p>
Effectiveness	<p>A 40 % reduction in household food waste, especially fresh fruit, vegetables and meat (50 % under these food categories), has been recorded.</p>
Efficiency	<p>Efficiency can be calculated as $(440 \text{ g} \times \text{number of households}) / \text{AUD } 205 \text{ 000}$.</p>
Sustainability over time	<p>There are no current monitoring plans.</p> <p>No partnership with a major Australian supermarket is planned to sell the tape to customers.</p> <p>Sustainability would depend on recurrent media and social media campaigns.</p>

Transferability and scalability	The intervention is transferable to any household worldwide.
Key features for replicability	This is a relatively easy and cheap intervention, with a large impact on self-reported food waste. The emphasis of the outreach is on reducing food waste, but it also has a strong climate action focus. A recurring message is that reducing food waste is one of the most impactful things an individual can do to tackle climate change.
Notes	No information was available on systemic effects. For more information, see the OzHarvest web page on Use It Up Tape .

Other nudges for household food waste

NH1: Food waste calculator

ID	Title: The less food waste project: food waste calculator for households
	Country: Finland
	Implemented by: Paulig Ltd and Natural Resources Institute Finland
	Experiment: no
	Intervention period: 30 March 2021 to 30 September 2022
Intervention design	<p>Objective. The objective was to get Finnish households to reduce food waste by offering information on households' food waste – its amount, how it is generated and its economic and climate impacts – and inspiration and tips to reduce it. The calculator was based on the extensive 2010–2012 foodspill food waste diary study by Natural Resource Institute Finland. In addition to measuring food waste and providing background information, the participants answered over 100 questions related to their shopping behaviour and food waste.</p> <p>The aim of the calculator is to make the consumer pay attention and understand their own food waste. The calculator offers the consumer concrete facts and numbers regarding their own food waste amount, its monetary value and its climate impact. This information is meant to be thought-provoking; in the best case scenario, it leads to changes in the consumer's behaviour and thus reduces food waste. The calculator has enabled its users to access information on how to improve their household economy skills by offering information on the causes and amounts of food waste (e.g. throwing out 2 dl of coffee a week equals circa 20 kg of waste annually), and how to avoid and reduce it (e.g. tips for better planning and storage and recipes for using food that would otherwise be waste).</p>
Effectiveness	It is difficult to estimate the amount of prevented food waste, but the food waste calculator already has 70 000 users. The average person in Finland currently produces 20–25 kg of food waste per year - around EUR 500 million. As climate impact, this corresponds to around the use of 140 000 passenger cars per year. However, different monitoring and research methods and different regions produce different results.
Efficiency	The overall budget was approximately EUR 100 000; EUR 25 000 was used for labour, EUR 20 000 for project management and EUR 30 000 for development of the digital platform. By the end of September 2022, the cost to add one user to the calculator was approximately EUR 1.4.
Sustainability over time	It is estimated that the intervention has had an effect on awareness since its launch in March 2021. The amount of users is followed and monitored closely through Google analytics and calculator use. Paulig Ltd will continue its communication on the food waste calculator. In the spring of 2022, Paulig Ltd wanted to focus on young people and encouraging them to reduce food waste. Paulig Ltd combined a material package on food waste and the calculator and collaborated with well-known Finnish influencer Pinkku Pinsky to make an inspiring video on the subject. The material package, including the information, tips, assignments and inspiration, was then offered open access to schools and everyone else in Finland. Many schools

	expressed interest in using the material in their home economics classes. Communication activities were to continue in the autumn of 2022, for example gathering feedback from home economics teacher regarding the food waste communication materials.
Transferability and scalability	<p>Transferability. Transferring the intervention would require calculating food waste amounts in different countries and resetting the calculator based on these values (i.e. large holistic food waste diary studies would be needed).</p> <ul style="list-style-type: none"> — Barriers. Data is always local and country specific. — Enablers. Food waste is a huge global problem but the means to reduce it are also global. <p>Scalability</p> <ul style="list-style-type: none"> —
Systemic effects	<p>Drivers. Drivers were who in the household did the grocery shopping, whether the household recycles waste, the kind of food bought and wasted (e.g. dairy, meat) and if the household was not aware of food waste's impact.</p> <p>Levers. Levers were raising awareness of households' food waste amount, its cost and how it is generated.</p>
Notes	For more information, see the less food waste project website .

NH2: Study leveraging cognitive dissonance to reduce household food waste

ID	Title: Food waste: disapproving, but still doing. An evidence-based intervention to reduce waste at household
	Country: France
	Implemented by: University of Lorraine, Aix-Marseille University and a French town's local authority for garbage collection and management
	Experiment: yes
	Intervention period: October 2014 to December 2015
Intervention design	<p>This was a dissonance-based intervention that used induced hypocrisy (i.e. making individuals aware of the gap between their normative beliefs and their transgressive behaviours). This involved the following experiments.</p> <ul style="list-style-type: none"> — Distribution of information (leaflets on the consequences of food waste and ways to reduce waste). This was a door-to-door intervention covering 34 households. — Awareness-raising intervention (food waste diary). A kitchen diary was used as a tool. Participants were provided with a paper kitchen diary containing a table to be completed, which included instructions to weigh food waste and to indicate the category of food waste; they also had to report why solid food was thrown away. This covered 33 households. — Implementation of cognitive dissonance principles (change of behaviour is related to a tension / reduction of tension dynamic, that is, arousal-then-reduction processes). Under the pretext of supporting a future campaign against food waste launched by a local public authority, the participants preached in favour of the reduction of food waste. They filled in a form about the means of reducing food waste and indicated their names, ages and cities of residence. Then, to recall their transgressive behaviours, they privately replied to three items in a survey, which asked them to describe transgressions and estimate the quantity of food their households had thrown out during the last 2 weeks. This covered 29 households. <p>The experiments had three steps: pre-experimental measurements, the experimental step and two post-experimental measurements.</p>

	Lever. Hypocrisy and recollection of past transgressive behaviour helps reduce food waste.
Effectiveness	<p>Results suggest the dissonance-based experiment was more effective at reducing food waste but only from the middle-term perspective (5 weeks). Interestingly, the awareness-raising experiment generated the opposite effects, as it seems that participants, when filling in the diaries, discovered that they wasted less food than they had thought.</p> <p>This is an interesting intervention for several reasons. First, it has clear policy implications, as it was funded by regional authorities who were engaged in different phases of the study. Second, in spite of difficulties, it relied on an objective measurement of food waste instead of using self-reported measures. It has been shown that this is not an easy task, with a high likelihood of participants' abandonment of the measure. Third, it compared three ways of providing information to induce behavioural change. The third intervention is particularly important as it deals with the paradigm of induced hypocrisy (the contradiction between social values and counternormative behaviours). Fourth, two post-intervention assessment periods were designed (1 and 5 weeks after the intervention) to test the durability of the intervention's impact, as behavioural changes could not have had an immediate effect.</p>
Sustainability over time	The intervention's sustainability over time has not been measured. The dissemination of the intervention has been through a scientific publication.
Transferability and scalability	<p>Some uncertainties arise regarding the extent to which these types of experiment can be scaled up or even extrapolated to other locations such as larger towns where garbage bags are collected in a different way.</p> <p>Enablers of transferability and scalability. The intervention should have the local authorities' support.</p>
Systemic effects	<p>Trade-offs are as follows.</p> <ul style="list-style-type: none"> — Recording the quantities of waste daily is no more effective than receiving information on reducing the actual quantity of waste. — The kitchen diary is thought to have led households to observe that, although they did create waste, it was only in small quantities. This bias could lead people to admit only a slight responsibility for global food waste. <p>Drivers. Drivers are the dilution of responsibility, not understanding cumulative effort, big portions and ignorance regarding cooking leftovers.</p>
Notes	<p>No information was available on efficiency.</p> <p>For more information, see Pelt et al. (2020).</p>

NH3: Study on eco-feedback device

ID	Title: Study on eco-feedback device
	Country: Canada
	Implemented by: Eindhoven University of Technology
	Experiment: yes
	Intervention period: 31 January 2016 to 30 April 2016

Intervention design	<p>This intervention developed a human-computer intervention system with the purpose of delivering messages on food waste and its impacts in the moment that waste occurs (throwing away food in a bin).</p> <p>Ecomate is an augmented bin that captures and visualises domestic food waste data as more readily comprehensible and accessible information that can be used within a home or in a semi-public environment.</p> <p>It immediately shows consumers their food waste amounts within their own kitchen environment, with the intention of eliciting self-reflection on what it means to waste food daily without much cognitive effort.</p> <p>Ecomate is designed to affect consumers in their immediate environments in relation to the food practices at hand, to regularly remind them about food waste and to support interventions with the goal of reducing food waste.</p>
Effectiveness	<p>The study showed that Ecomate potentially had a positive impact on participants' awareness of and behaviour towards their food waste. Participants who had Ecomate installed in their kitchens showed a significant decrease in food waste overall. In particular, they showed a decrease of almost 32 % in edible or once edible food waste and a 69 % decrease in generated compost waste from the first 2 weeks (baseline) to the last 2 weeks.</p> <p>The findings were the result of increased awareness. The constant presence and immediacy of Ecomate served as a reminder and provided their understanding of how much they waste as a group. Their awareness was reflected in how they adapted their shopping behaviour as one way to reduce waste at home.</p>
Efficiency	<p>Material costs. The tablet hardware cost EUR 500, scales cost EUR 250 and tablets cost EUR 300.</p> <p>Labour costs. For the development of Ecomate, a student assistant worked on the project for about 3 months. Therefore the total number of hours would be around 40 in this time range, which cost 40 × EUR 25 = EUR 1 000.</p> <p>There was at least EUR 5 000 of direct investment in the development of Ecomate; the overall cost of this Doctor of Philosophy degree project was about EUR 230 000. (supported by Erasmus Mundus funds and a Canadian scholarship)</p>
Sustainability over time	<p>Numerous scientific publications have been published related to the same project. There is no knowledge on the specific long-term effect of intervention.</p>
Transferability and scalability	<p>Transferability and scalability potential hinges on finding a commercial partner to develop and maintain the device.</p> <p>The Ecomate used was a prototype. It is difficult to estimate the real cost for this device, although it does seem to be relatively cheap for households. Scalability is feasible if combined with the effective communication tools tested in previous literature, as the tools used here specifically addressed university students.</p>
Systemic effects	<p>Drivers. Drivers were unawareness of food waste quantities, lack of clarity of the collective impact, excessive purchasing, limited food literacy, storage and leftovers.</p> <p>Levers. Levers were economic incentives, self-comparison, social comparison, self-reflection and concern for the global food security issue.</p> <p>Synergies and trade-offs. Ecomate affected awareness and encouraged users to translate their reflections on food waste into interventions, for instance buying prepared and cut vegetables or buying in smaller amounts.</p> <p>The use of servings and averages did not provide sufficient information for the users, as it left questions open such as what is wasted, when it was wasted, and most importantly who wasted it. Therefore, this left some participants distrusting the accuracy of the prototypes or other users' abilities to use the zero-waste station as it was supposed to be used.</p>

Notes	See Lim et al. (2021).
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NH4: Study on social media use for awareness

ID	Title: Can social media be a tool for reducing consumers' food waste? A behaviour change experiment by a UK retailer
	Country: United Kingdom
	Implemented by: University of Leeds, KEDGE Business School and Asda (retailer)
	Experiment: yes
	Intervention period: 1 October 2014 to 15 February 2015
Intervention design	<p>This is an attractive experiment based on a successful dual approach between researchers and practitioners called co-production. A shortlist of interventions was drafted collaboratively by researchers and retailers' marketing/sustainability departments. The interventions were as follows.</p> <ul style="list-style-type: none"> — Asda magazine. The magazine was distributed to 1.9 million readers every month and was available in stores and online. It published an article providing tips to reduce household food waste. It specifically highlighted methods to make the most of the most commonly wasted foods based on data from WRAP and the Everyday Expert Panel. Food covered in the article comprised (1) fruit and vegetables, (2) meat and fish, (3) bread and baked goods, (4) dairy items and (5) cooked rice and pasta. — Asda e-newsletter. The e-newsletter is circulated every 2 weeks and has a readership of 1.4 million customers. This intervention was circulated once in conjunction with the social media campaign. The e-newsletter had two specific features addressing household food waste. The first feature discussed using leftovers to reduce food waste and consisted of a web link connecting customers to the social media campaign encouraging them to share ideas for reducing food waste. The second feature highlighted correct storage as a method of keeping food fresh and preventing waste and provided a link for purchasing food storage items. — Social influence intervention: Asda's Facebook pages. Asda's Facebook site has 1.4 million likes; the intervention was designed to take advantage of this fact and consisted of posting a leftovers campaign on Facebook. This campaign asked Asda customers to submit their favourite recipes that involved using leftover food and directed users to a website providing WRAP's 'love food, hate waste' tips on reducing food waste at home. <p>Effectiveness was measured at three points: time 1 was baseline, time 2 was 2 weeks after the intervention and time 3 was 5 months after the intervention.</p> <p>Driver. The driver was food waste behaviour.</p> <p>Lever. The lever was social influence.</p>
Effectiveness	<p>For food waste quantity, there was a significant effect over time.</p> <ul style="list-style-type: none"> — Those who were exposed to the magazine showed a reduction in reported food waste between time 2 and time 3. No significant change was shown from time 1 levels. — Those who were exposed to the electronic newsletter showed a significant difference in their frequency of food waste time between time 2 and time 3. There was no significant reduction from time 1 levels. The food waste quantity showed a reduction between time 1 and time 3. — Those who viewed the Facebook intervention showed a significant difference in their frequency of food waste between time 2 and time 3. However, there was not a significant reduction from time 1 levels. For the quantity of food waste, there was a significant change between time 2 and time 3. A smaller change was seen between time 1 and time 3.

	None of the three intervention groups managed to perform better than the control group.
Efficiency	<p>The intervention cost GBP 180 000, not including Asda's costs for implementing the intervention. The cost breakdown is confidential due to working with a private company.</p> <p>It is estimated that those who saw the intervention saved GBP 57 in avoided food waste a year.</p> <p>The research sample size was 20 000, with an estimated 2 million customers having seen one intervention.</p>
Sustainability over time	The sustainability over time has not been measured. The dissemination of the intervention has been through a scientific publication.
Transferability and scalability	<p>Barriers. An intervention implemented in a food retailer competes with routine marketing campaigns run by the retailer and its suppliers. Measuring the actual food reduction in households for 18 million customers was not financially feasible.</p> <p>Enablers. One enabler was the retailer having daily or weekly contact with its customers, who have brand loyalty. Finding which environmental issues the customers would trust their food retailer to provide information on and gaining permission to influence this was key. Food waste was seen as one of these issues; hence, customers were more receptive to engaging with the interventions and reducing food waste.</p> <p>The intervention could be transferred to another study targeting customers from a large retailer with the same characteristics and resources as Asda.</p> <p>Scalability. The wider the reach to mainstream consumers was, the less impact was achievable per customer. Hence, the greater scale of the intervention meant big reductions in food waste overall, but smaller reductions per customer. In previous small-scale intensive interventions, greater food waste reductions were achieved per customer, but the total reduction was still small.</p> <p>Enablers of scalability. Enablers are government policy that fosters the implementation of this kind of social media influence intervention and the provision of enough resources.</p>
Notes	<p>No information was available on systemic effects.</p> <p>For more information, see Young et al. (2018).</p>

Labelling and visual cues on food packaging

NL1: Day on date label

ID	Title: Day on date label
	Country: United Kingdom
	Implemented by: WRAP
	Experiment: yes
	Intervention period: ongoing (started 1 June 2019; projected end date 31 March 2023)
Intervention design	<p>The day on date labels behavioural change intervention is an innovative label design aimed at reducing food waste by changing citizen behaviour. The intervention is a simple, behaviourally informed change to a date label so that labels display the day as well as the date to help citizens to use up their food before it expires.</p> <p>The hypothesis of this pilot is that by adding the day on the date label, the label will be more salient to the consumer. This increased salience will lead to the following behaviour changes in the home:</p> <ul style="list-style-type: none"> — more attention paid to the date label; — greater understanding of the connection between the day and date; — timely consumption of the food, thus avoiding wastage; — prioritisation of food close to its use-by date;

	— other methods of preserving the food for later consumption (e.g. freezing).
Sustainability over time	Dissemination of results will occur through WRAP's website.
Transferability and scalability	Barriers to transferability. Previous testing indicated that the day on date label intervention would be effective on certain products only. Barriers to scalability. Barriers are the ease of implementation from a manufacturing perspective (e.g. cost of changes to software and hardware when changing the printing of a date label) and the size of the space on packs where date label information is to be printed.
Systemic effects	Drivers. Drivers are a good understanding of food labelling and an understanding of what day it is. Trade-offs. It could elicit a 'chuck' response (e.g. making the day more salient may make the citizen throw the meat away).
Notes	No information was available on effectiveness or efficiency.

NL2: Evaluation of date labelling campaign encouraging consumers to look-smell-taste

ID	Title: Date labelling campaign
	Countries: Austria, Belgium, Denmark, France, Germany, Italy, Netherlands, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom
	Implemented by: Too Good To Go
	Experiment: no
	Intervention period: ongoing (started April 2020), reporting April 2020 to February 2022
Intervention design	<p>Objective. The intervention aims to change packaging, reclassify how products should be labelled and shake up the way consumers judge whether food is safe to eat. To implement the intervention on a large scale, Too Good To Go has teamed up with some of the world's biggest food brands. The intervention consists of displaying a pictogram on products with best before dates, to inspire consumers to use their senses, rather than automatically throwing the product away. The pictogram was designed to be stamped on foods that carry a best before date and it prompts us to check our food using our senses instead of simply binning it due to a lapsed best before date.</p> <p>An awareness-raising label has been designed for the campaign. Manufacturers across Europe have been encouraged to include the label on their products with best before dates and to join communication efforts targeting both employees and customers to inform them of the behaviour to adopt.</p> <p>In all 12 countries where the campaign is running, the initiative is also supported by relevant public authorities: national food authorities, related ministries or, occasionally, governments.</p> <p>Drivers. Drivers are a lack of understanding of differences between types of expiry date, a lack of clarity and visibility of expiry dates displayed on products and a lack of awareness of food waste linked to date marking.</p> <p>Levers. Levers are emphasising the difference between types of date labels and promoting behaviour change regarding products with best before dates.</p>
Effectiveness	<p>The current intervention results are as follows.</p> <ul style="list-style-type: none"> — In total, 483 brands have joined the campaign and ± 1.8 billion individual product packages carry the awareness label. — 16 % of consumers have noticed the awareness label on products. — There is an improved understanding of date labels. — 71 % of consumers have been inspired to change their behaviour (to look-smell-taste before wasting).

	<ul style="list-style-type: none"> — 67 % of consumers say that the label makes them more aware of the food waste problem and that they are now willing to reduce food waste. <p>The intervention is not targeted at a specific group of individuals; it has been rolled out across 12 countries in Europe and is currently displayed on billions of individual product packages. According to the survey results, 16 % of consumers have noticed the intervention, so it can be assumed that 40 million to 50 million individuals have seen the intervention.</p> <p>The overall scale and reach of the intervention shows that food businesses are both willing and able to commit to efforts to play an awareness-raising role regarding date labels in order to reduce consumer food waste levels.</p> <p>The key success factors of this intervention lie primarily in its scale (nearly 500 brands have joined) and consumer reach (40–50 million, estimated) across 12 countries in Europe. In addition, one of the survey conclusions shows a level of impact, as significant numbers of consumers have been inspired by the intervention to adopt the right behaviour when it comes to products with best before dates and to do more to reduce consumer food waste.</p> <p>Another strength is the wide variety of groups involved in the intervention campaign, including public and private organisations from across the food supply chain and also government bodies, NGOs and academics.</p>
Efficiency	Labour costs are 50 % to 75 % of the annual salary of a campaign manager per country (so salary will vary) plus the costs for companies to change label designs (not accounted for).
Sustainability over time	<p>A feedback form was recently issued to partners implementing the intervention. Adjustments are being made to facilitate on-pack implementation of the intervention (e.g. using two colours instead of four). No other monitoring plan is currently planned.</p> <p>In-store communication campaigns (in collaboration with retailers) targeted at consumers are reinforcing the intervention, for example:</p> <ul style="list-style-type: none"> — Too Good To Go communications (PR, social media content, newsletter, website, business-to-business marketing); — the involvement of influencers; — communications (including via social media) by government bodies.
Transferability and scalability	<p>Scalability. This was a priority when designing the intervention. One occasional barrier identified during the implementation of the intervention relates to available packaging space and material type, which was resolved by creating larger and smaller variations of the intervention. The intervention now functions on all packages (large, small, square, round, plastic, carton, etc.)</p> <p>Another barrier relates to language issues with the intervention, which is best addressed in conversation with either food authorities or related ministries in a given country.</p> <p>The intervention is already being scaled up from 1 to 13 markets and this is likely to increase further. It is also being scaled up in terms of the number of brands joining the intervention, with nearly 500 large and small brands now participating.</p> <p>Transferability. The labels are available in different graphic iterations, in different languages, in different sizes and at different levels of detail.</p>
Systemic effects	Survey results confirmed that there is confusion around date labels, but this was different than expected (a response bias showing that people thought food was OK to eat for too long after best before dates).
Notes	For more information, see the Too Good To Go web page on the look, smell, taste, don't waste campaign .

NL3: On-pack storage and consumption guidance (Refresh)

ID	Title: On-pack storage and consumption guidance (Refresh)
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	Countries: Germany, Spain, Hungary and the Netherlands																																																				
	Implemented by: Wageningen University & Research and Samen Tegen Voedselverspilling																																																				
	Experiment: yes																																																				
	Intervention period: 11 July 2017 to 31 July 2017																																																				
Intervention design	<p>Goal. The goal was to stimulate consumers to make better storage decisions by providing two types of on-pack information – date labelling and storage advice.</p> <p>Implementation. The two types of on-pack information were tested through online surveys.</p> <p>Table 1: Products and date marks selected for testing – date labelling</p> <table border="1"> <thead> <tr> <th>Product</th> <th>Date marks</th> <th>Type of label and date format</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Yoghurt</td> <td>Use By</td> <td>Non-sticker-effect</td> </tr> <tr> <td></td> <td>Non-sticker-effect</td> </tr> <tr> <td rowspan="2">Orange juice</td> <td>Best Before</td> <td>Sticker-effect</td> </tr> <tr> <td></td> <td>Sticker-effect plus day of the week</td> </tr> <tr> <td rowspan="2">Pre-packaged carrots</td> <td>No date</td> <td>Non-sticker-effect</td> </tr> <tr> <td>Display Until</td> <td>Non-sticker-effect</td> </tr> <tr> <td rowspan="2">Bagged oranges</td> <td></td> <td>Non-sticker-effect</td> </tr> <tr> <td>Best Before</td> <td>Sticker-effect</td> </tr> </tbody> </table> <p>Table 2: Products on pack guidance selected for testing – storage guidance</p> <table border="1"> <thead> <tr> <th>Product</th> <th>Guidance</th> <th>Type of label</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Pre-packaged carrots</td> <td>No storage guidance</td> <td>Non-sticker-effect label</td> </tr> <tr> <td>For best quality store in the fridge</td> <td>Non-sticker-effect label</td> </tr> <tr> <td rowspan="2">Bagged oranges</td> <td>Keep me in the fridge</td> <td>Sticker-effect label</td> </tr> <tr> <td>Store in a cool, dry place</td> <td>Non-sticker-effect label</td> </tr> <tr> <td rowspan="2">Bread</td> <td>For best quality do NOT store in fridge</td> <td>Non-sticker-effect label</td> </tr> <tr> <td>Do NOT store in fridge</td> <td>Sticker-effect label</td> </tr> <tr> <td rowspan="2">Chicken portions</td> <td>No guidance</td> <td>Non-sticker-effect</td> </tr> <tr> <td>Freeze by date</td> <td>Non-sticker-effect</td> </tr> <tr> <td rowspan="2">Loaf of bread</td> <td>Freeze on day of purchase</td> <td>Non-sticker-effect</td> </tr> <tr> <td>Chicken portions</td> <td>Suitable for freezing by date</td> <td>Sticker-effect</td> </tr> </tbody> </table> <p>Participants were shown either three or four labels for each product type and asked about how they would act (their intended behaviour) in response to the guidance shown. They were also asked to rate the helpfulness of the guidance.</p>	Product	Date marks	Type of label and date format	Yoghurt	Use By	Non-sticker-effect		Non-sticker-effect	Orange juice	Best Before	Sticker-effect		Sticker-effect plus day of the week	Pre-packaged carrots	No date	Non-sticker-effect	Display Until	Non-sticker-effect	Bagged oranges		Non-sticker-effect	Best Before	Sticker-effect	Product	Guidance	Type of label	Pre-packaged carrots	No storage guidance	Non-sticker-effect label	For best quality store in the fridge	Non-sticker-effect label	Bagged oranges	Keep me in the fridge	Sticker-effect label	Store in a cool, dry place	Non-sticker-effect label	Bread	For best quality do NOT store in fridge	Non-sticker-effect label	Do NOT store in fridge	Sticker-effect label	Chicken portions	No guidance	Non-sticker-effect	Freeze by date	Non-sticker-effect	Loaf of bread	Freeze on day of purchase	Non-sticker-effect	Chicken portions	Suitable for freezing by date	Sticker-effect
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Effectiveness	<p>Date labelling results are as follows.</p> <ul style="list-style-type: none"> — The effects of adding a sticker to the date label were mixed. The sticker-effect label on yoghurt resulted in more appropriate behaviour (77 % compared with 70 % when no sticker); no effect was found for orange juice, pre-packaged carrots or bagged oranges. — No evidence was found that adding the day of the week to a best before label increased effectiveness. <p>Storage guidance results are as follows.</p> <ul style="list-style-type: none"> — Providing guidance about optimal storage location is likely to significantly change behaviour in a positive direction (the intention to store optimally tripled on average). — Guidance in a directive tone on sticker-effect labels was rated as the most helpful. This is information such as 'Keep me in the fridge'. <p>The study concerned self-reported behavioural intentions, so obtaining more evidence of actual behaviour would be insightful.</p>																																																				
Transferability and scalability	Guidance on storage and expiration dates could be placed on product packaging by manufacturers. There was no action plan in place.																																																				

Key features for replicability	<p>The artificiality of the test environment may have contributed to the results so, despite the lack of evidence from this study, the approach might be worth testing in a real-world setting.</p> <p>Recommendations. To capitalise on the potential for on-pack labelling to help reduce food waste, manufacturers and retailers should consider removing use-by dates from products where they are not required; removing or codifying display-until dates, since these can cause consumer confusion; replacing 'freeze on day of purchase' with 'freeze by [date]'; and including guidance on where and how to store fresh produce.</p> <p>See the latest DG Health and Food Safety recommendations on date labelling (European Commission, DG Health and Food Safety, undated).</p>
Notes	No information was available on systemic effects, efficiency or sustainability over time.

NL4: Stickers on bread packaging and communication campaign

ID	Title: Bread campaign
	Country: Netherlands
	Implemented by: Samen Tegen Voedselverspilling
	Experiment: yes
	Intervention period: 2021–2022, with a bread commercial on TV for 3 weeks in 2021
Intervention design	<p>Goal. The goal was to show consumers ways to reduce (old) bread waste by offering concrete behavioural advice (what to do with the last slices of bread and a reminder that freezing is possible).</p> <p>Implementation. Stickers (nudges) on bread bags in retail stores were used, along with in-store flyers and posters for supermarkets and bakeries, during two annual campaigns and in a specific commercial on TV in 2021. This intervention took place in 2021 and 2022 following a 2019 global campaign against food waste (#verspillingsvrij). The campaign was evaluated through a survey conducted on a sample of 1 014 consumers and a more in-depth evaluation was conducted in a pilot study with 86 respondents, which gathered information on respondents':</p> <ul style="list-style-type: none"> — knowledge about the campaign (memory and recognition); — evaluations of the campaign; — behaviour in response to the campaign. <p>Hence, the results are based on self-reported change in respondents' behaviour.</p>
Effectiveness	<p>The results of the intervention are as follows.</p> <ul style="list-style-type: none"> — Globally, 45 % of respondents stated that they had seen the campaign (mostly thanks to stickers on bread rather than posters in stores, which were barely noticed). — On average, 45 % of respondents declared that the campaign helped them to reduce bread waste (by being more aware). — 15 % of respondents indicated that the campaign stimulated concrete action (making something tasty from old bread, freezing their bread more often, stopping buying more than needed). — The QR code on the sticker did not entice people to scan it (only 18 % indicated that they would be likely to do so). — 90 % of respondents are familiar with the advice that was given. <p>It is possible to conclude that this campaign raised awareness among half of respondents, who are now more likely to buy only what they need, but that only 15 % of respondents were stimulated to take action at home.</p>
Transferability and scalability	The intervention is scalable and transferable, but the recipes made with bread leftovers provided online could be adapted to national tastes, habits and kinds of bread.

Notes	No information was available on efficiency, systemic effects or the sustainability over time For more information, see the Samen Tegen Voedselverspilling web page on ways to waste less bread at home .
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NL5: Time-temperature indicator – Germany

ID	Title: Trialling a time-temperature indicator on salmon in HelloFresh meal boxes
	Country: Germany
	Implemented by: HelloFresh
	Experiment: yes
	Intervention period: November 2021
Intervention design	<p>The intervention assessed the trial implementation of the time-temperature indicator Keep-it as an alternative date-coding method for prepacked salmon in HelloFresh meal boxes. Due to current EU regulations, this intervention could only trial alternative approaches and consequently only showcased the theoretical potential of a time-temperature indicator regarding behaviour change and resultant food waste reductions.</p> <p>Drivers. Drivers were misunderstanding and/or misuses of commonly used expiry dates / no clear understanding of food labelling such as best before or use-by dates and the risk perception of eating unsafe (fish) products.</p> <p>Levers. Levers were offering clear information and tools regarding the safety of the (fish) products.</p>
Effectiveness	<p>Even though the actual food waste reduction seen along the food chain through using a time-temperature indicator cannot be precisely quantified, the results of the study demonstrated the great theoretical potential of these innovative packaging technologies in tackling food waste; the reduction in food waste was estimated to be around 15 % (rounded down). Both survey groups agreed that the indicator could have an impact on meal planning, correctly storing food and disposing of less food, thereby affecting the behaviour of handling food. It can also be assumed that the participants dealt with the topic of food waste by answering the survey and became more aware of the issue of food waste. Furthermore, a potential food waste reduction was also identified for HelloFresh as the meal kit provider: there could be an increase in process efficiency if the company could use the indicator as an alternative expiry date.</p>
Efficiency	<p>Investment costs (materials, design, purchasing equipment) were as follows.</p> <ul style="list-style-type: none"> — The indicator price and application cost are confidential. — EUR 14.45 was spent on flyer and product stickers for the test group of the trial. <p>Labour costs were as follows.</p> <ul style="list-style-type: none"> — The intervention was conducted in the framework of the Federal Ministry of Food and Agriculture-funded dialogue forum on wholesale and retail to reduce food waste in Germany. The resources for the work from the Johann Heinrich von Thünen Institute and the supporting organisation the Collaborating Centre on Sustainable Consumption and Production (CSCP) were covered by the project. <p>HelloFresh invested time in preparing the leaflet, including it in the boxes, setting up the survey and collecting the survey responses.</p>

	The (environmental) cost of indicator production was assumed to be negligible: 1.7 kg of CO ₂ eq was emitted in making flyers and product stickers for the test group of the trial.
Sustainability over time	The intervention did not have a measurable effect because the indicator was only used in the trial; time-temperature indicators cannot currently be used as an alternative to expiry dates. Potentially, there may have been a non-quantifiable effect on the awareness of the participants on the issue of food waste beyond the time of the survey.
Transferability and scalability	Barriers are current EU regulations requiring that a static (printed) date has to be present on a food product (Regulation (EU) No 1169/2011). Hence, time-temperature indicators are not allowed to be used as an alternative to expiry dates. The EU regulation on date marking needs to be revised to allow the use of time-temperature indicators as an alternative to expiry dates.
Systemic effects	Driver. There were concerns about the edibility of products due to the date labelling. Lever. An improved understanding of the edibility of the fish was seen thanks to the time-temperature indicator.

NL6: Time-temperature indicator – the Netherlands

ID	Title: A time-temperature indicator (Keep-it®) in the HelloFresh meal box
	Countries: Belgium (Flanders only) and the Netherlands
	Implemented by: the Wageningen Food & Biobased Research-led public-private partnership
	Experiment: yes
	Intervention period: 13 August 2020 to 3 September 2020
Intervention design	Goal. The goals were to investigate consumer experiences of a time-temperature indicator (Keep-it) on a food product (salmon sold in a food box), gauge its potential impact on food-waste-related behaviour, assess if consumers understand the indicator and assess if they consequently adapt their behaviour. Implementation. The Keep-it indicator, date-marking experiences and self-reported food waste behaviours were investigated through an online survey sent to both an intervention group, which received the product (fresh salmon) equipped with the indicator, and a control group, which only received information about the indicator. Drivers. The driver was consumers not understanding date labels. Levers. The time-temperature indicator shows the remaining shelf life based on constant monitoring of temperature over time to help consumers in planning their meals.
Effectiveness	No actual behavioural changes were investigated; only consumer experiences and opinions were assessed. 75 % of respondents expected that the Keep-it indicator would influence their meal planning and help them to throw away less food. The main results were as follows. <ul style="list-style-type: none"> — The majority agreed that the indicator was positive, reliable, useful, intuitive, value-adding and not confusing. The test group gave significantly higher scores for these aspects than the control group. — Test group participants who had seen the indicator understood it better (mean 6.2 out of 7) than participants who had not seen it and had only judged a picture of the indicator (mean 5.2 out of 7).

	<p>Most respondents (both in the test group and in the control group) expected that the indicator would:</p> <ul style="list-style-type: none"> — make it easier to see for how long a fresh product can be used; — help to determine for how long a fresh product can safely be eaten.
Sustainability over time	There have been dissemination and communication activities related to the projects. No long-term effects are known.
Transferability and scalability	<p>The indicator is currently being used in Norway.</p> <p>Barriers. The European regulation (Regulation (EU) No 1169/2011) currently does not allow time-temperature indicators on products. It states that there should always be a static, printed date.</p>
Systemic effects	An unintended consequence was that people developed new competencies while participating in the experiment: they learned more about shelf life / expiry dates and meal planning.
Key features for replicability	There is a need to monitor how consumers use the indicator in real life to be able to evaluate this solution properly.
Notes	No information was available on efficiency.

NL7: Visual cue study on labels – effects on consumers

ID	Title: Visual cue study on labels: look-smell-taste – effects on consumers
	Country: The Netherlands
	Implemented by: Wageningen Food & Biobased Research led public-private partnership
	Experiment: yes (already adopted by some brands)
	Intervention period: May-June 2021
Intervention design	<p>Goal. The goal was to test the effect date-marking-related visual cues on product packages had on the discarding behaviour of consumers.</p> <p>Implementation. The intervention was an online survey among a representative sample of 1500 Dutch participants. It involved a choice experiment in which each participant was shown product photos with or without a visual cue and were asked to imagine themselves when they wanted to prepare a meal. They were asked what to do with several products either on the day of or the day after their expiry dates: eat the food, look-smell-taste it or discard it.</p> <p>The consumers targeted were households, taking a representative sample of adults.</p> <p>Driver. The driver was misinterpretation of date labelling (use-by and best before dates).</p> <p>Lever. Additional information may help consumers in their understanding of date marking.</p>
Effectiveness	<p>For products with best before dates, the cue triggered respondents to look-smell-taste products after their expiry dates. Respondents were somewhat less likely to discard the food in the presence of a visual cue.</p> <p>For products with use-by dates, the cue triggered respondents to eat (instead of look-smell-taste) products on their expiry dates. After the expiry dates, the cue triggered respondents to discard the products instead of the look-taste-smell behaviour.</p> <p>Regarding whether visual cues on food packages can contribute to less food waste, the findings showed that the majority of consumers made similar choices with and without the cues. The group of consumers who changed their behaviour due to the cues did this in the desired direction (for products with best before dates, choosing to look-smell-taste instead of discarding products after their</p>

	<p>expiry dates), suggesting the cues had a small positive effect for products with best before dates.</p> <p>The intervention will only be effective when consumers notice these visual cues on the product packages.</p>
Sustainability over time	<p>Communication and dissemination activities, along with a Samen Tegen Voedselverspilling campaign, on visual cues and an instruction/background document are available. In addition, another study will be undertaken, which aims to take the findings of this study one step further.</p>
Transferability and scalability	<p>The research team considered an approach that is transferable, including outside the Netherlands, through the use of clear icons/symbols.</p>
Key features for replicability	<p>Replicability would require the correct translation of extra text, checks of whether visual cues are appropriate in other countries/cultures and checks of the impact on behaviour in real-life conditions.</p>
Notes	<p>No information was available on systemic effects or efficiency.</p>

Nudges out of the home

N00H1: Food waste reduction at music and arts festival

ID	Title: Zero waste of food – the right portion!
	Country: Portugal
	Implemented by: PédeXumbo, the Cultural Association for the Promotion of Music and Dance
	Experiment: no
	Intervention period: ongoing (started 2007), reporting 18 August 2022 to 21 August 2022
Intervention design	<p>The initiative is run yearly during an arts festival in Portugal. Andanças is a dance festival for the promotion of popular music and dance as the primary means of learning and exchange between generations, knowledge holders and cultures. The festival organisers encourage festival attendees to take only the quantity of food they need (the right portion – ‘<i>Dose certa</i>’). A monitoring activity was executed by volunteers on a sample representing 6 % of festival attendance.</p>
Effectiveness	<p>A comparison of recent editions of the festival in which food waste was monitored shows that there is a decreasing trend in food waste: 2015, 50.3 g/meal; 2016, 44.4 g/meal; 2022, 41.4 g/meal. In 2022, 8 371 meals were served, which corresponds to 24 kg of food waste that has been prevented.</p> <p>Outreach. The festival has a daily average of 1 379 visitors, plus 114 children under the age of 13 and 490 volunteers, artists and workers, making a daily average total of 1 983 participants.</p>
Efficiency	<p>Costs have included kitchen scales and two dynamometric scales – one 20 kg and one 50 kg – for EUR 37.5. In addition, all the work has been undertaken by festival volunteers (52), for whom PédeXumbo has paid for admission for all days of the festival, one meal a day and personal accident insurance (totalling EUR 5 626.4).</p> <p>In 2022, the total food waste produced in the 4 days of the festival was 835 kg. Of that, 384 kg was produced in the preparation and cooking of food (in the kitchen) and 451 kg was due to leftovers collected from dishes at the end of meals.</p> <p>Efficiency can be calculated as $835 \text{ kg} / \text{EUR } 5\,663.89 = 0.15$.</p>

Sustainability over time	<p>In 2006, PédeXumbo first started monitoring although still on a rough basis, waste production and separation, water and electricity consumption, food waste and the amount of water recycled and re-used were measured.</p> <p>The last results obtained for the characterisation campaigns of food waste are from 2015, 2016 and 2022.</p> <p>PédeXumbo intends to continue monitoring sustainability parameters with a special emphasis on food waste, increase the representativeness of the sample, create more posters to publicise the initiative and place dishes with different amounts of food (small, medium and large) on the service lines for users to collect their right portion without delaying queues.</p> <p>It is planned for the data obtained to be disseminated from monitoring the sustainability parameters of the Andanças festival by sharing the report with social partners, the community, municipal service operators, food service providers and the general public. It is intended for some of the data obtained to be shared through the Pédexumbo website and social networks.</p>
Transferability and scalability	<p>PédeXumbo is often asked to share best practices and contacts with other festivals both in Portugal and abroad (something PédeXumbo does with utmost pleasure). The ecological practices implemented in Andanças have been copied by other events and noted as practical solutions to daily questions. Andanças was mentioned in a legal disposition regarding the urban waste prevention programme (Portuguese Ministry of the Environment and Spatial Planning, 2010) as an example of a best practice in the social community: it mentioned the Andanças cup, the meal discount for those using their own dishware and the great reduction of general garbage production.</p>
Notes	No information was available on systemic effects.

NOOH2: Lariso

ID	Title: Does changing the meal serving matter for reducing food waste in schools?
	Country: Italy
	Implemented by: Department of Agricultural and Food Science, University of Bologna, and Emilia-Romagna region
	Experiment: yes
	Intervention period: ongoing (started October 2022)
Intervention design	<p>Goal. The goal is to verify if a change in the serving of the school meal (i.e. serving the side dish made of vegetables before the main dish) has an impact on food waste.</p> <p>Population. The intervention targets children aged 7–8 (third grade of primary school) of 7 out of 26 primary schools in the Emilia-Romagna region.</p> <p>Sample. Schools are selected through stratified random sampling. Considering the school catering service is operated by the local sanitary service, the eight Emilia-Romagna local sanitary services are considered the strata for the sample (eight strata of different dimensions in territorial areas and population). For each stratum, selected schools are randomly assigned to treatment and control groups. The stratification also considers variables such as school dimension, location (urban or rural area), type of catering provider (private or public food service) and kitchen location (internal or external to school facilities).</p> <p>Implementation. Third-grade classes in each primary school are selected. Data collection is carried out both pre intervention (with the status quo menu) and post intervention (with the change in the serving of the school meal). Leftovers are always collected in separate bins for each of the three courses, plus bread and fruit. Food waste is weighed using digital scales and recorded per class and per course. For the data collection, researchers, catering services and teachers are appointed in each school.</p>

	<p>Outcome variable. The outcome variable is waste per capita (grams/day), measured at the class level and then averaged by the number of pupils per class.</p> <p>Drivers. Drivers are food management, the environment and context influencing behaviours (opportunity).</p> <p>Levers. Levers are designing environments and modifying choice options so that they can nudge food waste reduction practices and ensure healthier dietary intakes.</p>
Effectiveness	So far, the average treatment effect has led to a preliminary rough reduction of food waste in the selected schools. Specifically, the change in the meal service has led to a decrease in the waste from the first course (pasta or similar). Other elements positively correlated with food waste reduction are the role of teachers in nudging pupils to eat during the meal and the presence of awareness material on food waste and/or healthy diets.
Efficiency	The intervention is being conducted within the Laboratorio di Ristorazione Sostenibile , a living lab where multiple groups in the school-catering sector are mobilised on different activities. As a result, no additional resources and budgets are being used for the implementation of the intervention.
Sustainability over time	The effect on pupils was measured after 3 consecutive weeks of meal order inversion. At the moment, there is no information on the effect over a longer period.
Systemic effects	The evaluation of a systemic effect will be conducted when collecting the data of the remaining 19 schools. At the moment, the evaluation of a systemic effect is not applicable.
Transferability and scalability	The research protocol is easily adaptable to different school-catering settings.
Notes	The intervention is ongoing in the other 19 Italian schools, so additional data will be collected in the upcoming months. The final results will benefit from the robustness of the schools' randomised sample.

NOOH3: Nudging strategies in school canteens

ID	Title: From evaluation to action: testing nudging strategies to prevent food waste in school canteens
	Country: Spain
	Implemented by: Research Center for Agrofood Economics and Development
	Experiment: yes
	Intervention period: February 2019 to May 2019
Intervention design	<p>The intervention tested the power of nudging strategies in preventing plate waste in school canteens by tackling its main drivers; its second objective was to provide direct daily measurements of plate waste for the whole menu. The nudging strategies were decided in collaboration with canteen staff and entailed three approaches:</p> <ul style="list-style-type: none"> — visual (menu of the day, hunger traffic light, how to eat an apple), — participatory (demonstration by canteen staff of how to cut fruit), — educational (food waste talks during tutoring time, message in the coordinator speech). <p>Drivers. Drivers were a lack of knowledge on the menu composition, not being aware of their own level of hunger, overproviding and a lack of knowledge on cutting fruit.</p> <p>Levers. Merely providing information through posters is not effective enough to change behaviour; simple demonstrations can be more effective.</p>

Effectiveness	<p>During the nudging strategies' implementation, the total daily meal waste among the four case studies was significantly reduced from the baseline values.</p> <p>On average, students from all canteens wasted more food at baseline than during the nudging strategies' implementation. This difference was 19.29 g and represented a large intervention effect.</p> <p>Nudging strategies had a major effect on preventing daily dessert plate waste, as it decreased in total by 59 % (14.43 g) from the value at baseline. This reduction was statistically significant. The results also suggested that merely using posters to provide information to students may not be effective enough, as interpretation could be subjective and not all students paid the same amount of attention to them. Contrastingly, staff performing simple demonstrations on how to cut and eat fruit seemed to be effective.</p> <p>Outreach. A total of 1768 students received the intervention daily for 10 days. In addition, canteen staff, school board members and teachers working or eating in the lunchrooms were aware of it, even though their food waste was not included in the study.</p>
Efficiency	<p>Investment costs (materials, design, purchasing equipment) equalled EUR 4 000. This covered, for example, the printing of the paper food diary and purchase of smart scales.</p> <p>Labour costs, for example wages for researchers, equalled EUR 40 000.</p> <p>Operational costs (logistics) equalled EUR 1 000. This included fuel for transportation and maintenance.</p> <p>Other fees (e.g. administration fees) totalled EUR 3 000.</p> <p>Therefore, the total cost was EUR 48 000.</p>
Sustainability over time	<p>No long-term effect is available.</p> <p>Dissemination of the results was achieved through the creation of the website (Escoles Contra El Malbaratament Alimentari). This includes all the nudging strategies designed and applied in the project, together with explanations on how to implement them. In addition, it provides tools to quantify food waste and measure the interventions' impact on plate waste. A workshop (online and in person) was held to present the study results and the designed tools. The target group was the school canteens community, including school boards, catering companies and administration.</p>
Transferability and scalability	<p>The barrier identified was to be scaled was the ratio of students to staff members needed. The higher the ratio, the larger the work overload of canteen staff; a larger overload would make it more difficult to implement new measures, such as interventions aiming to reduce food waste. The intervention could be replicable in all schools functioning in the same way as the ones in the study, which would cover at least all the public schools with canteen services in Catalonia.</p> <p>The enabler for scalability is school boards and catering companies being willing to prevent food waste.</p>
Systemic effects	<p>The intervention had an awareness-raising effect on canteen staff regarding the amount of food wasted. Many of them found this intervention useful for reviewing their school canteen processes to reduce the amount of food wasted and for improving menu acceptance by the students.</p>

NOOH4: Online experiment in retailers

ID	Title: Calm/cold state space
	Country: United Kingdom
	Implemented by: WRAP
	Experiment: yes
	Intervention period: 12 November 2018 to 30 March 2019

Intervention design	<p>Goal. The goal was to indicate or give permission that it is OK to take an item of food out of a shopping basket/trolley and not purchase it when reaching the checkouts in supermarkets/stores.</p> <p>Just before the checkouts, when people are likely to be in a more rational mindset or 'cold state' (thinking about paying!), different messages were tested to prompt shoppers to think about whether they will eat all of the food they have picked up. The intervention also provided a space where they could leave excess products.</p> <p>The research was conducted through a survey to explore if the intervention would be effective or not and whether it would be worth implementing in stores. The goal of the research was to provide the information needed to design the intervention.</p> <p>Implementation. Four messages were tested, each based on a different behavioural principle.</p> <ul style="list-style-type: none"> — Reciprocity (if someone is generous or helpful, we feel inclined to return the favour). 'Leave it with us, if you've picked up too much food, leave it here and we'll put it back for you.' The supermarket is being overly helpful and generous to the shopper. — Psychological distance. 'Take a moment ... Realised you've more food than you'll eat? ... Why not leave it here?' — Loss aversion. 'Don't pay for food you'll never eat. We carry home 200 kg of uneaten food every year. Save your money and leave it here.' — Social norms (we adjust our behaviour to follow others). 'Together, we're shopping smarter ... If you've picked up too much food, join other shoppers and leave it here.' <p>The survey tested the concept on 400 customers, corresponding to three consumer profiles.</p> <p>The perceptions of customers were evaluated through two types of responses:</p> <ul style="list-style-type: none"> — response rates against chosen criteria in implicit association testing, — self-reported explicit answers to questions. <p>Driver. The driver was buying too much food when in an emotional state in the retail environment, whatever the reason: being hangry, being in a hurry or having fallen foul of supermarkets' buying nudges.</p> <p>Lever. The lever was using behavioural messages to nudge people to return food items.</p>
Effectiveness	More than 75 % of respondents considered it a 'good to excellent' idea.
Transferability and scalability	WRAP has been actively looking for retail partners to trial a put back space for over 3 years. No partner has shown interest. Therefore, the major barrier is partner interest, as opposed to citizens' lack of interest in using a put-it-back zone.
Key features for replicability	It is clear that what people say is different to what they think or feel. For example, message three – which leverages loss aversion – tested the strongest explicitly, but not implicitly.
Notes	No information was available on efficiency or sustainability.

NOOH5: Posters displaying social norms

ID	Title: Posters displaying social norms
	Country: France
	Implemented by: International Food Waste Coalition
	Experiment: no
	Intervention period: 1 March 2022 to end of 2022, reporting 1 March 2022 to 9 May 2022

<p>Intervention design</p>	<p>After an observation of the acceptance of food waste behaviour, the International Food Waste Coalition designed an intervention with the rationale that consumers in corporate restaurants would be willing to waste less food if while they chose their food they (1) are reminded the correct way to do it is to 'adapt your portion' and (2) acknowledge that doing this is a social norm / a valorised behaviour and even an accelerating trend in the restaurant.</p> <p>The intervention took place in:</p> <ul style="list-style-type: none"> — corporate restaurants (lunch self-service and service at the counter); — breakfast buffets in hotels (self-service). <p>The intervention involved:</p> <ul style="list-style-type: none"> — 10 days of measurements of consumer food waste without the intervention; — 10 days of measurements of consumer food waste while displaying messages on posters and screens. <p>Messages leveraged social and dynamic social norms and incorporated a reminder of the virtuous behaviour ('adapt your portion').</p> <p>Drivers. Drivers were the overprovision of food at the buffet, a lack of awareness and care about food waste, a lack of attention and communication with kitchen staff.</p> <p>Levers. Levers were social and dynamic social norms, for example '70 % people don't waste food', if you do not waste food you might feel included under the 70 % not wasting food reinforced with a positive message.</p>
<p>Effectiveness</p>	<p>The results per location were as follows.</p> <ul style="list-style-type: none"> — Corporate restaurants. There was an 8 % reduction on average, but it was estimated that posters had no significant impact. — Hotels. Not applicable because no intervention was launched due to the negligible consumer food waste quantities measured. <p>The goal was to assess the effectiveness of messages, but this could not be assessed appropriately as it was observed that people in corporate restaurants do not pay attention to posters. We estimate that only 10 % of customers noticed the posters and even fewer customers could tell what the overall message was.</p> <p>Although a non-significant food waste reduction occurred, it cannot be concluded that messages are not effective. However, it can be concluded that poster supports or displaying messages on screens has not worked.</p> <p>In hotels, edible food waste measured from plates was less than 8 grams/plate; therefore, the poster campaign was cancelled.</p> <p>The consumer is busy dealing with all the messages communicated in a corporate restaurant (e.g. menu information, health and safety, promotional). Adding an extra message on food waste has not raised any attention through posters on the walls or at the counters or in the form of animated message on screens in the restaurant or at the entrance.</p>
<p>Efficiency</p>	<p>There were investment costs (materials, design, purchasing equipment). The message design cost EUR 1 200; poster printing cost EUR 200.</p> <p>Labour costs were the wages of supplementary staff to sort, measure and report consumer food waste and equalled EUR 2 100.</p>
<p>Sustainability over time</p>	<p>The intervention's long-term effect is unknown.</p> <p>After the assessment of the intervention, the next steps proposed to identify and test better ways to communicate with customers in the restaurants were:</p> <ul style="list-style-type: none"> — conducting interviews with people wasting food to understand the reasons for this; — identifying effective communication support (e.g. oral communication with staff or nudges).

Transferability and scalability	<p>All corporate restaurants basically work the same way, so as long as consumers are able to choose their portion, the intervention is transferable.</p> <p>Food waste measurement methodology is not easy.</p> <p>The set up of the nudges / communication materials would be specific to each site.</p>
Systemic effects	<p>The work has raised the level of interest from the staff to whom we presented the intervention.</p> <p>Drivers. People in corporate restaurants have their routines; very often they do not pay attention to the food they get served or pick. 70 % of people in corporate restaurants and 90 % in hotels brought little food waste or empty plates. This means that food waste tends to be generated by a minority of people who could be characterised as big wasters.</p> <p>Levers. When people at the counter get served, service staff being willing and able to remind customers of virtuous behaviour through direct exchanges are more effective than writing a message on the wall or on a screen. We believe that, when food is served by staff, staff should be trained to better communicate with consumers as a complement to any communication materials. As the environment is busy, neither serving staff nor consumers have the time for this sort of communication (e.g. are you little or very hungry, do you want more or less).</p>

NOOH6: Prompts encouraging right portion consumption

ID	Title: <i>Dose Certa</i> (the right portion)
	Country: Portugal
	Implemented by: LIPOR, the Municipal Association for Sustainable Waste Management of Greater Porto
	Experiment: no
	Intervention period: ongoing (started 2008)
Intervention design	<p>The <i>Dose Certa</i> project is directed at catering establishments (canteens, restaurants, hotels, shopping centres, markets and others) and combines food waste reduction with the adoption of sustainable food. This project is in partnership with the Portuguese Association of Nutrition and intends to create an improvement plan by analysing and assessing the practices of each establishment, thus reducing losses and, consequently, costs.</p> <p>The <i>Dose Certa</i> project raises awareness among partners and convinces them to create more sustainable menus by using seasonal and local products, while taking the variety, quantity and nutritional value of the food into account.</p> <p>The <i>Dose Certa</i> project is being developed in restaurants and canteens. By accounting for and characterising (i.e. splitting into edible and inedible) the food waste produced, it is possible to point out which type of food is wasted and correct the quantities that are served to the client, thus reducing the food waste. Combining two paths – analysing food and waste produced and training chefs and workers in more conscious meal planning – it has been possible to reduce the amount of food waste.</p> <p>The <i>Dose Certa</i> project methodology is divided into five parts: (1) the diagnosis phase (1 week), where food waste is weighed and the number of meals sold is registered; (2) training in environmental and healthy practices, sustainable purchasing, cooking and menus; (3) the evaluation phase (1 week), which features a food waste awareness campaign, with a second analysis of food waste production; (4) certification; and (5) monitoring, when an annual checklist of good practices is applied to each restaurant/canteen with the <i>Dose Certa</i> certificate.</p>

	<p>Drivers: Drivers are motivating restaurants owners to join and get involved and demonstrating the economic benefit, in addition to the environmental benefit.</p> <p>Levers: Levers are that this is a free project and there is capacity to adapt the project to different realities and ambitions.</p>
Effectiveness	The food waste reduction per quarter is 326 kg or 53 % for restaurants and 624 kg or 37 % for canteens; the average is 38.8 %.
Efficiency	The intervention costs EUR 1 260/restaurant.
Sustainability over time	The <i>Dose Certa</i> certification makes it mandatory to complete an annual checklist of good practices in each restaurant/canteen with the certificate. If necessary, it is possible to repeat the entire methodology to recertificate.
Transferability and scalability	<p>Barriers. It is very difficult to convince restaurants/canteens to participate in the intervention.</p> <p>Enablers. Enablers are being part of a sustainable restaurant network, being in the interests of the restaurant owner, showing the economic benefits and having the ability to adapt the methodology to the reality of each restaurant/canteen.</p>
Systemic effects	This intervention provides an opportunity to connect restaurants and canteens to a local food donation network.

NOOH7: Study investigating effect of context manipulation

ID	Title: Stimulating food waste reduction behaviour among hotel guests through context manipulation
	Country: Spain
	Implemented by: Sunprime Atlantic View (four-star hotel) in Maspalomas, Gran Canaria (Spain)
	Experiment: yes
	Intervention period: 23 July 2017 to 29 July 2017, reporting 9 July 2017 to 29 July 2017
Intervention design	The intervention was based on the development of some communication tools through a co-design process that used the operational experience of hotel management and staff. The different communication tools and their messages had been pretested in another context.

	<p>The tools were placed at three contact points: at the entrance to the restaurant, at the buffet and on the guest tables. A quasi-experiment design was chosen, which was conducted in the field. In this approach, groups are not randomly assigned, but an attempt is made to select existing groups that are as homogeneous as possible with respect to potentially confounding variables.</p> <p>Driver. The driver was hotel guests overserving themselves at the all-you-can-eat buffet.</p> <p>Lever. Manipulating the context in which customers eat will trigger behaviour change.</p>
Effectiveness	<p>There was a 14.39 % (2.65 g per guest) decrease in plate waste.</p> <p>In the test phase, 393 hotel guests were present at the hotel breakfast. Considering guest rotation, it is estimated that around 500 individuals received the intervention.</p> <p>The results show the effectiveness of the selected communication tools in promoting food waste reduction.</p> <p>The context manipulation had an immediate decreasing effect on the amount of edible plate waste. With respect to the attitude-behaviour-context theory, the context change caused by the communication tools was strong enough to lift the overall attitude-context combination above the behavioural threshold.</p> <p>Furthermore, the guest table is by far the strongest contact point and placing the tools there had a medium effect on recognition.</p>
Efficiency	A maximum of EUR 400 of cost was linked to printing documents.
Sustainability over time	Dissemination was undertaken through academic publications.
Transferability and scalability	<p>The intervention is easily scalable and transferable to other hotels; it needs to be adapted to the specific consumption context.</p> <p>Barriers are hotel regulations; enablers are the ease of use and low costs.</p>
Systemic effects	<p>Drivers. Drivers were overserving by guests and a lack of or insufficient buffet planning.</p> <p>Levers. Levers were management/staff awareness of the problem of food waste.</p>

NOOH8: Study on types of restaurants and food waste production

ID	Title: Consumer's food waste in different restaurants configuration: a comparison between different levels of incentive and intervention
	Country: Brazil
	Implemented by: university. Federal University of Rio Grande do Sul
	Experiment: no
	Intervention period: 5 days of measurement in 2020
Intervention design	<p>Different incentives and levels of autonomy can affect consumers' choice of food types and exert influence on plate food waste.</p> <p>The experiment measured food waste in three types of restaurants with different characteristics. The aim of the study was to investigate how different levels of incentives and interaction with food can lead to different food waste levels.</p> <ul style="list-style-type: none"> — Variable-price buffet service. This covers restaurants where consumers directly choose their food (type and amount) and can look at and smell the food. — Fixed-price buffet / all you can eat. This covers restaurants where consumers will pay the same price regardless of how much food they choose to put on their plate and the number of times they refill their plate and where they can look at and smell the food.

	<ul style="list-style-type: none"> — Canteen restaurant service. This covers restaurants where consumers are being served by staff, can ask for less food but not more and can look at and smell the food. — Fixed-price table service. This covers restaurants where consumers are choosing between some food options without looking at or smelling the food during the selection process and are served by staff. <p>Drivers. Drivers were autonomy, fixed meal cost and not being able to look at and smell food before ordering</p> <p>Levers. Levers were autonomy and price per kilogram (financial incentive to waste less).</p>
Effectiveness	<p>When incentive and autonomy are low (fixed-price table service), the amount of food waste is larger – this is the case in à la carte restaurants. Intermediate incentive and autonomy (fixed-price buffet/ canteen service) showed intermediate levels of waste, which is the case for fixed-price buffets (all you can eat) and canteen restaurants. The best performance in the restaurant categories was when incentive and level of interaction were higher (variable-price buffet service). Buffet restaurants with prices per kilogram, therefore, is the configuration that generates the least food waste. When the customer pays for the amount of food they serve and can look at and smell the food before serving it, they tend to serve themselves smaller portions and generate less plate waste. Changing the restaurant to this kind of configuration is, therefore, a possible food waste intervention for restaurants with other configurations.</p> <p>Consumer food waste increases as both incentive and autonomy decrease. Average waste per plate was as follows.</p> <ul style="list-style-type: none"> — Variable-price buffet service had 23.9 g/plate. — Fixed-price buffet / canteen service had 45.8 g/plate. — Fixed-price table service had 69.8 g/plate. <p>This study verified the correlation between the volume of sales and wasted mass, with the majority of the waste consisting of cheap food (and staples) sold in large quantities. This means that consumer satisfaction/habits are associated with compensating cheap food by providing big quantities. Price per kilogram offers a solution to combat this habit, as consumers are incentivised to save money by taking an adapted portion.</p>
Transferability and scalability	<p>Selecting sites when creating the categories of restaurant configuration must take into account the:</p> <ul style="list-style-type: none"> — degree of control over portion; — whether they have fixed or variable prices; — contact with food (taste, smell and look). <p>A similar type of study is needed to collect more data and knowledge to formulate other recommendations to be transferred and /or scaled.</p>
Systemic effects	<p>In one of the price-per-kg restaurants, when consumers had to pay for dessert separately, no wastage of desserts was observed. However, if some products were close to their expiry dates, the restaurants made some desserts and offered them to customers for free in their buffet service. Dessert was the most wasted food product on those days.</p> <p>Restaurants had tried several campaigns and interventions to make consumers waste less, without success, since consumers recognise that if they are paying they are entitled to serve themselves as much as they want, even if this results in food waste.</p> <p>Consumers could choose between two colours of tray. Orange indicated that the customer wanted to receive the full portion of food and yellow indicated that the customer wanted to receive a smaller portion of food. However, since the price</p>

	<p>was the same, only a few customers chose to ask for smaller portions, even if they knew that this would result in food waste.</p> <p>Portion sizes were bigger in fixed-price table service restaurants.</p>
Notes	No information was available on efficiency or sustainability over time.

NOOH9: Take away doggy bags

ID	Title: <i>Embrulha</i>
	Country: Portugal
	Implemented by: LIPOR, the Municipal Association for Sustainable Waste Management of Greater Porto
	Experiment: no
	Intervention period: ongoing (started 2016)
Intervention design	<p>The project is part of Lipor’s food waste production prevention strategy. Lipor is the company that manages, recovers and treats the municipal waste produced in eight municipalities of the Greater Porto area. In its area of operation, around 27 % of the garbage comprises wasted food and the aim is to minimise it and respond to the principles of the waste management hierarchy.</p> <p>The <i>Embrulha</i> project aims to revive the habit of taking leftovers home and removing the shame or stigma associated with it. It involves providing participating restaurants with biodegradable packaging, free of charge, thus allowing customers to take their food home so they can enjoy their leftovers instead of throwing them away.</p> <p>This project has had an important role in transforming cultural issues by changing the negative social perception associated with asking to take leftovers home and nowadays it is common for restaurants to provide boxes (although they are mostly made of plastic and not biodegradable, unlike the <i>Embrulha</i> ones) when customers ask to take their leftovers home.</p> <p>Drivers. Drivers are commitment from restaurant managers and the restaurant format. Awareness of food waste among customers and restaurant owners is needed to ensure its success.</p> <p>Levers. Levers are being a free project and defining the measurements for number of boxes distributed and box weight (sampling).</p>
Effectiveness	<p>In 2022:</p> <ul style="list-style-type: none"> — 177 restaurants in eight municipalities were involved in the project. — 52 790 boxes were delivered for clients to take the leftovers of their meals home. — 17.68 t of food waste were avoided.
Efficiency	The intervention costs EUR 250/restaurant/year (for communication materials, the <i>Embrulha</i> package).
Sustainability over time	The restaurants must fill out a monitoring spreadsheet. This is analysed by the technical staff in order to adapt practices, when needed.

Transferability and scalability	<p>Barriers to transferability. Barriers are the difficulty identifying suitable restaurants and controlling if they maintain the activity.</p> <p>Enabler of transferability. The enabler is being part of a sustainable restaurant network.</p> <p>Considerations for scalability. Scalability may be affected by the type of restaurant, the price of the packages and the definition of a methodology to measure the impacts.</p>
Notes	No information was available on systemic effects.

NOOH10: Use of anthropomorphic food in messages

ID	Title: Winnow, LSE and Melco team up to reduce plate waste
	Country: China
	Implemented by: Winnow, London School of Economics and Melco Resorts and Entertainment
	Experiment: yes
	Intervention period: 21 December 2020 to 23 May 2021
Intervention design	<p>Three staff cafeterias in different Melco hotels (in China) received smart bins and fortnightly informational feedback on the amount of food they wasted. The type of feedback each site received was varied to investigate how it can be communicated more effectively: feedback in site A solely illustrated how much food was wasted, whereas in sites B and C feedback was framed with environmental information without and with anthropomorphic cues (e.g. the food icons did not or did have faces).</p> <p>The rationale behind the intervention was that food waste is the emergent outcome of different factors stemming from multiple levels of influence (individual – micro, household – meso, external to household – macro). The intervention thus tested if informational feedback interventions implemented in staff cafeterias can help reduce food waste in the workplace and facilitate pro-environmental behaviours in households.</p> <p>Drivers. NA.</p> <p>Levers. Levers were environmental framing (drawing attention to the specific environmental consequences of food waste) and anthropomorphism (attributing human-like characteristics to food icons).</p>
Effectiveness	<p>In total, 9 819.73 kg of food waste have been prevented (equivalent to 42.22 metric tonnes of CO₂ reduction).</p> <p>The observed behavioural changes are related to the amount of food wasted at work and at home; moreover, behavioural change positively correlated with the intervention involved pro-environmental interventions at home (use of less plastic packaging, sorting waste before disposing it).</p>
Sustainability over time	The site with food waste feedback (site A) and the site with environmental framing (site B) had slight reductions during the first 3 weeks of the intervention, before seeing food waste increasing again. The site with food waste feedback, environmental framing and anthropomorphism (site C) maintained stable food waste levels 3 weeks after the intervention.
Transferability and scalability	The intervention could be transferred to other types of workplaces, schools and other contexts external to households, identified by the multilevel framework as mesolevels. Among the considerations to be taken into account is that the intervention combining environmental framing and anthropomorphism was the most successful one.

	The intervention could be proficiently scaled up by designing large-scale communication campaigns integrating the use of environmental framing and anthropomorphism with regard to food waste information.
Systemic effects	<p>The contextual behavioural spillovers of the interventions were investigated, that is, the behavioural intervention aiming to change behaviour in the workplace also influencing behaviour at home. This has implications for how interventions can lead to effects on other desirable behaviours.</p> <p>The results of the analysis show that efforts to reduce food waste at work were positively and significantly associated with both using less plastic packaging at home and sorting waste at home before disposing of it. This supports the hypothesis that the effects of workplace food waste campaigns could spill over to produce other pro-environmental behaviours at home.</p>
Notes	No information was available on efficiency.

Education

Action code	Action name	Sub-type	Quality of intervention design	Effectiveness	Efficiency	Sustainability over time	Transferability	Scalability	Systemic Effects
ES1	Intervention targeting children's and parents' food-related behaviours by encouraging them to make lunch	School programs							
ES2	Food and nutrition education programme – the Netherlands	School programs							
ES3	Food waste battle for teenagers (Hävikki-battle)	School programs							
ES4	Green Chef – youth-targeted competition	School programs							
ES5	'Do good, save food' campaign	School programs							
ES6	Study on food and nutrition education – Italy	School programs							
ES7	Programa Z(h)ero – zero-waste schools	School programs							
ES8	Mon École Anti Gaspi (my school against food waste)	School programs							
ET1	PENNY apprenticeship programme	Training for food business workers							
ET2	Zero-waste restaurant	Training for food business workers							
EC1	Alimenter Sem Desperdicar	Coaching for households							
EC2	Coaching methods and measurement	Coaching for households							
EC3	Cooking classes and workshops - GE	Coaching for households							
EC4	FoodWIN Brugge	Coaching for households							
EC5	Love Food Hate Waste Scotland cascade training	Coaching for households							
EC6	Study on comprehensive intervention/coaching for households - USA	Coaching for households							
EC7	Tailored intervention with personalized coaching	Coaching for households							
EC8	Volunteer and Community Advocate Programme	Coaching for households							

School programmes

ES1: Intervention targeting children's and parents' food-related behaviours by encouraging them to make lunch

ID	Title: Lunch makers
	Country: Australia
	Implemented by: MidWaste Regional Waste Forum
	Experiment: yes, with longer-term intervention
	Intervention period: ongoing (started mid 2020), reporting mid 2020 to the end of 2020
Intervention design	<p>Goal. The goal is to promote the target behaviour 'parents involving their children (5–12 years old) in choosing and making food to take to school'. This in turn is expected to reduce food waste in participating schools and households.</p> <p>Implementation. Food waste baselines were measured at participating schools (through a visual audit and count of items). Student behavioural frequency baselines were measured through a survey. Post-intervention interviews were conducted with parents and teachers to complement the evaluation.</p> <p>Driver. NA.</p> <p>Lever. Children who are more actively involved in food choice and decision-making are assumed to be more likely to try a greater range of foods, to eat more and to waste less.</p>

Effectiveness	<ul style="list-style-type: none"> — Food waste. Based on counts of avoidable food waste items in pre- and post-intervention waste audit photos, the intervention identified a 35 % reduction in avoidable food waste items across the entire sample of participating schools. This occurred over the 6-week delivery of the intervention in these schools. — Behaviour. Students were choosing food for school more frequently after the intervention (45 % before and 54 % after). Students were cooking food for school more frequently after the intervention (36 % before and 41 % after).
Efficiency	<p>The intervention cost breakdown is as follows.</p> <ul style="list-style-type: none"> — Development (resources/graphics) cost AUD 4 000. — BWA research/evaluation cost AUD 10 000. — Delivery (workshops / schools' liaison staff) cost AUD 6 000. — Evaluation/presentations cost AUD 2 250. — The total cost was AUD 22 250 (excluding tax).
Sustainability over time	Not reported
Transferability and scalability	This intervention would be effective in those contexts where children take food from home to eat at school. It would not be relevant in contexts in which children eat at school canteens.
Systemic effects	The influence of children being more involved in food preparation activities is an important driver of reduced food waste. School-based programmes have an effect on household food waste practices/behaviours, with children as important agents of change: they bring new ideas and practices from schools to the home.
Key features for replicability	The intervention led to behavioural change (children being more involved in lunch preparation) and a reduction of 35 % in avoidable food waste in participating schools. This makes it an impactful intervention, but its application is bound to a cultural context in which children take pre-packaged lunch to school.

ES2: Food and nutrition education programme – the Netherlands

ID	Title: <i>Smaakmissie</i>
	Country: Netherlands
	Implemented by: Wageningen municipality and associated schools' boards
	Experiment: no
	Intervention period: 2016–2021
Intervention design	<p>Goal. The goal was to provide children with knowledge (understanding of food waste and associated drawbacks) and the skills to prevent food waste (e.g. in daily life: food planning, storage, using leftovers)</p> <p>Implementation. Two groups of pupils from 8 to 12 years old (total 2 260 children) tested different educational programmes. The impacts on children have been assessed through knowledge–attitudes–practices surveys conducted before and after the programmes.</p> <p>One of the groups associated food waste lessons with a more general package of lessons about food and nutrition to evaluate potential synergies.</p>
Effectiveness	<p>There was no evaluation in terms of food waste reduction, only the knowledge–attitudes–practices surveys.</p> <ul style="list-style-type: none"> — Increased knowledge about healthy nutrition was also seen 6 months after the lessons.

	<ul style="list-style-type: none"> — A relationship was found between the health-promoting behaviour of caregivers and the consumption of fruit and vegetables and children's knowledge of what makes a healthy diet. — Children who are less stimulated to eat healthily at home showed a significant increase in fruit and vegetable consumption compared with children who are stimulated to eat healthily at home. This implies that food education programmes are especially effective for children who are less stimulated to eat healthily at home.
Efficiency	The global budget of the project was EUR 300 000 per year (which includes costs of the food waste module).
Sustainability over time	Teachers receive newsletters during the school year to activate the theme of food waste in their classrooms.
Transferability and scalability	<i>Smaakmissie</i> can be used in other countries. Previously, other <i>Smaakmissies</i> have been used abroad (Denmark and the United Kingdom). Because <i>Smaakmissie</i> is available for free for all teachers on the digital portal Chef!, there is no limit on usage within the Netherlands. Outside the Netherlands, <i>Smaakmissie</i> has to be translated and different cultures must be taken into account.
Systemic effects	The lessons contain information on broader nutrition/food literacy and have a module on food waste. The effects are reported generally on the improvements in knowledge and cooking skills in children – gathered from context.
Key features for replicability	This intervention with lessons about food waste reduction is used in many schools in the Netherlands. The more general package of lessons about food and nutrition that this intervention is part of has been evaluated and has been shown to increase knowledge and attitudes. However, this evaluation did not target the food waste lessons specifically and no questions about food waste were included.

ES3: Food waste battle for teenagers (*Hävikki-battle*)

ID	Title: Food waste battle for teenagers (<i>Hävikki-battle</i>)
	Country: Finland
	Implemented by: Motiva Oy, schools and retailers
	Experiment: no
	Intervention period: ongoing (started 2017)
Intervention design	<p>The intervention is an educational concept for secondary schools and home economics classes that increases awareness of food waste and provides the skills to prevent it.</p> <p>The idea of the food waste battle is that pupils will receive waste food from local supermarkets and grocery stores and they will plan and prepare two-course meal from the waste in home economics classes. Pupils can share photographs of dishes on social media (Instagram) and take part in a photographic contest. During the class, pupils will study facts on food waste. In addition teaching material on the topic is available for teachers and tasks are available for pupils.</p>
Effectiveness	<p>The number of pupils enrolled in the class has steadily increased since the inception of the project (2 000 in 2017 to 8 600 in 2022). The KPI for this intervention is pupil participation.</p> <p>A change in attitudes towards food waste has been reported among pupils. In addition, awareness of the vast amount of food waste and knowledge of ways to prevent food waste have been increased; no quantitative information is available.</p>

Efficiency	The intervention costs EUR 5000–10 000 annually. The resources required were highest in the first year, during the planning and testing of the concept. The annual cost of ongoing coordination work is lower. It is quite cost-efficient: around EUR 1.72 per pupil engaged.
Systemic effects	Drivers. There is potential for home economics teaching to affect teenagers' skills and awareness of food waste.
Note	No information was available on sustainability or transferability and scalability.

ES4: Green Chef – youth-targeted competition

ID	Title: Green Chef
	Country: Portugal
	Implemented by: Portuguese Association for Consumer Protection (DECO)
	Experiment: no
	Intervention period: 2013–2022
Intervention design	<p>Green Chef encourages young people to take an active role in combating food waste. To participate in the initiative, teams from schools are encouraged to submit creative videos in which they show the cooking of a recipe made from food leftovers and/or with better use of food.</p> <p>Green Chef invites children and young people to become expert chefs in preparing and cooking recipes using food leftovers and/or with better use of food and encourages them to produce original and creative videos that motivate people to reuse leftovers, thus contributing to combating food waste. In Green Chef 7 (2022), the focus of the recipes was bread, so bread was a mandatory food in the recipes.</p> <p>The recipes should be healthy and sustainable, which emphasises the importance that these recipes can have in balancing the family budget. When preparing recipes, young people should follow all the rules of hygiene and food safety. The videos must be creative and innovative to motivate and raise awareness of the adoption of behaviours that combat food waste.</p> <p>Food waste reduction was an indirect and long-term objective of the initiative; the aim was not to quantify food waste prevented but to raise awareness.</p>
Effectiveness	<p>Each year, DECO launches the challenge and the participation of the schools is voluntary. The numbers of students and videos sent varies each year (e.g. Green Chef 2 (2014), 306 students participated, from 30 schools all over the country, with 102 original projects; in Green Chef 5 (2017), over 100 students participated and a total of 40 cooking recipes (videos) with very diverse cooking recipe suggestions were received).</p> <p>It was difficult to calculate the total number of people reached by this initiative; in addition to the school community, households were also expected to become aware of food waste and how to combat it, as it was expected that students would discuss this challenge at home and that this may have triggered a reflection on waste in their households.</p>
Systemic effects	<p>Drivers. Drivers were a lack of cooking skills and reuse of leftovers.</p> <p>Levers. Levers were emphasising the impact of food waste on a household's budget and co-benefits arriving when food waste is related to healthy diets.</p>
Notes	No information was available on efficiency, sustainability over time or transferability and scalability.

ES5: 'Do good, save food' campaign

ID	Title: 'Do good, save food' campaign
	Country: International

	Implemented by: International Food Waste Coalition
	Experiment: no
	Intervention period: ongoing (started 1 September 2016), reporting 1 September 2016 to 1 January 2020
Intervention design	<p>The 'do good, save food' programme aims to reduce food waste in primary and secondary schools. Developed in partnership with the UN Food and Agriculture Organization, it links all the actors in school catering (students, teachers, kitchen and canteen staff, municipalities, parents, local producers) to reduce food waste throughout the chain and reassert the value of food.</p> <p>The pilot is based on three interconnected subprojects.</p> <ul style="list-style-type: none"> — Student education. This involves showing what food waste is, why we need to prevent it and how to do this. — Food optimisation. This involves measuring and reducing loss and waste in the kitchen and canteen. — Collaboration within the value chain. This involves connecting actors to work together. <p>Where. The intervention takes place in Belgium with six primary schools; England, with three primary and secondary schools; France with eight primary schools; and Italy with four primary schools.</p> <p>What. The intervention involves plate waste measurement in canteens (all schools) and education activities, in and out of class, with all material available in the education material package (only available to volunteer teachers and counsellors).</p> <p>Drivers. Drivers are children being unaware or not caring about wasting food, there being a lack of attention paid to / communication with the service staff and children being unaware of the value within food (work, resources).</p> <p>Levers. Levers are teaching knowledge about the value of food, what food waste is and its consequences (ecological, economic and social), highlighting virtuous behaviour and the nine easy tips to reduce food waste, running activities to help children practice the nine easy tips and running school challenges to collectively reduce food waste.</p>
Effectiveness	<p>There was a 15 % average reduction in waste over the 2 years of pilots.</p> <p>During the pilots, 5 000 children from primary and secondary schools were involved from 18 schools in four countries. Some of them (no count) implemented food waste diaries at home.</p> <p>The quality of the programme activities and materials is high.</p> <p>The comprehensive approach to including the intervention in classrooms with teachers and during lunch with canteen staff is valuable to support children to reduce food waste.</p>
Efficiency	<p>The intervention cost breakdown is as follows</p> <ul style="list-style-type: none"> — Translation and lay out (education) cost EUR 10 000. — Translation and lay out (complementary activities with kitchen and canteen staff) cost EUR 4 000. — Printing (one school, 10 classes) costs EUR 1 000. — Project coordination (training, implementation) costs EUR 3 400. — The total cost is EUR 18 400, or EUR 4 400 excluding translation and a new lay out.
Sustainability over time	<p>There was no follow-up with schools involved in the pilot; there are no resources available for follow-up. There is a communication plan to promote the programme.</p>

Transferability and scalability	<p>Barriers to transferability. The programme requires ambassadors at the city level and project coordinators at the school level. The intervention did not manage to set up the right collaboration network to get these people committed to make sure more schools would implement the programme over time.</p> <p>Opportunities for transferability. Municipalities have access to the materials in their languages and commit to implementing the programme in their schools. Project managers are funded to support teachers and canteen staff.</p> <p>The Food and Agriculture Organization Regional Office for Europe and Central Asia is working on the usage of teaching manuals and incorporating the 'do good, save food' programme into a national strategy to reduce food waste in households and in primary and secondary schools in Albania, Croatia, Hungary, Lithuania, Portugal and Türkiye.</p> <p>Scalability. This would require funding local organisations to support implementation in schools.</p>
Systemic effects	<p>Lever. The most important lever is being able to support/communicate with children during lunch.</p> <p>Dedicating time in classrooms to teach children about food waste reduction is not easy for teachers but appeared essential for the success of the programme.</p> <p>Training staff to better support children in the canteen complements staff using class time to teach them about food waste and interventions to reduce it.</p>

ES6: Study on food and nutrition education – Italy

ID	Title: Evaluation of an alimentary education intervention on school canteen waste at a primary school in Bari, Italy
	Country: Italy
	Implemented by: Azienda Sanitaria Locale della provincia di Bari (ASL Bari) and University of Bari Aldo Moro
	Experiment: yes
	Intervention period: January-May 2019
Intervention design	<p>This educational intervention was carried out through a press release posted on school websites, starting in January 2019 and ending in May 2019. It included training for teachers, canteen employees, parents and students.</p> <p>The food waste was detected and weighed before and after the intervention. The intervention took place in 12 schools of the metropolitan area of Bari, where meals were delivered by a catering company.</p> <p>This intervention was implemented in collaboration with teachers, canteen employees and supervisors. The teachers and canteen staff were separately trained on the project's rationale, objectives and implementation methods, focusing on the method used to weigh the waste and the correct way to fill out the survey forms and questionnaires.</p> <p>Teachers were trained on food safety and nutrition issues, the epidemiology of disorders related to poor nutrition in children, data on food waste and its ethical, environmental and economic implications. These issues were then addressed in class to introduce the project to the students and implement the teachers' tutoring roles during classroom sharing and brainstorming.</p> <p>Canteen staff were trained on administration and school lunch management as per current legislation.</p> <p>Parents were taught the epidemiology and clinical consequences of incorrect nutrition in children, the characteristics of a balanced food day and conscientious spending.</p> <p>For children, the flipped classroom was used, with the first step consisting of autonomous learning by each student at home and the second step involving</p>

	<p>putting the new knowledge into practice under the teacher’s guidance. Four didactic sheets were formulated and given to children to be studied at home, where they should have actively participated in purchasing, reading labels and looking at and touching foods to evaluate their shape, their consistency and any differences.</p> <p>They should also have experienced tasting food and learned how to preserve, to cleanse and to cook it. All these practical experiences should have been reported in modules as homework. In the classroom, the teachers then evaluated the skills acquired by the children and the children had a new experience of food and meals at the practical level in the canteen.</p>
Effectiveness	<p>This study revealed a high amount of food waste in school canteens. A single educational intervention, however complex, is insufficient to observe significant changes.</p> <p>This study failed to find a robust effect of educational intervention on the amount of waste produced in school canteens.</p> <p>Researchers did a very good job of training participants, which was one of the most positive outcomes here.</p> <p>The intervention was not directly related to food waste. As the authors mentioned in the published paper (Evaluation of an alimentary education intervention on school canteen waste at a primary school in Bari, Italy), the intervention consisted of providing students with some didactic sheets corresponding to four food categories. Each didactic sheet provided information on production and selling methods, how to choose food and evaluate food quality, conservation methods, cooking methods, nutritional content and recommended consumption frequencies. As can be observed, no specific information was provided on the consequences of food waste. It seems that the information was generic and about increasing awareness among children regarding nutrition and diet issue.</p> <p>A second limitation could be that the information was not treated in the same way in all schools. In all schools, students were given the didactic sheets to work on them at home with parents and they were also asked to participate in the family shopping activities, but it seems that there were not any guidelines on how parents should collaborate. Moreover, there was no information on how these sheets were used in class. Teachers were trained but it is not clear if there were common guidelines on how these sheets were used or a common template for reporting the outcome.</p> <p>In total, 69 teachers participated in the training and collaborated in the educational activities and 12 canteen employees and 5 supervisors attended the informational meetings and administered the surveys.</p>
Systemic effects	<p>Drivers. Drivers were judgements on meals, big portions and the type of kitchen.</p> <p>Levers. Levers were inclusion in the students’ long-term eating behaviour and patterns and attention paid to sustainability by school managers and teachers.</p>
Notes	<p>No information was available on efficiency, transferability and scalability or sustainability.</p>

ES7: Programa Z(h)ero – zero-waste schools

ID	Title: <i>Programa Z(h)ero</i> – zero-waste schools
	Country: Portugal
	Implemented by: zero-waste store and Os Aprendizizes school
	Experiment: no
	Intervention period: ongoing (started 31 August 2022; projected end date 30 June 2023)

Intervention design	<p>The zero-waste schools programme, which is dedicated to reducing the amount of school food waste being sent to landfills by up to 90 %, has one training unit dedicated to food waste. This training unit aims to raise awareness of the global dimension of the problem, its causes and its environmental, social, financial, and ethical effects. It also aims to develop practical tools for the school to reduce the waste it generates and that produced by its community.</p> <p>The training (2 hours) has been delivered to a team of 13 people, all working directly in the canteen, and included the following topics: food waste; losses and waste; global, European and national data; causes of waste; environmental, social, financial and ethical consequences; and techniques for avoiding waste (before going shopping, how to store food, food conservation, cooking – integral utilisation, recycling – use of leftovers, how to organise the pantry and the fridge).</p> <p>Drivers. Drivers are consumers' behaviour and lifestyles, food supply management and institutional business management.</p> <p>Lever. The lever is driving down costs.</p>
Effectiveness	The project was recently approved by the school board. It is still in its early stages and the quantification of food waste to serve as a baseline for evaluating whether the 90 % reduction target will be achieved has not yet happened.
Notes	No information was available on efficiency, sustainability over time, transferability and scalability or systemic effects.

ES8: *Mon École Anti Gaspi* (my school against food waste)

ID	Title: <i>Mon École Anti Gaspi</i> (my school against food waste)
	Country: France
	Implemented by: Too Good To Go; pilot phase supported by the French Ministry of National Education, Youth and Sports
	Experiment: no
	Intervention period: ongoing (started September 2021), reporting up to May 2022
Intervention design	<p><i>Mon École Anti Gaspi</i> is a large-scale programme that aims to raise awareness of food waste by giving teachers and primary school facilitators educational tools to be used and applied in class, in extracurricular activities and in canteens. It is a free programme for schools to bring more awareness of food waste to children in primary schools (6–12 years) while doing fun activities. The programme:</p> <ul style="list-style-type: none"> — provides free school materials to teachers and activity leaders, which are downloadable from the Too Good To Go website; — is 100 % free, digital and self-explanatory; — was conceived in collaboration with education experts to guarantee alignment with French school curriculum, thus increasing its relevance. <p>Drivers. Drivers are a lack of awareness of the consequences of food waste and a lack of educational focus on food waste.</p> <p>Levers. Levers are integrating food waste prevention into a primary school education campaign, understanding the environmental impact of food waste and learning to fight food waste by improving daily habits.</p>
Effectiveness	<p>Around 600 schoolchildren benefited from the intervention in the pilot phase, which is the intervention phase being evaluated in this data template. However, more than 200 000 schoolchildren are expected to benefit from the intervention, which is currently being scaled up across France.</p> <p>Understanding/awareness results are as follows.</p>

	<ul style="list-style-type: none"> — Schoolchildren already have good knowledge of anti-food-waste behaviours and attitudes. — Nevertheless, the intervention has proved useful to create a knowledge baseline, stimulate discussions and raise awareness importance in daily life. — Schoolchildren have learned about the definition of food waste and the environmental consequences of food waste. <p>Behaviour change results are as follows.</p> <ul style="list-style-type: none"> — The subject of food waste is at the top of children’s minds, but it is difficult to evaluate real behaviour change with schoolchildren. — It is too early in the intervention to measure behaviour change. — There is no direct visibility of what happens in the school canteen. — Conversations in the classroom lead to conversations at home, so there is a need to expand the scope of intervention to cover behaviour at home. <p>Nevertheless, there is real awareness of the behaviour to adopt in the school canteen.</p> <p>The intervention also affects the food (waste) behaviour of teachers.</p>
Efficiency	The intervention had a one-off cost of EUR 2 000 (material design/logistics).
Sustainability over time	<p>The intervention is ongoing. The intervention will be adjusted based on the feedback and responses provided by teachers to the planned voluntary survey, which was to be conducted at the end of the school year in May 2023. The following communication resources have been used to promote the visibility and uptake of the intervention:</p> <ul style="list-style-type: none"> — official communication from the French Ministry of National Education, Youth and Sports (online), — communications by cooperation stakeholders (school material publisher, canteen operators), — involvement of influencers, — Too Good To Go communication (PR, social media content, newsletter, website, business-to-business marketing).
Transferability and scalability	<p>Scalability. The intervention is very much scalable across France after the pilot. There are no barriers and no cost to this.</p> <p>Outside France, there are cultural barriers to scaling up the intervention and to access to cooperation stakeholders in other markets.</p> <p>Moving the intervention to households instead of conducting it in schools may remove barriers, such as potential regulatory barriers to scalability.</p>
Notes	No information was available on systemic effects.

Training for food business workers

ET1: PENNY apprenticeship programme

ID	Title: Integrating the topic of food waste into existing PENNY apprenticeship programme to create awareness in private and professional context
	Country: Germany
	Implemented by: PENNY (retail chain) and CSCP
	Experiment: no
	Intervention period: 5 September 2017 to 31 July 2018

Intervention design	<p>Implementation. This is an apprentice training programme run by a large retail chain for its employees. PENNY and CSCP decided to implement a train-the-trainer approach.</p> <ul style="list-style-type: none"> — CSCP trained 12 PENNY staff members on the topic of food waste. In turn, the staff rolled out the training to apprentices. The training was integrated into the existing apprenticeship programme so that it was received by all new employees. — The train-the-trainer workshops took place in a 3.5-hour session, then each PENNY trainer delivered food waste training to groups of apprentices in 2-hour sessions. Apprentices were encouraged to take part in a competition where they proposed creative ideas for customers to avoid food waste. — PENNY received more than 200 entries to the competition, including many creative, fun and innovative ideas. Ideas included handing out shopping lists at the cashier, apps to match neighbours for food sharing or to enable PENNY customers to share surplus with food banks and recipes for using leftovers. <p>The content of the training was meant to enhance the apprentices' motivation and abilities. The training included consumer tips (including smart grocery shopping), information on the storage and use of leftovers, stock and market information and information on challenges in the market.</p> <p>An idea contest following the training on tips for consumers incentivised the opportunity part by encouraging the apprentices to also support customers in their professional environment.</p> <p>Drivers. Drivers were awareness/perception and knowledge.</p>
Effectiveness	<p>In total, over 800 PENNY apprentices, from three consecutive years of apprenticeships, were trained between the autumn of 2017 and the summer of 2018 by 12 trainers, who had received training themselves.</p> <p>Through questionnaires, an increase in awareness was reported by 96 % of trained respondents. Results show that PENNY apprentices discussed food waste most with friends (18 %), family (25 %) and colleagues (23 %), but only 10 apprentices said they had spoken to customers about food waste. However, over half of the apprentices (179 respondents) described an increase in food waste awareness and felt that the training taught them to behave more sustainably in the workplace and at home. 12 % confirmed that they had developed their own ideas for reducing food waste.</p>
Notes	<p>No information was available on efficiency, sustainability over time, transferability and scalability or systemic effects.</p>

ET2: Zero-waste restaurant

ID	Title: Zero-waste restaurant & awareness about sustainable diets
	Country: Portugal
	Implemented by: Kitchen Dates
	Experiment: no
	Intervention period: ongoing (started 1 October 2019)
Intervention design	<p>This is part of a food literacy project to help people and organisations make more informed and conscious food choices. The project has had several parts. One of them was a zero-waste restaurant – the first to open in Portugal (it was closed last in 2021). The others are more directly related to education and general awareness around the topics of more sustainable diets and food waste.</p> <p>Kitchen Date was the first bin-free restaurant in Portugal. In addition to minimising its waste, the restaurant committed to the exclusive use of locally sourced products, to raising awareness about food waste and to showing people</p>

	<p>how to tackle challenges related to food waste, from sourcing ingredients to handling leftovers and unused organic matter.</p> <p>The concept of a zero-waste restaurant is based on seven fundamental principles.</p> <ul style="list-style-type: none"> — Circular. Everything that comes through the door is consumed, reused or transformed into compost – by the electric composting machine Eva, which processes the organic material in 24 hours. This compost is then delivered to the food producers or forwarded to the community vegetable garden at Parque Hortícola da Quinta das Carmelitas, in Carnide. — 100 % vegetal. This concerns the areas health, environment and animal welfare. No diet has more of a positive impact on these three areas than an exclusively plant-based diet. — Local. Everyday vegetables and fruit must come from within 50 km of the restaurant. For other ingredients, there is a radius of 500 km from Lisbon. This implies no products such as coffee, cocoa, bananas, cashews or spices. — Seasonal. Respect for the seasons is fundamental. Everything has its time and the restaurant must know how to wait, mirroring in the menus what the producers' lands give each week. — No packaging. All raw materials must arrive in reusable containers; for example, olive oil could be in a stainless steel vat or almonds and carobs could be in raffia bags. — Organic. The restaurant only works with organic producers and makes a point of visiting them and getting to know them – and their land – better. — Transparent. This challenge of zero waste brings daily achievements and defeats and demands full transparency in sharing the moments of greatest success and failure. <p>The intervention includes a practical part (organisation of workshops) and a theoretical part (sharing of newsletters, masterclasses, social media/website posts).</p> <p>Drivers. Drivers are sourcing, menu design, food preparation (repurpose scraps, peels, etc.) and leftovers.</p> <p>Levers. Levers are efficient sourcing and demand forecast, clever menu design and portioning, adequate storage and knowledge.</p>
Effectiveness	<p>Estimates point to a 75–95 % reduction in food waste from the level of the average restaurant in Portugal, based on menu design and on preservation/conservation techniques employed in the kitchen (dehydration, fermentation, etc.). A key element in menu design is ditching fixed menus that remain intact for months (even years). In this restaurant, this meant making weekly – sometimes even daily – adjustments to the menu, based on product availability at the farmer level.</p> <p>Outreach. More than 3 000 people have had a direct experience (dining in), more than 2 000 people have attended our workshops and more than 300 000 people have been reached through communication (including more than 2 700 subscribers to a newsletter on food and sustainability sent out every 2 weeks).</p>
Efficiency	<p>The intervention cost breakdown is as follows.</p> <ul style="list-style-type: none"> — Investment costs were EUR 35 000. — Labour costs were EUR 6 000 per month. — Operational costs were EUR 2 000 per month.

Sustainability over time	The experience and knowledge amassed with the restaurant are being used to leverage impact through communication channels (website, newsletter, social media and other related projects that will soon be revealed). These are targeting two groups: (1) individuals in their early 20s to late 30s, mostly living in urban areas, regardless of their education/work experience; and (2) restaurant owners/managers and people in similar positions with the power/ability to implement substantial changes in food service practices.
Transferability and scalability	The principles are fully transferable, as long as the people running the intervention are willing to commit to them and define a clear set of rules to be followed. These principles can be applied to a 25-seat restaurant (as in the intervention) or a 250-seat restaurant. It is only a matter of scaling all relevant aspects: physical space, equipment and human resources. This means the idea itself is 100 % scalable, as it relies on creating local connections with the community surrounding the restaurant: suppliers, partners, local government, customers, etc. This envisages a food system based on restaurants similar to the intervention restaurant, which would pop up and grow in their own communities with their own identities and adjust to the challenges and opportunities at their specific locations.
Systemic effects	Even though the actual restaurant lasted a relatively short period, its influence in the food service sector in Portugal, and also on a consumer level, is still being felt. The organisers assert that they are sharing their experience with other organisations, schools, NGOs and other groups. The organisers also point out that provider farmers have adjusted their practices towards sustainability based on the experience of working with the restaurant.

Coaching for households

EC1: *Alimentar Sem Desperdicar*

ID	Title: <i>Alimentar Sem Desperdicar</i>
	Country: Portugal
	Implemented by: DECO
	Experiment: no
	Intervention period: 15 March 2022 to 15 July 2022
Intervention design	<p>DECO Algarve responded to the call for intervention 'Put your Accionad ODS project in motion!', which was developed to finance local initiatives for the achievement of the sustainable development goals.</p> <p>The intervention involved the organisation of 15 information workshops on food waste, which were aimed at vulnerable consumers (low-income families, senior citizens and immigrants, among others). It also produced five flyers, in a partnership with local media, with useful advice for consumers on how to manage meals in a sustainable way and combat food waste. A video with useful advice on how to reduce food waste at home was produced for dissemination on DECO's and partners' digital channels.</p> <p>Two activities were developed throughout the sessions, one at the beginning, as an icebreaker, and another one at the end. The latter was called 'Master chef moment' and was carried out using cards with pictures of leftover food, distributed to the audience. Consumers were challenged to make suggestions for recipes with the ingredients they had been given.</p> <p>DECO believes that, by creating/accelerating the process of developing municipal plans to combat food waste, it will be possible to promote the reduction of food waste through an integrated and multidisciplinary approach, thus making it possible to raise awareness among households about the</p>

	environmental, economic and social costs of food waste so that households become active agents of change.
Effectiveness	<p>Overall, 19 information sessions were held, directly involving 251 consumers. This initiative was implemented in the Algarve region.</p> <p>Regarding media outreach, five flyers were published, which created 70 media clippings at the regional and national levels, namely in the written press, and on the radio and television. In addition to this publication, the dissemination carried out by the partners through their social networks and the media created an additional 17 posts.</p> <p>This volume of clippings translated into a media reach of 11 862 717 readers.</p> <p>The articles published on our social networks gathered 488 views.</p> <p>The launch of the video had a good outreach on DECO's social media and at the social network level. The production of the video was in two languages, Portuguese and English, and two versions with different lengths were created to enhance dissemination. This allowed the video to reach 45 736 people, with 9 299 interactions.</p>
Efficiency	The total budget was EUR 7 886.
Sustainability over time	No information was available on long-term effects, but dissemination with local media is planned and there is a plan to continue developing the information sessions. The implementing organisation plans to send articles to the media to disseminate information on food waste and to continue to develop information sessions at the request of social solidarity institutions, oriented towards vulnerable consumers and populations.
Transferability and scalability	The promotional materials were created and tested and can be used in similar projects in other regions of the country. They could also be translated into other languages to be used in other European countries.
Systemic effects	<p>Drivers. Drivers were food literacy and improved community cohesion.</p> <p>Levers. Levers were promoting food planning and sharing good practices.</p> <p>During the implementation of the project, connections were created between institutions in the Algarve region and it is hoped that they can be maintained for other initiatives; after its conclusion, the intervention team were invited to organise sessions at the facilities of other institutions that became aware of this initiative.</p>

EC2: Coaching methods and measurement

ID	Title: Coaching methods and measurement
	Country: Germany
	Implemented by: University of Stuttgart
	Experiment: yes, field experiment
	Intervention period: 2011–2012
Intervention design	<p>The intervention was implemented in two panels of households in the same area, one using an offline system and one using a web-based online system. The study outcomes were based on experimental data collected in these two sets of households and demonstrated a clear improvement in the participants' behaviour regarding food purchase and waste production.</p> <ul style="list-style-type: none"> — Panel 1. This group used an offline self-reporting system, based on netbooks with spreadsheet software installed on them. — Panel 2. This group used a web-based online platform to document and report its data. The online platform was used to communicate and display

	information within the coaching sessions to the participants without any additional in-person meetings.
Effectiveness	<p>The food waste trends showed a steady, almost linear, decline before, during and after the coaching for both offline (Panel 1) and online (Panel 2) interaction. Panel 1 reduced its average avoidable food waste mass by more than 59.6 % during the 3 months of investigation, reducing it from 49.08 g per capita per day to 19.81 g per capita per day. A similar waste reduction occurred within the online-based self-reporting group, decreasing avoidable food waste mass by more than 53.7 %, from 34.93 g per capita per day to 16.16 g per capita per day. The achieved reduction in food waste correlated with a monetary value of between EUR 0.09 and EUR 0.11 per capita per day.</p> <p>An almost 60 % reduction was achieved with coaching and measurement (though the sample size is small).</p>
Notes	No information was available on efficiency, sustainability, transferability and scalability or systemic effects.

EC3: Cooking classes and workshops – Germany

ID	Title: <i>Küchenlabore gegen Lebensmittelverschwendung</i> (kitchen laboratories against food waste)
	Country: Germany
	Implemented by: Slow Food Deutschland (and Technical University of Berlin)
	Experiment: no
	Intervention period: 27 September 2021 to 14 July 2022
Intervention design	<p>Slow Food Deutschland organised five kitchen labs in which participants learned various techniques and practical tips for effectively reducing food waste in private households under the guidance of knowledgeable experts. The implementation of the approaches was evaluated by the Technical University of Berlin by applying a uniform method developed within the project, consisting of:</p> <ul style="list-style-type: none"> — questionnaires; — a digital kitchen diary; — guidelines for creating an impact logic. <p>Drivers. Drivers were planning, food capability (see specifically kitchen labs 1 and 4) and knowledge on techniques for managing and discarding food efficiently (see specifically kitchen labs 2, 3, 5)</p> <p>Levers. Levers were promoting and introducing food planning or storage methods, cooking skills, and food reduction tips, and promoting efficient food planning or storage methods.</p>
Effectiveness	Pre-post analysis showed that the kitchen laboratories seemed to reduce food waste by an average of 16 % (equating to an average reduction of 158 g per person per day) . Participants weighed their kitchen waste before and after each lab over 1 week.
Efficiency	The global budget was EUR 7 850. Approximately 500 people were interested in the workshops. Therefore, costs amounted to EUR 15.70 per person. It considered 72 participants.
Sustainability over time	The long-term objective was to offer this tested evaluation method to further actors (after project completion) to enable them to review and optimise their work fighting against food waste.

Transferability and scalability	Transferability. Staff positions for the planning and implementation of workshops have to be accounted for; the financial resources for the implementation must also be provided.
Notes	No information was available on systemic effects.

EC4: FoodWIN Brugge

ID	Title: FoodWIN Brugge
	Country: Belgium
	Implemented by: FoodWIN, together with regional and local authorities
	Experiment: no
	Intervention period: 1 April 2020 to 1 September 2022
Intervention design	<p>Goal. The goal was to engage a growing base of households in Bruges to reduce food waste at home by 30 %.</p> <p>Implementation. Participants received instructions on how to carry out the measurement themselves at home during the week. The monitoring was based on 50 ambassadors participating in a waste audit for three phases.</p> <ul style="list-style-type: none"> — Phase 1 (March 2020 to March 2021) involved an intensive process with 50 households (ambassadors). Initially, 148 households signed up. From these, 50 ambassadors were selected. They then went through training to become experts at fighting against food waste, which was based on nine challenges on buying, storing and cooking food. The training demonstrated how much money households could save and what impact they could have on the environment. Participants were also motivated through personal and group meetings, intensive coaching, challenges and awards. — Phase 2 (January 2021 to December 2021) challenged a wider audience of 500 citizens to reduce food waste based on communication materials developed in phase 1. In total, 728 households signed up, accounting for 1 437 people. This phase included engaging groups. For instance, schools, companies and organisations could also participate as one group. A total of 25 groups signed up. There were also prizes to be won, to increase involvement. — Phase 3 (January 2022 to December 2022) reached a total of 2 900 citizens (1 010 households). It involved other groups such as Bio-Planet, Howest University of Applied Sciences, VIVES University of Applied Sciences and KULeuven's Bruges Campus. Phase 3 participants received personalised materials such as posters and designs for newsletters. Participants had the choice of registering individually or as a group.
Effectiveness	<p>Phase 1. Many ambassadors remained intensively involved until the end of the campaign. The ambassadors achieved a reduction of as much as 65 %, saving 2.1 t of food annually.</p> <p>Phase 2. The households achieved a reduction of as much as 67 %, saving 24.7 t of food annually.</p> <p>For the three phases combined, participants reduced their food waste by 55 %, saving 45 032 kg of food annually (45 t), equivalent to 144 102 kg of CO₂ and EUR 188 684.</p>
Efficiency	<p>The intervention cost EUR 94 540 (FoodWIN plus subcontractors and materials) plus the Bruges' personnel cost.</p> <p>The estimated cost of the food waste avoided over a year (if reduction levels were maintained) was EUR 188 684.</p>

Sustainability over time	A roadmap has been prepared on the project, which will soon be released by Bruges. This roadmap targets cities and municipalities that want to set up a food waste reduction campaign for households.
Transferability and scalability	Yes, the intervention is transferable once translation of the communication material from Dutch is complete; upscaling might be difficult due to cost.
Key features for replicability	This is an impressive reduction of food waste, and especially phase 2 with distribution of standardised materials through email should be relatively easy to replicate in other cities. Interesting coaching approach in phase 1 with individual and group meetings, challenges, etc. In future studies, it would be good to check the reduction using a different measurement approach, e.g. waste sorting rather than self-reported.'
Notes	No information was available on systemic effects. For more information, see the FoodWIN Brugge website.

EC5: 'Love food, hate waste' Scotland cascade training

ID	Title: 'Love food, hate waste' Scotland cascade training
	Country: Scotland
	Implemented by: Zero Waste Scotland
	Experiment: no
	Intervention period: ongoing (started September 2017), reporting 1 April 2018 to 30 September 2018
Intervention design	<p>Goal. The goal is to provide participants' households with knowledge on the scale of food waste in Scotland, knowledge on how food waste contributes to climate change and the understanding and practical skills to enable participants to reduce food waste in their homes (increased use of freezers, understanding of date labels, improved storage behaviours and use of the freezer, knowledge of how to use up leftovers, understanding of what constitutes a recommended portion sizes for different foods, participants sharing information with others).</p> <p>Implementation. In the reporting period, 486 people were trained in 44 interactive workshops (1–1.5 hours long).</p> <ul style="list-style-type: none"> — Baseline measurements were taken from self-reported knowledge, attitudes and behaviours. Surveys during the workshop and 1 month after workshop were used to evaluate impact. — Resources were provided during the training (shopping list templates, portion measurers for spaghetti, fridge and freezer thermometers, bag clips for improved food storage, top tips information leaflet). <p>Drivers. Drivers are a lack of awareness and skills to act and time pressures.</p> <p>Levers. Levers are using 'shock and awe' Scottish food waste facts, putting emphasis on the link to climate change and putting emphasis on how to keep food safe. Money-saving is one of the key levers used. Promoting take-home and easy-to-adopt methods for attendees to reduce food waste is also a lever. Focus should be on quick and easy smart behaviours and tools available to save time, rather than take up time (counteracting the perceived time management driver).</p>
Effectiveness	<p>88 % of participants said that they have felt differently about throwing away food since attending the workshop and that they are routinely doing something differently to reduce food waste (adapting food storage and freezing, planning and shopping behaviours, etc.)</p> <p>68 % said that they intend to do something differently in relation to food storage and freezing, shopping, planning or food use in future months.</p> <p>96 % reported that they have shared what they have learned with others.</p> <p>100 % of participants said that they would recommend the training to others.</p>

Efficiency	<p>Outreach efficiency can be calculated as EUR 66 773 / 18 468 people reached = EUR 3.62, based on WRAP methodology (each participant can affect 38 people).</p> <p>The average behaviour change reported / the cost of intervention or in a specific time (intervention duration) is calculated as EUR 66 773 / 486 workshop participants = EUR 137.39.</p>
Sustainability over time	Sustainability largely depends on the budget available to fund the programme, as more lasting impact could be expected if people in the population are trained continuously.
Transferability and scalability	<p>Trainers should consider how the training can be personalised as much as possible for different audiences. The cost of the intervention is a potential barrier to scaling up.</p> <p>As the intervention follows a tried and tested training programme structure and the content is based on research into food waste behaviours, it could be relatively easily replicated. However, replication would require investment in adapting the training to suit the country or region and may require research into food waste levels and behaviours if information on these is not already available in the new location.</p>
Systemic effects	<p>Systemic effects include food safety concerns and demand for information to ensure food is safe, a need for improved cooking skills and food education.</p> <p>Specific drivers are found in particular types of households, such as single-person households and families with small children.</p> <p>Food safety and food waste reduction messages and education could be combined and aligned.</p>
Key features for replicability	<p>To improve the understanding of the effectiveness of the intervention, it is recommended that the intervention design is reviewed and strengthened by:</p> <ul style="list-style-type: none"> — setting objectives and behaviour-related targets, against which results can then be evaluated; — including a measurement of food waste by providing an incentive for selected participants at partner organisations to conduct more in-depth pre- and post-workshop food waste measurement and behavioural and attitudinal surveys; — creating a plan for follow-up communication with participants.

EC6: Study on comprehensive intervention/coaching for households – the United States

ID	Title: Waste watchers: a food waste reduction intervention among households in Arizona.
	Country: United States
	Implemented by: Arizona State University, Loma Linda University and city of Phoenix's local government
	Experiment: yes
	Intervention period: May 2019 to September 2019 (5 weeks of intervention)
Intervention design	<p>The intervention was a collaboration between a research team at a major university in the south-western part of the United States and the city of Phoenix to conduct a novel, evidence-based and theoretically founded household food waste intervention, following a single group, pre-post test design.</p> <p>Specific intervention. Education and strategic information were delivered presenting home strategies for food waste reduction in a variety of formats (podcasts, infographics, videos). Edible food waste was collected in line with a standardised procedure (collection buckets and scales provided by researchers). The information given in the intervention used three perspectives</p>

	<p>on impact: impacts on health, impacts on home finances and impacts on the environment.</p> <p>This intervention successfully introduced a simple methodology to quantify and track food waste in the home over 7 weeks. It also identified podcasts and videos as the most effective educational approaches through which to reduce food waste at home.</p> <p>Drivers. Drivers were perceived behavioural control and intentions, norms and attitudes.</p> <p>Levers. Education and the provision of specific information will help households in reducing food waste.</p>
Effectiveness	<p>There was a significant decrease of 27.85 % in food waste from baseline to follow-up and a significant reduction from week 1 to follow-up. Variation within phases continuously decreased as the intervention progressed and there were fewer people with extreme food waste values.</p> <p>Effect sizes were small in the first week of the study; however, effect sizes became larger at the end of the study. There was also a significant decrease in subjective household food waste at the end of the study compared with that at baseline.</p> <p>There was a significant increase in all behaviour change constructs following the waste watchers intervention, indicating an improved disposition of participants towards changing their behaviour to avoid food waste.</p> <p>During the qualitative exit interviews, some participants expressed that recipes presented on the website were useful as they helped them to make strategic use of the foods that were about to spoil. Others described how they learned to plan their grocery shopping more strategically to avoid purchasing food that may end up getting thrown away.</p> <p>Motivation. The motivation was awareness of the food waste issue.</p> <p>Ability. Abilities were planning skills to shop smarter, creative cooking, skills to properly store food, food literacy and skills to properly use the freezer.</p> <p>Opportunity. The opportunity was the education and strategic information provided by the researchers.</p>
Sustainability over time	<p>The effect beyond the time of intervention is unknown. The research team is currently conducting a follow-up study to understand the durability of food waste behaviour changes.</p>
Transferability and scalability	<p>As long as the educational materials are available (now available on the waste watchers website) and the intervention has the support of the corresponding authorities, it is replicable. However, the survey questions should be adapted to the new sample, as individuals from different cultures tend to be affected by various sets of beliefs.</p> <p>Replication at scale should include a control group and the extension of the theory of planned behaviour constructs by including social practices and improving food waste quantification.</p>
Systemic effects	<p>Driver. The driver was excessive purchase of groceries.</p> <p>Levers. Levers were using information and strategies, connecting values or issues to the problem of household food waste, saving money, strategically grocery shopping, properly using the refrigerator and understanding the connection between food waste and the environment.</p>
Notes	<p>No information was available on efficiency.</p>

EC7: Tailored intervention with personalised coaching

ID	Title: A randomized controlled trial to address consumer food waste with a technology assisted tailored intervention
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	Country: United States
	Implemented by: university
	Experiment: yes
	Intervention period: 1 week in 2018. Details in the paper.
Intervention design	<p>Implementation. The sample was randomised and half of the participants were assigned to the food waste reduction intervention (independent of behaviour during baseline monitoring). Participants in the treatment group were trained individually by a trained coach who presented informative materials (introduction to food waste and ways that food waste could be reduced over time). Participants used a technology-aided delivery and measurement approach (food image app) to take photos of receipts, food and waste items, which included instructions to place a standardised visual reference card in each photo involving food.</p> <p>The intervention captured information on:</p> <ul style="list-style-type: none"> — food shopping; — food waste behaviour (self-reported). <p>Levers. Repeated playing and engagement with the game was necessary to sustain food waste reduction; establishing new habits was also a lever.</p> <p>Drivers. Drivers were competing goals that may negatively affect motivations to reduce food waste.</p>
Effectiveness	The intervention achieved up to 79 % reduction in specific categories of waste (plate waste at dinner); generally, it achieved a 46 % reduction.
Transferability and scalability	The intervention is unlikely to be easy to scale up as is due to the fact that the personalised coaching given to study participants is time and resource intensive.
Notes	A Randomized Controlled Trial to Address Consumer Food Waste with a Technology-aided Tailored Sustainability Intervention

EC8: Volunteer and community advocate programme

ID	Title: Volunteer and community advocate programme
	Country: Scotland
	Implemented by: Zero Waste Scotland
	Experiment: no
	Intervention period: 1 July 2013 to 31 June 2015, reporting 1 July 2013 to 30 March 2015
Intervention design	<p>Goal. The goals were to reduce households' food waste through community-level interventions, assuming that individuals from the community are best placed to reach and influence their friends, family and neighbours; to leverage food waste prevention activities centred on encouraging behaviours known to reduce food waste (understanding of date labels, storage, use of the freezer, portion sizes, how to use up leftovers), with a strong focus on cost savings for households and environmental cost savings for society; and for communities to share experience and cascade down good practices.</p> <p>Implementation. The volunteer and community advocate programme supported the development of groups responsible for implementing activities and events at the community level and covering a range of topics, including a focus on food waste prevention; as a result, delivery models were as varied as the communities and contexts in which they operated.</p> <p>Driver. The driver was a lack of awareness.</p>

	Levers. These varied based on the communities in which interventions took place, but there was a consistent focus on emphasising the environmental impact of food waste and promoting the monetary incentives for citizens to reduce food waste.
Effectiveness	An estimated 17 523 people were engaged on the topic of food waste, of whom 14 % will have taken some action, resulting in a reduction in avoidable food waste of 0.7 kg per household per week (based on WRAP, 2013). Over the course of the 91-week evaluation period, this added up to a total food waste prevention of 156 247 kg – approximately 156 t, a CO ₂ eq of 601 146 and financial savings of GBP 467 376 for households and GBP 15 470 for the local authorities in which the intervention operated. No solid data was available on the per-household improvement that might be expected.
Efficiency	The (unconfirmed) total budget for this programme was approximately GBP 1 million (circa EUR 1141 000); on the face of it, this makes the reduction in food waste (alongside additional estimated behaviour change in relation to recycling) expensive and therefore makes cost-effectiveness low.
Sustainability over time	The initiative has ended and there is no plan to extend its life.
Transferability and scalability	A volunteer programme delivered in local communities could be transferred anywhere if resources are available. It should keep local priorities, opportunities and barriers in mind. No action plan for this is in place. The key issue for transferability would probably be how to identify and fund local organisations or networks to mobilise local communities.
Systemic effects	Interventions gain traction fastest where they link to existing networks and community initiatives. Audience interest may not always match (Zero Waste Scotland's) organisational priorities. Often audiences want to discuss wider issues. Synergies can be found if food waste messages can be linked effectively with healthy eating and sustainable or local food messages.
Key features for replicability	To better monitor the impact of community programmes, conventional survey techniques should be adapted, as individuals engaged may be dispersed. Improving the design of this community-level intervention is crucial (action plan, KPIs, evaluation protocols).

Awareness raising

Action code	Action name	Sub-type	Quality of intervention design	Effectiveness	Efficiency	Sustainability over time	Transferability	Scalability	Systemic Effects
AL1	Fish scale	Local initiatives							
AL2	Food Waste Prevention Campaign in Public Housing Areas	Local initiatives							
AL3	Keep your refrigerator tidy	Local initiatives							
AL4	Maizuru City Food Waste Reduction Pilot Project	Local initiatives							
AL5	Reduce Food Waste, Save Money	Local initiatives							
AL6	Trifocal project	Local initiatives							
AL7	West London Food Waste Prevention Campaign	Local initiatives							
AS1	Best before exhibition	Large scale initiatives							
AS2	COP26 campaign with Rankin	Large scale initiatives							
AS3	Food Waste-Free Week	Large scale initiatives							
AS4	Great Taste No Waste	Large scale initiatives							

Local initiatives

AL1: Fish scale

ID	Title: Food information and safeguard of habitat. A sustainable consumption approach in local environment
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	Country: Italy
	Implemented by: Acquario di Genova
	Experiment: no
	Intervention period: 2010–2013
Intervention design	<p>The fish scale project addressed the problem of the overexploitation of marine resources and fishing discards by promoting a more sustainable use of the sea and by improving the protection of marine biodiversity in the Mediterranean. The project sought to change the attitudes of consumers by increasing their awareness of the importance of by-catch species. The project aimed to establish a virtuous cycle by stimulating greater demand for neglected fish species, thereby increasing their commercial value, leading in turn to a reduction in fish discards and, hence, better preservation of marine biodiversity. To achieve this, the project aimed to develop integrated communication and demonstration measures involving the whole supply chain of the fishing sector together with final consumers so that they can become pro-active and discover mutual benefits to using currently neglected fish species.</p> <p>The project <i>Pesce Ritrovato</i> (Fish Scale) aimed to raise consumers' awareness and encourage them to change their eating habits, by increasing their knowledge and appreciation of neglected fish species, to reduce fishing pressure on species currently being overexploited. The project pioneered the EU fisheries policy and strategy. As neglected species are often a significant fraction of fish waste, increasing their demand and commercial value surely helps to incentivise and motivate fishermen to reduce and ultimately avoid fish discards. Moreover, during many project events, different field operators were put in contact, thus laying the groundwork for future collaborations.</p>
Effectiveness	<p>Around 2 000 people were directly involved in the project's awareness-raising campaign through questionnaires and interviews; the project also participated in 99 events and conducted an extensive media campaign. The fish scale project reached more than 100 fish providers, including fishmongers, distributors, restaurants and hotels, to facilitate the inclusion of sustainable fish target species among the fish they supply, sell or offer on their menus.</p> <ul style="list-style-type: none"> — The quantity of 'sustainable fish' sold in supermarkets and by other fish providers participating in the project increased by 14 % to 70 %. — This led to an increase in awareness of the issues relating to edible discards of about 27 % (intended as the understanding of the problem and of its causes). — The quantity of rediscovered marketed species increased by 37 %.
Efficiency	EUR 1 074 526 of funding was spent over the 3 years of the project (no breakdown available).
Sustainability over time	Dissemination of project activities was widespread through retailers / other LIFE programme projects.
Transferability and scalability	The lessons from the intervention were used as the basis for the development of other LIFE programme projects focusing on marine life. The project was already quite scaled up at the start.
Systemic effects	<p>Driver. Drivers were difficulties in changing consumers habits. To overcome this, the project made a large communication campaign and organised many cooking demonstrations.</p> <p>Synergies. Consumers started to ask for species that are usually not consumed. The intervention itself is not focused on consumer food waste but on consumers themselves being drivers of losses occurring in other steps of the supply chain. It shows how consumer behaviour can have an effect on the food system as a whole.</p>

Key features for replicability	The intervention was carried out through the EU-funded LIFE programme. Overall, it is an interesting concept because it has a more systemic view of the food system, linking the environmental issues deriving from biodiversity loss of marine ecosystems to the drivers of this issue (i.e. overexploitation of specific fish species due to the lack of a market for other species). It leverages the link between the lack of consumer awareness, the lack of market incentives for fishers and environmental issues. The intervention provides some information on improvements in behaviours but has no quantitative data on fish consumed / not wasted. It would be interesting to know if the information generated from the project was used in subsequent projects or maintained after the project's end.
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AL2: Food waste prevention campaign in public housing areas

ID	Title: Food waste prevention campaign in public housing areas
	Country: Austria
	Implemented by: Institute of Waste Management and Circularity, University of Natural Resources and Life Sciences
	Experiment: no
	Intervention period: 1 June 2022 to 1 July 2022
Intervention design	<p>This intervention was an awareness campaign run in three public housing facilities in Vienna covering:</p> <ul style="list-style-type: none"> — 1 278 Karl-Marx-Hof apartments, — 473 Franz-Karl-Effenberg-Hof apartments, — 348 Franz-Weber-Hof apartments. <p>Three core issues were addressed by the campaign.</p> <ul style="list-style-type: none"> — Food waste costs. This addressed images of food waste in Austrian residual waste and the costs of food waste, including costs incurred by Wiener Wohnen (e.g. pest control). Looking at the value chain shows that the largest amounts of waste are generated at the household level. — Safety concerns. This covered dealing with sell-by dates (which foods are good for longer), dealing with cooked food (refrigerating, reheating, freezing, etc.) and dealing with food that is rotten or mouldy. — Improved planning. This addressed proper shopping planning (shopping tips and tricks); an overview of shelves and refrigerator/freezer compartments; and menu planning (portion sizes). <p>Driver. The driver was poor knowledge on food safety and correct food management.</p> <p>Levers. Information about the costs of food waste and knowledge on improved food management will lead to a waste reduction.</p>
Effectiveness	No significant differences were found between the groups. Posters were perceived best. The majority of participants who received posters or reminder cards could imagine rethinking their behaviour as a result of the measures. No measurement was performed.
Efficiency	The printing costs for the poster totalled EUR 60; special paper cost EUR 110.
Transferability and scalability	<p>Interactions with the public body were very complicated during the intervention. The boxes for the questionnaires and the posters were destroyed.</p> <p>It has proven true that you cannot really reach a group of uninterested people. The selection of areas for interventions should therefore not necessarily be limited to social housing.</p>
Notes	No information was available on systemic effects or sustainability.

AL3: Keep your refrigerator tidy

ID	Title: Keep your refrigerator tidy
	Country: Japan
	Implemented by: Kyoto Prefectural University, Seika Town Council's Environment Department
	Experiment: yes
	Intervention period: October–November 2019
Intervention design	<p>Implementation. This was a door-to-door intervention encouraging people to keep their fridges tidy and to reduce food waste. It resulted in a 30 % reduction in avoidable food waste, while no effect was identified for those with only general awareness-raising measures (e.g. posters and leaflets). Pre- and post-intervention measurements in target and control neighbourhoods were conducted. Measurement methods included questionnaire surveys and waste sorting analyses.</p> <p>Goal. This project aimed to make an accurate estimation of its effects through sorting analyses of discharged waste from households. An intensive set of interventions was designed using the experiences of WRAP as a reference. Past surveys in the target locality (Seika, Kyoto Prefecture) by Yamakawa implied that the refrigerator is an important point for intervention.</p> <p>Articles on food waste were published in the municipal newsletter that is distributed regularly to all households in the municipality. Leaflets on food waste were distributed to each household as well. Posters were displayed in municipal buses, rail stations, supermarkets, childcare facilities and other municipal facilities. As pinpoint interventions in neighbourhood B, door-to-door visits were made to households, where recommended interventions (tips for reducing food waste) were explained and a magnet sticker with the slogan was distributed to be put on the fridge door. Eco-cooking workshops were held for households in the neighbourhood B.</p> <p>Drivers. Drivers were a lack of awareness of the food waste issue and its impact on the environment; norms, such as the perception of enhanced prominence of the food waste issue (leaflets, intensive posters), were also a driver.</p> <p>Levers. Levers were being a face-to-face intervention with campaigners (door-to-door visits by campaigners in the target neighbourhood) and participating in food waste reduction workshops (easy-to-adopt methods for attendees to reduce food waste).</p>
Effectiveness	<p>Results were as follows.</p> <ul style="list-style-type: none"> — Neighbourhood B had a 5 % reduction in avoidable food waste. — Neighbourhood C had a 2 % reduction. — Neighbourhood D had a 2 % increase. <p>The interventions in neighbourhood B (general plus door-to-door intervention) resulted in a 5 % reduction in avoidable food waste, while no significant change in the amount happened in neighbourhoods C and D (general intervention only).</p> <p>The general intervention (news articles, leaflets, posters) was aimed at the whole population of Seika (circa 37 000 people or 15 400 households). In addition, 375 households in neighbourhood B received pinpoint interventions (face-to-face intervention etc.).</p>
Sustainability over time	No follow-up is planned at the moment; Seika is monitoring the day-to-day quantity of household waste collected, conducting sorting analyses at regular intervals and occasionally conducting questionnaire surveys.

Transferability and scalability	Local authorities' (and neighbourhood associations') cooperation is essential. Interventions may need minor adjustments to suit the local conditions. Door-to-door interventions delivered to a larger number of households are probably too costly, which is a barrier to scaling them up.
Systemic effects	Synergies include the fact that some households were happy to keep their fridge tidy, regardless of the potential to avoid food waste.
Notes	No information was available on efficiency.

AL4: Maizuru city food waste reduction pilot project

ID	Title: Maizuru city food waste reduction pilot project
	Country: Japan
	Implemented by: Teikyo University, Taisho University, Kyoto Prefectural University, Maizuru City Council and Environmental Restoration and Conservation Agency
	Experiment: yes
	Intervention period: September–October 2022
Intervention design	<p>Implementation. The intervention was co-designed with researchers and waste management officers. The refrigerator is considered the focal point from which to leverage food waste reduction. Two interventions were proposed: one was to suggest households designate a visible area in the fridge for items that should be consumed quickly and distributing a divider box and coloured masking tapes to help; the other was providing households with magnet stickers of food items to be stuck on the door of the fridge to show what is stored within the fridge and what requires quick consumption.</p> <p>Monitoring. To assess the effectiveness of the interventions quantitatively, the researchers designated a control neighbourhood that did not receive the intervention and planned to carry out questionnaire surveys and sorting analyses of waste from households in both neighbourhoods, before and after the interventions.</p> <p>The target group was informed through notices posted to their mailboxes, the delivery of goods for designating an 'eat-me-soon' area in the fridge and magnet stickers of food items to be stuck on fridge doors. An instruction session was organised by the neighbourhood association, where municipal waste management officers and the team of researchers explained to the target households what the aims were and how to use the delivered items.</p>
Notes	The results of the quantification are not available yet.

AL5: Reduce food waste, save money

ID	Title: Reduce food waste, save money
	Country: Canada
	Implemented by: Human Environments Analysis Laboratory, Department of Geography and Environment, University of Western Ontario
	Experiment: yes
	Intervention period: 2 October 2017 to 25 October 2017, with long-term follow-up in June 2020
Intervention design	<p>Goal. The goals were to encourage a reduction in avoidable food waste generation as a means to save money and to provide the resources to empower households to act to improve food planning; efficiently purchase, store and prepare food; and use leftovers.</p> <p>Implementation of the intervention involved the following.</p>

	<ul style="list-style-type: none"> — A subset of 160 volunteer households were randomly selected for the pre-intervention baseline audit (418 out of 1 263 households who completed the survey volunteered to participate in the study). — The amount of household food waste placed in the bin was measured on a household's rubbish collection day (sorting sampled rubbish). — Overall, 47 treatment households were provided with the intervention package. <p>Evaluation of the long-term effectiveness of the intervention was undertaken by comparing direct measurements of household food waste disposal for the treatment and control households before and during the COVID-19 pandemic.</p> <p>The intervention package used a commercially available 4 l container, designed to extend produce life, as an envelope. The package included a reduce food waste, save money postcard affixed to the top of this container, along with a fridge magnet version of the postcard and food waste reduction tools, including an explanatory letter, freezer stickers and a grocery list pad inside the container. All messaging included directions on how to access a purpose-built website, which provided additional details on the various food waste reduction tips provided on the postcard and fridge magnet.</p> <p>Driver. The driver was poor food literacy.</p> <p>Levers. Levers were the personal economic benefits of food waste reduction and strengthened capacity to act.</p>
Effectiveness	Treatment households significantly reduced their avoidable food waste generation by 31%.
Sustainability over time	Treatment households continued to generate a similar amount of avoidable food waste in June 2020 (1.523 kg per household per week) as in October 2017 (1.498 kg per household per week). The insignificant change in avoidable food waste generated by treatment households between these two periods indicated a long-term, sustained 30 % reduction in avoidable food waste following the implementation of the reduce food waste, save money intervention.
Transferability and scalability	The intervention should be transferable to other contexts, though it should be noted that it was monitored through kerbside collection of waste and that the targeted households were single-family households.
Key features for replicability	<p>More lessons could be learned from the intervention if treatment households:</p> <ul style="list-style-type: none"> — socioeconomic characteristics were given; — could measure food waste per capita; — were interviewed to learn about what helped them sustain their food waste performance over time. <p>Note that the food waste measurement during pandemic, especially over lockdown periods, could be different from that in normal periods, as more time was available for food care.</p>
Notes	No information was available on systemic effects or efficiency. For more information, see van der Werf et al. (2021).

AL6: Trifocal project

ID	Title: Trifocal project
	Country: United Kingdom
	Implemented by: WRAP
	Experiment: no
	Intervention period: 2016 to January 2020

<p>Intervention design</p>	<p>Goal. The goal was encouraging sustainable food behaviours by piloting campaign delivery in London (to be able to share the lessons learned with a network of cities across the EU).</p> <p>Specific objectives were to:</p> <ul style="list-style-type: none"> — reduce the per capita tonnage of avoidable food waste generated by Londoners; — increase the amount of unavoidable food waste recycled by households across London; — increase the number of Londoners aware of the key steps that they need to take to eat more healthily and sustainably. <p>Implementation. Awareness and behaviour change were promoted through specific campaigns and material supports for targeted groups.</p> <ul style="list-style-type: none"> — Citizens were targeted by campaigns (e.g. pop-up events featuring speakers such as chefs and dieticians, social media activity with food waste facts, billboards, newspaper and livery advertising, cookery classes, leaflets, food waste prevention videos with healthy recipes). — Communities received cooking workshops in the form of discussions, sharing ideas and tips, measuring food waste at home and cooking demonstration, training sessions for community leaders and event/festival attendees. — Primary school children were targeted by a curriculum-based programme developed by the project partners (i.e. experiential learning throughout the workshops). — Food businesses received a staff engagement toolkit, training to use the toolkit 'your business is food, don't throw it away', events and the chef ambassador programme. <p>Food waste figures pre intervention (baseline) had been measured and were available for comparison. Healthy and sustainable eating figures are based on the results of pre-test surveys.</p> <p>Driver. The driver was low levels of knowledge on food waste prevention.</p> <p>Lever. Engaging communities at scale by conducting a consistent awareness campaign and training will increase food waste prevention.</p>
<p>Effectiveness</p>	<p>The results for change in level of waste were as follows.</p> <ul style="list-style-type: none"> — There was a 9 % reduction in avoidable food waste generated (kg/household/week) between 2017 and 2019. The amount generated fell from 1.59 kg/household/week to 1.44 kg/household/week. — Food waste overall (including unavoidable and possibly avoidable waste) decreased by 14 % from 2.58 kg/household/week to 2.21 kg/household/week. — A 14 % increase in the amount of avoidable food waste recycled was recorded. — There was a 15 % increase in Londoners demonstrating knowledge on and reporting taking action on healthy sustainable eating. <p>The outreach of the campaign was as follows.</p> <ul style="list-style-type: none"> — The campaign gained 11 000 followers across Facebook, Instagram and Twitter. — A total of 266 citizens attended the cookery classes. — There were more than 82 000 views of the web page. — Training sessions on healthy and sustainable eating, food waste prevention and food waste recycling were attended by approximately 1776 community leaders and members.

	<ul style="list-style-type: none"> — The designed education programme for pupils aged between 7 and 11 years was delivered in 24 schools in nine boroughs across London. — Business working group meetings were held and attended by 128 organisations, of which 50 were in hospitality and food service.
Efficiency	The intervention cost EUR 3.2 million, which was funded by the LIFE programme of the EU. A breakdown of the costs was not available.
Sustainability over time	The effects on citizens lasted from October 2017 to October 2019.
Transferability and scalability	<p>A total of 11 cities across Europe replicated aspects of the Trifocal project and the small change, big difference campaign to reach citizens across Europe. Using the key Trifocal messaging and materials available, the 11 cities collectively engaged with citizens, local businesses, schools and communities across Europe through a range of initiatives and activities. These included social media activity, roadshow events, workshops for schools, business consultancy and food waste monitoring through pilots programmes.</p> <p>The project team was involved in the replication phase in Europe by providing advice and bespoke training (capacity building) to each city to prepare / support delivery of the campaign. All campaign materials were made available to EU cities. The replication programme was designed to be flexible so that it could be tailored to complement local strategies and objectives</p> <p>The project operated within the context of the economic and political uncertainty surrounding Brexit, which had a particularly strong impact on the business engagement work. Thus, the businesses reported that the timing was not suitable for implementing food waste measurement and/or that food waste was not a priority at this time. Therefore, the project focused on the legacy outputs.</p>
Systemic effects	The intervention (or bundle of interventions) focused on sustainable food-related behaviours, including food waste prevention and recycling.
Key features for replicability	There was no detailed information about behaviour change (e.g. what behaviours were changed).
Notes	For more information, see the Trifocal resources web page .

AL7: West London food waste prevention campaign

ID	Title: West London food waste prevention campaign
	Country: United Kingdom
	Implemented by: WRAP
	Experiment:
	Intervention period: September 2012 to July 2013
Intervention design	<p>The 'love food, hate waste' campaign by WRAP, larger campaign under this one was developed, was tested using waste compositional analysis for household waste and household interviews in west London. The awareness campaign included radio advertising, digital adverts and social media running in west London.</p> <p>The intervention used the core campaign message: throwing away less food could save you up to GBP 50 per month. It also provided practical cookery skills and information to enable people to make the most of the food that they buy.</p>
Effectiveness	The average amount of food waste generated within the sample decreased by 15 % (± 14 %) from 2.60 kg/household/week pre campaign to 2.20 kg/household/week pos campaign. This reduction is statistically significant at the 95 % confidence level.

	<p>Both avoidable and unavoidable food waste reduced, with avoidable food waste reducing by 0.17 kg/household/week (14 %) and unavoidable food waste reducing by 0.27 kg/household/week (24 %).</p> <p>This decrease in food waste was accompanied by a shift towards behaviours that are associated with lower levels of food waste, such as planning meals, making shopping lists and wrapping items (e.g. cheese) appropriately to optimise their shelf life.</p> <p>14 % of households interviewed after the campaign had seen something recently about food waste and said that they were doing something different as a result.</p> <p>In terms of outreach, the intervention reached households in west London (601 000 households).</p>
Efficiency	The intervention had a total budget of GBP 168 472; no breakdown was available.
Systemic effects	No evaluated
Notes	<p>No information was available on sustainability over time or transferability and scalability.</p> <p>For more information, see the WRAP web page on the West London food waste campaign resources.</p>

Large-scale initiatives

AS1: Best before exhibition

ID	Title: Best before – when food becomes waste
	Country: Austria
	Implemented by: Natural History Museum Vienna (Naturhistorisches Museum Wien)
	Experiment: no
	Intervention period: 8 December 2020 to 5 September 2021
Intervention design	<p>The intervention involved the organisation of an exhibition at the Natural History Museum Vienna showcasing eye-catching facts and figures. It showed what one can do to escape the vicious circle of food waste.</p> <p>Drivers. Drivers were a lack of awareness of the food waste problem, a lack of knowledge about expiry dates, a lack of knowledge of correct food storage, a lack of knowledge of the origins of food and a lack of perception of food.</p> <p>Levers. Levers were increasing appreciation of food, imparting knowledge about best before dates and storage, imparting knowledge about the origins of food and creating problem awareness.</p> <p>A questionnaire for evaluation of the exhibition was administered to visitors. It inquired about food waste generation in the household, attitudes towards food waste, perception and evaluation of the exhibition content, knowledge about food waste, potential behaviour change, wishes for future awareness raising and demographic information.</p>
Effectiveness	<p>Overall, the exhibition was very well received by the respondents.</p> <ul style="list-style-type: none"> — 65 % of the participants rated it as very good and 29 % as good. — 59 % of respondents expressed they would walk away from the exhibition feeling informed. 40 % felt affected, while 37 % felt motivated. 16 % indicated feeling sad and 16 % indicated feeling shocked at the end of the exhibition. <p>The results show that the environmental impacts of food production were rated as the most important content. A total of 83 % of the respondents named this aspect. 32 % rated environmental impacts as most important (rank 1); 23 % ranked it as second most important (rank 2). The issue of animal welfare in food production and the social impact were important content for 70 % and 68 %</p>

	<p>of participants, respectively. Educating people about the importance of expiration dates was indicated by 59 %.</p> <p>To assess the influence of the exhibition on the level of knowledge regarding food waste, four questions were asked; the correct answers were tabulated to give a general score. It could be shown that people tended to give more correct answers after visiting the exhibition than people did before. A significant correlation was found between the number of correctly answered knowledge questions and the time of the survey. Consequently, the exhibition visit caused an increase in the visitors' level of knowledge.</p> <p>The vast majority of respondents could imagine that their handling of food or food waste would change after the exhibition. 39 % and 46 % definitely and rather agreed, respectively. 10 % and 1 % said that their handling would rather not or certainly not change, respectively. Whether real behavioural change took place is not known.</p> <p>More than 200 000 people seems to be a realistic estimation of the outreach of the exhibition, based on the museum receiving more than 800 000 visitors per year and the exhibition's duration of 9 months, partly during COVID-19 restrictions.</p>
Sustainability over time	The exhibition lasted 9 months. No similar future intervention is planned, but, based on the outcome of the survey, a smaller touring exhibition is planned.
Transferability and scalability	The main contents and exhibits can also be used in other exhibitions and another smaller travelling exhibition has been created mainly for schools. As the exhibition was already hosted in a major national museum, it is considered to be already at scale.
Notes	No information was available on efficiency or systemic effects.

AS2: COP26 campaign with Rankin

ID	Title: COP26 campaign with Rankin
	Country: Scotland
	Implemented by: Zero Waste Scotland
	Experiment: no
	Intervention period: 18 October 2021 to 21 November 2021, with post-intervention survey between 26 November 2021 and 30 November 2021
Intervention design	<p>Goal. The goal was increased awareness of the environmental consequences of food waste (in the percentage of Scottish consumers who care about reducing food waste and who feel guilty about binning food waste).</p> <p>Implementation. Zero Waste Scotland collaborated with internationally known celebrity and fashion photographer Rankin, originally from Glasgow, to shine a light on the scale of food waste (compared with the global plastic issue, which is well recognised in the population) and its contribution to climate change. The focus of the campaign was a series of five photography exhibits featuring some of Scotland's most wasted foods.</p> <ul style="list-style-type: none"> — A pre-campaign online survey was carried out using research data and analytics group YouGov, with a sample of 1 004 adults. The figures were weighted and representative of Scottish adults aged 18+. — A follow-up survey was carried out to gauge awareness, but without targeting people exposed to the campaign specifically. — KPIs were set in relation to social media, PR and website visitors. <p>Driver. The driver was awareness of the consequences of food waste.</p> <p>Levers. Levers were the emphasis on food waste as a major contributor to climate and the focus on the environmental consequences of food waste.</p>

Effectiveness	<p>In terms of outreach, the results were as follows.</p> <ul style="list-style-type: none"> — The total number of people reached was calculated as 3 686 239. — The PR reach for the campaign was calculated as 1.3 billion from a total of 284 pieces of media coverage. — Social media aspects had a total reach of 3 520 000 people, with a total engagement (reactions, comments, shares, post clicks) of 42 900. — The total number of unique website visitors was 9 700. <p>In comparison with the pre-campaign survey, the post-intervention survey (with a different sample aged 16+ and with no intervention exposure check) showed the following.</p> <ul style="list-style-type: none"> — The overall percentage of people who believed food waste contributes more than plastic waste had rose from 14 % to 19 %. — The answers from respondents living in the west of Scotland and in Glasgow also showed an increase in awareness of this fact, from 9 % to 20 % and from 11 % to 17 %, respectively.
Efficiency	Efficiency can be calculated as $GBP\ 53\ 329.50 / 3\ 686\ 239 = GBP\ 0.014$ (approximately EUR 0.016).
Transferability and scalability	<p>The intervention could be easily transferred by forming similar partnerships with an artist or artists to use photography or other art forms to highlight the impact of food waste. There is no action plan in place.</p> <p>The intervention could be taken to other cities, to a bigger region or possibly nation-wide, provided a sufficient budget is available.</p>
Key features for replicability	<p>The concept of this campaign was very strong; its message was eye-catching and surprising, presenting the receiver with facts that challenge psychological factors and norms. The results in terms of reach and engagement confirmed its effectiveness in this respect, with highly impressive PR reach and social media engagement. This was also reflected in the cost-effectiveness: the reach and engagement was estimated to cost EUR 0.016 per person.</p> <p>There are areas for improvement in the intervention.</p> <ul style="list-style-type: none"> — The campaign fails to connect awareness with behaviour change. — It is not possible to attribute the increase in awareness found in the post-campaign survey to the intervention, as the sample for the two surveys were separate and no questions were asked regarding whether respondents had interacted with the campaign. — A control group in an area not exposed to the campaign could have added to the intervention design.
Notes	<p>No information was available on sustainability over time or systemic effects.</p> <p>For more information, see the Zero Waste Scotland web page on the COP26 food waste campaign.</p>

AS3: Food waste-free week

ID	Title: Food waste-free week
	Country: Netherlands
	Implemented by: Netherlands Nutrition Centre
	Experiment: no
	Intervention period: 12 September 2022 to 18 September 2022

Intervention design	<p>This was a national awareness campaign run for a week in September in the Netherlands.</p> <p>The overall aims of the intervention were:</p> <ul style="list-style-type: none"> — to reduce food waste per capita; — to change the social norm by showing the movement against food waste and increasing self-efficacy (to use leftovers); — to reach as many Dutch consumers as possible and ensure that the topic is at the top of their minds; — as a bonus, to set the agenda for a wider target group than just consumers (e.g. supermarkets, catering). <p>The week after the initiative, a campaign evaluation started. A representative sample of Dutch consumers was asked about the food waste-free week.</p> <p>Target 1. 50 % of the Netherlands had to have seen or heard something about food waste.</p> <p>Target 2. 50 % of those who had heard about food waste had to take extra action during the food waste-free week.</p>
Effectiveness	<p>This intervention strived to increase awareness, signal social norms and facilitate the reduction of food waste through a food-waste-free week in the Netherlands. While it is unclear how much food waste was reduced because of this intervention, it reached 49 % of the Netherlands and 55 % of those reached said they had taken action to fight against food waste. In addition, more than 250 000 tools such as measuring cups, fridge stickers and folders with recipes for using leftovers have been distributed. The costs of this intervention per aware inhabitant and per inhabitant intending to reduce food waste were very low (EUR 0.01 and EUR 0.022, respectively). However, the cost per inhabitant who actually reduced food waste would be much higher (primarily due to the intention-action gap, which can be expected).</p>
Efficiency	<p>The total cost was EUR 100 000, excluding personnel and media costs.</p> <p>Target 2. 49 % of the Dutch population (17 000 000 inhabitants) were reached and 55 % of that 49 % had acted. Therefore, efficiency can be calculated as $\text{EUR } 100\,000 / \text{the } 4\,581\,500 \text{ aware inhabitants intending to reduce food waste} = \text{EUR } 0.022 \text{ per aware and actionable (meaning they reported having taken extra action to fight against food waste, that is, self-reports) inhabitant.}$ This is the lower bound because it excludes personnel and media costs.</p>
Transferability and scalability	<p>Awareness-raising activities can probably be scaled up easily. The dissemination of measuring cups, etc. will be more difficult to scale up because of costs.</p>
Notes	<p>No information was available on sustainability over time or systemic effects. For more information, see the Samen Tegen Voedselverspilling web page on Verspillingsvrije Week (food waste-free week).</p>

AS4: Great taste, no waste

ID	Title: Great taste, no waste
	Country: Scotland
	Implemented by: Zero Waste Scotland and Lidl
	Experiment: no
	Intervention period: 30 July 2020 to 6 September 2020
Intervention design	<p>Goal. The great taste, no waste campaign aimed to meet changing consumer needs in the United Kingdom during the COVID-19 pandemic by helping Scottish shoppers to do a weekly shop on a budget with no food waste. The</p>

	<p>target group was families with children (families of four seeking convenience and value).</p> <p>Implementation was as follows.</p> <ul style="list-style-type: none"> — The campaign consisted of a series of four weekly ‘waste-free’ shopping lists, meal plans and accompanying recipes for Lidl shoppers in all stores in Scotland, featuring ingredients to make breakfast, lunch and dinner each day for less than GBP 40 a week for a family of four. — This desired behaviour was promoted via inserts in the Lidl customer magazine, billboards at Lidl stores, Zero Waste Scotland PR and social media (including a collaboration with Scottish social media influencer ‘this little house’) and the use of Spotify audio adverts. <p>Drivers. Drivers were lack of awareness, skills and motivation.</p> <p>Levers. Levers were saving money (core lever for the intervention), improving ability (food planning, cooking method) and emphasising the environmental consequences of food waste.</p>
Effectiveness	<p>There was no baseline in terms of food waste measurement or of awareness or behaviours. However, an attitudinal survey was carried out in advance of the intervention to support its development.</p> <p>The outreach of the campaign was quite large and in line with the KPIs set.</p> <ul style="list-style-type: none"> — Engagement with social media users increased traffic on the Scottish ‘love food, hate waste’ Facebook and Instagram accounts. — A post-intervention survey run on social media platforms (36 respondents) showed that 83 % of consumers were willing to use meal plans and lists after the intervention. — Behaviour change was reported from a sample of 36 people (97 % of those surveyed who had taken part in the intervention reported having zero food waste as a result). <p>However, these results cannot be considered robust enough to calculate behaviour change results.</p>
Efficiency	<p>Efficiency can be calculated as GBP 50 000 / 2 700 000 people (as per measurement of reach and engagement) = GBP 0.185 per individual reached (EUR 0.21).</p>
Transferability and scalability	<p>The intervention could be easily replicated with the retailer or another retailer, in Scotland or elsewhere.</p> <p>Menus and shopping plans would need some adjustment to reflect the food culture if the intervention was transferred to another country or region. Menus should also be developed in line with the nutritional guidelines in the countries where the intervention is implemented.</p> <p>The retailer was interested in potentially scaling up the activity to other parts of the United Kingdom, depending on the outcome of the intervention carried out in Scotland. To date, this has not been actioned.</p>
Systemic effects	<p>Household sizes and dietary requirements have an impact on behaviour. Offering lists and plans for various household sizes and dietary requirements would allow more people to get involved.</p> <p>Keeping to the cost set for the shopping lists (a total of GBP 40 per week for a family of four), something that was a key ask from the retail partner, meant a trade-off on the amount of fresh fruit and vegetables included and some trade-offs in relation to sustainability. This resulted in not all menu plans meeting nutritional guidelines. This was the key challenge experienced during the development of the intervention.</p>
Notes	<p>No information was available on sustainability over time.</p> <p>For more information, see the Lidl web page on food waste.</p>

Large-scale national programmes

Action code	Action name	Sub-type	Quality of intervention design	Effectiveness	Efficiency	Sustainability over time	Transferability	Scalability	Systemic Effects
G1	Project Wasteless	Large scale national programs							
G2	Life Foodprint	Large scale national programs							

G1: Project wasteless

ID	Title: Project wasteless (<i>Maradék nélkül</i>)
	Country: Hungary
	Implemented by: National Food Chain Safety Office
	Experiment: no
	Intervention period: ongoing (started 2016)
Intervention design	<p>This is a national multifaceted campaign on food waste prevention. To decrease the amount of food wasted in Hungary, the following main interventions have been implemented:</p> <ul style="list-style-type: none"> — An awareness-raising communication campaign for adult consumers has reached more than 100 million consumers. — A school programme has been organised to increase the awareness of food waste prevention among primary school students. This intervention is necessary for raising the awareness of the future generations with regard to food waste prevention. The school programme has reached almost 300 000 children. — Best practices for food waste prevention have been collected in four sectors of the food chain (food processors, food retailers, restaurants and NGOs). — Collaboration and cooperation with other EU Member States have been undertaken in order to contribute to the international implementation of the project's results. — The impact of the awareness-raising campaign has been monitored by measuring the food waste generated in Hungarian households, based on the EU-recommended methodology. <p>Drivers. Drivers are awareness/perception of consequences of food waste, environmental concern, saving money, poor planning, knowledge of techniques for purchasing, managing and discarding food efficiently, portion awareness, convenience, age and household composition.</p> <p>Levers. Levers are using different communication strategies to emphasise the environmental consequences of food waste to generate better attitude; emphasising food-waste-related issues to raise awareness; emphasising food-waste-related issues to trigger concern and other personal emotions; promoting live and on-line community activities to promote results from good practices for the reduction of household food waste, food management advice and awareness campaigns on the environmental consequences of food waste; promoting monetary and non-monetary incentives for citizens to reduce food waste; promoting and introducing food planning or storage methods, cooking skills and food reduction tips; designing environments that can nudge food waste reduction practices; and promoting discourses targeting different generations, considering that different age groups are more reactive to different issues in climate and awareness campaigns. In addition, the attitudes of others family members (partners, friends and family circles) might play a key role in supporting individual behaviours, highlighting the importance of social norms.</p>

Effectiveness	<p>Studies have shown that between 2016 and 2021 the amount of avoidable household food waste per capita decreased by 24 %.</p> <p>The outreach results so far are as follows.</p> <ul style="list-style-type: none"> — Population affected by the project. The target was 2 000 000; actual reach was 140 000 000. — Children reached by the educational programme. The target was 5 000; actual reach was 20 000. — Teachers reached by the educational programme. The target was 200; actual reach was 1 500. — University students reached by the educational programme. The target was 500; actual reach was 7 400.
Efficiency	<p>The project has been supported by the EU LIFE programme's funding framework, with a total budget of EUR 964 468; the EU contribution was EUR 578 680 (2016–2020).</p>
Sustainability over time	<p>Effects have been recorded over 6 years. The project will continue along with monitoring efforts.</p> <p>An internal budget has been allocated to maintaining communication activities, but new collaboration and new project opportunities to exploit the results are being sought.</p>
Transferability and scalability	<p>Main enabler. Project wasteless has been declared the national food waste prevention programme of Hungary by the Food is Value Forum, which is the official stakeholder platform in Hungary concerned with food waste, co-hosted by the Ministry of Agriculture and the Hungarian Food Bank Association.</p> <p>Developed materials and methods are available. Professional support for the adaptation of materials can be provided on demand by the experts of the project.</p> <p>Enablers on the national and international scales. All materials produced by project wasteless are available and freely downloadable on the website of the project. The project maintains its activities to promote and share materials via several platforms and educational events.</p> <p>The project is a member of the EU Platform of Food Losses and Food Waste.</p> <p>Barriers on the international scale. Though the materials are available online not just in Hungarian but also in English, translating them into other languages is still a challenge.</p>
Systemic effects	<p>Project wasteless has been launched by the National Food Chain Safety Office of Hungary. While the reduction of waste in the food chain is clearly an important sustainability issue, some of the seemingly obvious solutions can potentially raise the risks for consumers. Therefore, balancing the desire to decrease food waste and the requirements of food safety requires constant work to educate both consumers and food entrepreneurs. It is also important that a food chain safety authority system is open to new ideas and able to react – and in many cases adapt – quickly to the changing market situations. Despite the fact that innovations in this field are usually delivered by NGOs and business entities, public institutions should also consider taking part in these initiatives. In addition to repressing food safety risks, the participation of authorities could also empower trustworthy initiatives by helping them appear even more credible and legitimate to the public.</p>
Notes	<p>For more information, see the project wasteless website.</p>

G2: Life footprint

ID	Title: Life – foodprint / awareness-raising campaign to prevent and manage food waste among consumers, the food and hospitality industries
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	Country: Cyprus
	Implemented by: Zero Waste Cyprus
	Experiment: no
	Intervention period: ongoing (started 1 September 2020; projected end date 30 April 2023)
Intervention design	<p>The project aims to bridge the gap between the awareness and the behaviour of key stakeholders regarding the environmental problem of food waste in Cyprus. The key objective of the project is to directly involve stakeholders from the food and hospitality industries of Cyprus and social actors such as local authorities and NGOs in creating a collaboration network for social food donation.</p> <p>Specific objectives for consumers are raising awareness of the scale of the food waste problem in the hospitality and food industries in Cyprus and among consumers.</p> <p>Drivers. Drivers are a lack of awareness and a lack of sustainable practices in the food and hospitality industries of Cyprus and among consumers.</p> <p>Levers. Levers are raising awareness of the reasons why food is wasted and how waste is managed and the feelings triggered by wasting food.</p>
Effectiveness	<p>Regarding outreach, so far the intervention has reached 500 000 consumers through the implementation of the horizontal media campaign. In the recent report that was published in June 2022, it was shown that consumers still believe that they have surplus food and do not manage the leftovers properly. They also need more knowledge and awareness of how they assess the costs they cause by wasting food. According to the survey, most households tend to buy more food than they need. When asked why they buy more food than they need, most respondents said they prefer to stock up in case something happens (emergency). Two surveys, one in 2020 and a similar one in 2022, were conducted to measure the behavioural change of the consumers. According to the most important findings of the survey, the habits of consumers in Cyprus in relation to the purchase, preservation and consumption of food are improving.</p>
Efficiency	<p>The global budget is EUR 1 018 869 for the whole project.</p> <p>Efficiency can be calculated as EUR 1 018 869 / the 500 000 people aware of the campaign = EUR 2.04. Bear in mind that the project supports a variety of measures, not just the awareness-raising campaigns.</p>
Sustainability over time	<p>Results will be disseminated and presented to stakeholders in Cyprus and the EU outside the hospitality industry, while efforts shall be made to create synergies with other LIFE programme projects on food waste prevention and management.</p>
Transferability and scalability	<p>Individuals and companies do not realise the connection between wasting food and the effect that this has on the economy, environment and resources in general (water, human resources, etc). It has been really difficult to engage individuals to engage with the project. This project needs a lot of support from individuals.</p>
Systemic effects	<p>Drivers. The driver is buying more food than needed (stock in case of emergencies, being prepared for visitors, different food preferences, the feeling of security, inability to calculate the amount needed).</p> <p>Levers. Levers are planning, prepping and storing food.</p>
Notes	<p>For more information, see the foodprint Cyprus website.</p>

Interventions uncovering new drivers

Action code	Action name	Sub-type	Quality of intervention design	Effectiveness	Efficiency	Sustainability over time	Transferability	Scalability	Systemic Effects
O1	Study on domestic food practices	Interventions uncovering new drivers							
O2	Good Deeds Calendar	Interventions uncovering new drivers							
O3	Education and leveraging social influence in school environments	Interventions uncovering new drivers							

01: Study on domestic food practices

ID	Title: Domestic food practices: a study of food management behaviours and the role of food preparation planning in reducing waste.
	Country: Italy
	Implemented by: Free International University of Social Studies Guido Carli, University of Modena and Reggio Emilia and University of Michigan
	Experiment: yes
	Intervention period: NA
Intervention design	<p>The intervention was part of a study aiming to examine the extent to which consumer household food management behaviours result in unnecessary food waste through three approaches: an interview, a survey and a field experiment. Participants were recruited by master's degree students; participants belonged to households including at least one child. The intervention was reading an educational article explaining how to organise a weekly menu quickly and simply. The quasi-experiment was articulated as follows.</p> <ul style="list-style-type: none"> — One group (57 respondents) completed a pre-test diary, received the article to read and completed a post-test diary. The materials were delivered to respondents personally by students who spent some time with them commenting on and explaining the diaries and the article. — A second group (56 respondents) completed a pre-test and a post-test diary, but did not receive the article to read. — The third group (49 respondents) received the article and completed the post-test diary, but did not complete the pre-test diary. — The final group (48 respondents) completed only the post-test diary. The last two groups allowed the authors to assess the presence of pre-test sensitisation. <p>Driver. The driver was poor meal planning. Lever. Receiving information and guidance on meal planning will improve meal planning.</p>
Effectiveness	<p>Reductions of 737.7 g in group 1 and 370.6 g in group 2 were recorded. The study improved skills in planning meals during the intervention. The intervention focused on increasing the consumers' meal-planning skills, without studying the behavioural aspect.</p> <p>Results concluded that the educational information was effective at reducing food waste.</p>
Transferability and scalability	The intervention can be easily replicated in another study as long as the educational materials are available.
Systemic effects	Enablers. A related food waste-prevention policy or legislation could encourage schools, companies and the government to introduce interventions to provide their students, employees and inhabitants with educational material to improve their food-related literacy.
Notes	No information was available on efficiency or sustainability over time. For more information, see Romani et al. (2018).

02: Good deeds calendar

ID	Title: Good deeds calendar - pilot during Ramadan and Eid 2022
	Country: United Kingdom

	Implemented by: WRAP
	Experiment: yes
	Intervention period: 1 April 2022 to 1 May 2022
Intervention design	<p>Goal. The goal was to use children aged between 6 and 11 as messengers by incorporating positive food waste behaviours into a simple, rewarding and customisable good deeds calendar for 1 month.</p> <p>Implementation. Implementation took place as follows.</p> <ul style="list-style-type: none"> — The deeds addressed capability. The lack of knowledge and skill to repurpose was addressed by providing motivation and opportunity to portion, store and use leftovers. The motivation was for the children to go on a journey with fun deeds to undertake and incentives (e.g. win points and a prize) and for the adults to guide their children to learn virtuous behaviours and participate in managing food well at home. — In total, 106 households received the good deeds calendar. The 107 control households did not. — Results were monitored through self-reported changes in adults' and children's food waste prevention behaviours between the treatment and control groups post-intervention. — In addition, 14 respondents from the treatment group participated in one of two focus group discussions following the survey. <p>Drivers. Drivers were the overprovision of food, incorrect leftover storage knowledge, a lack of knowledge of how to / skills for using up leftovers, motivation to use up food and not wasting food.</p> <p>Lever. The lever was the provision of deeds addressing the food waste drivers.</p>
Effectiveness	<p>67 % of households in the intervention group reported wasting less food (compared with 32 % in the control group) while using the calendar and positive change was reported in:</p> <ul style="list-style-type: none"> — the children's behaviour; — the number of behaviours that have persisted in children 2 weeks after the intervention. <p>Regarding how parents/guardians deal with leftovers, those reporting daily use of the calendar were more likely (60 %) to say that they deal with leftovers differently than those who were not using the calendar every day (32 %).</p>
Efficiency	<p>Investment costs (materials, design, purchasing equipment) totalled GBP 500 for printing the calendars (100).</p> <p>Operational costs (logistics) totalled GBP 700 for sending the calendars to recipients via post and for the labour costs for designing the pilot study.</p>
Sustainability over time	<p>It is too early to say whether reported changes in behaviour will persist, though there was some evidence of a lasting effect in the weeks immediately following the intervention.</p> <p>Consideration should be given to making the calendar last longer or providing deeds to do over the year.</p>
Transferability and scalability	<p>The intervention focused on Ramadan and Eid. Below are the principles of the intervention that can be used for other events / in other communities.</p> <ul style="list-style-type: none"> — It is important to overcome the overprovision of food at 'special occasions', that is, events, birthdays, weddings, religious celebrations, etc. The assumption is that on these occasions food is overprovided due to a fear of not being a good host. — The principles for tying into the right motivator for the special occasion are transferable. Focus should be on preventing or eating leftovers, as

	<p>opposed to being a good host (and providing a variety and abundance of food), which was deemed to be a stronger motivator and harder to address.</p> <ul style="list-style-type: none"> — Incentivising deeds make them fun and rewarding. — Interventions can show that saving food is saving money and acting in favour of preserving the planet. — Deeds can be used as an opportunity to act and better organise action in daily life, taking into account the time constraints. — Children can play an important role as 'vehicles' to engage action in households. — Regarding scalability (opportunities), the calendar could be sold via local retailers, distributed via mosques or local authorities. The licensing to use the calendars would be relatively straightforward: a higher cost for profit-making companies but a low charge for non-profit organisations.
Key features for replicability	The good deeds calendar might be a good tool to be replicated under other events.
Notes	No information was available on systemic effects.

03: Education and leveraging social influence in school environments

ID	Title: Food waste between environmental education, peers, and family influence. Insights from primary school students in northern Italy
	Country: Italy
	Implemented by: University of Bologna and local school board
	Experiment: yes
	Intervention period: November 2017 to May 2018
Intervention design	<p>The overall aim of the intervention was to test the impact on the food waste generated by primary school students of a lesson about the environmental consequences of food waste.</p> <p>Hypotheses tested in the experiment were that :</p> <ul style="list-style-type: none"> — children who contribute more to the public good tend to waste less food; — children who receive education on the environmental impact of food waste waste less in both the short and long terms; — children's food waste is positively related to the food waste of their peers, including (1) their friends, (2) children considered popular and (3) physically close peers in food-related activities; — children whose parents are more concerned about food waste and/or have a stricter attitude towards wasting food waste less food.
Effectiveness	<p>Result 1. The generation of food waste is unrelated to children's contribution to the public good.</p> <p>Result 2. The only effect of receiving education on the environmental impacts of food waste was a reduction in self-declared food waste in the short-term.</p> <p>Result 3. Children's food waste is unrelated to the food waste of (1) their friends and (2) children considered popular. However, it is positively related to the food waste of (3) physically close peers in food-related activities, namely those sitting near them in school canteens.</p>

	<p>Food waste at home is unrelated to the network variables considered – food waste behaviours at school and at home. This result might represent a challenge for the diffusion of virtuous behaviours learned at school.</p> <p>Result 4. Neither parents’ opinions on food waste nor the strictness of their attitudes towards their children wasting food made a difference regarding the children’s food waste behaviour.</p>
Sustainability over time	<p>The class in question was conducted in January 2018 and by the second questionnaire (May 2018) the effect on the children had dissipated. The experiment found that this concept-based educational initiative was not successful in reducing food waste; it had an impact on the students’ self-assessment of this behaviour in the short-term but this impact was not visible after some months.</p>
Systemic effects	<p>The message that food waste has negative environmental consequences was passed on to the students and this awareness persisted after several months, but with no cross-contamination of behaviours between school and home. The parents’ approach to wasting food and their opinions on food waste were unrelated to their children’s behaviour in both settings.</p> <p>What seemed to matter most for the students’ food waste was social influence through the direct observation of peers’ behaviours in the food consumption locus (i.e. the school canteen).</p>
Notes	<p>No information was available on efficiency or transferability and scalability. For more information, see Piras et al. (2023).</p>

Interventions outside the scope

The following section shows the evaluation and analysis of interventions that were excluded from the initial scope of the ECFWF. The analysis was excluded from the main body of the report but the evaluation was carried out by the forum nonetheless.

Action code	Action name	Sub-type	Quality of intervention design	Effectiveness	Efficiency	Sustainability over time	Transferability	Scalability	Systemic Effects
M1	Gladsaxe measurement	Measurement							
M2	Copenhagen municipality	Measurement							
R1	OLIO App	Redistribution - out of scope							
R2	Munch App	Redistribution - out of scope							
R3	Food saving event catering	Redistribution - out of scope							

Measurement interventions

Two interventions were reviewed in this subcategory. M1 measures food waste accruing in the food services of kindergartens and nursing homes owned by the municipality, with the aim of reducing food waste. In addition to measurement, the intervention has an awareness-raising component, including educational material and training for food service staff. M2 aims to measure food waste in various municipal food service units, such as daycare institutions, schools, residential institutions, nursing homes and commercial kitchens. Both interventions assume that the mere measurement of food waste can motivate people to reduce it.

Quality of intervention design

M1 uses FoodOp, a digital platform that enables municipalities to automatically measure and document food waste. It utilises an experiment-like design, including a pre-intervention measurement, treatment (awareness raising and education/training) and a post-intervention measurement. FoodOp ensures fairly standardised sampling and data management, thus creating reliable data. M2 seems to be a well-designed intervention, with a set baseline, physical measurements in a subsample and an estimation for the rest of the food service units.

Effectiveness

M1 covers 14 kindergartens and 5 nursing homes. Their food services are estimated to serve 700 children, 125 pedagogues and assistants, 750 elderly people and 225 nursing home employees. However, data has not been disclosed about the result of the pre- and post-intervention tests or about the quantities of food waste reduction.

In M2, the measurements cover 29 municipal food service units of various types. The estimation was performed in 746 units, covering approximately 10 000 food service professionals and 100 000 citizens. Data about the measurement was not available at the time of evaluation, but it was said that it will be published at a later point.

Efficiency

Data on the budget, which is required for the efficiency estimation, is missing for both interventions.

Sustainability over time

M1 appears to be a one-time intervention, which lacks a set baseline, target values, indicators and monitoring. M2, however, is designed to be a continuous activity, with a commitment to halve food waste in the concerned units by 2030. Both programmes were fostered by municipalities.

Transferability

Both measurement interventions deal with institutional catering, which is quite universal. They can be used in other municipalities, even in other European countries. Therefore, transferability is possible, in general.

Scalability

Different methodologies are being used in the two interventions and both can be scaled to different levels. M1 uses FoodOp, which is designed to be scaled. M2 uses classical subsampling and estimation based on the sample results. Applying this sampling methodology can be difficult in diverse institutional environments, but in many environments, such as nursery schools and primary schools, it can be relatively easily generalised.

Systemic effects

The systemic effects are moderate in this subcategory, although clients (including children) of the food services will surely take some important messages about food waste prevention home, thus possibly creating a positive impact on other food habits.

Box 13 presents the challenges identified for these interventions.

Box 13. Identified challenges in measurement interventions

Implementing measurements in a working environment that serves food to many thousands of people is clearly challenging. Nevertheless, innovative technologies (of which FoodOp in M1 is a good example) can be viable solutions. Another challenge is securing the long-term engagement of staff. As seen in M1, a one-time intervention will not set target values for waste reduction, nor will it be able to build systematically on the results to provide a persistent effect.

The key takeaway messages are as follows.

- Food waste measurement in food service units (e.g. school and office canteens) could be a way to reduce food waste quantities, especially when the effort is visible to the consumers (systemic effect).
- Measures can be implemented in other places relatively easily, as most of the procedures and the infrastructural elements are similar.
- There is a good opportunity to combine these interventions with others, such as awareness campaigns and school programmes.

M1: Gladsaxe measurement

ID	Title: Gladsaxe municipality food service intervention
	Country: Denmark
	Implemented by: municipality

	Experiment: no
	Intervention period: ongoing (started 1 January 2021), reporting 1 January 2021 to 1 November 2022
Intervention design	<p>The intervention focuses on food waste measurement in food service in kindergartens and nursing homes owned by the municipality. The food waste mitigation activity is a targeted intervention in public food services that is owned and operated by the municipality of Gladsaxe. The intervention is a political priority of the municipality's Children's and Education Committee. The intervention targets 5 nursing homes and 14 kindergartens in the municipality. The intervention has an awareness-raising component that includes educational material and training for food service staff. In addition, the data collection part – the measurement component – is seen as part of the intervention.</p> <p>Drivers. The intervention assumes that knowing specific amounts of food waste is an important determinant for being able to reduce it.</p> <p>Levers. NA.</p>
Effectiveness	<p>In total, 14 kindergartens and 5 nursing homes are targeted by the programme. It can be estimated from known average sizes that in the kindergartens around 700 kids and around 125 pedagogues and food service staff are involved in the programme. It can be estimated that in the nursing homes around 750 elderly people and 225 nursing home assistants and nursing home food service professionals are involved in the programme. The evaluation of the intervention is based on automatic collection of data on food waste pre and post test. The intervention itself involves semi-automatised food waste data collection based on smart mini digital scales delivered by the technology provider FoodOp. The data is automatically collected using wireless technology and transferred through a server organised around the lunch buffet. When the buffet is open, the system constantly sends data to the FoodOp server on what food is taken from the buffet. Thus, the data collection itself can be considered both as part of the intervention and as part of the measurement of the intervention. The data is expected to be made publicly available.</p>
Efficiency	The cost of subscription to the FoodOp methodology is estimated at DKK 150 000 per year.
Transferability and scalability	The tradition of institutional caring is quite universal and is a public service provision that is offered in most European countries. The fact that institutional catering operates slightly differently depending on the welfare system in place must be taken into consideration, but otherwise it is straightforward to implement an automatised data collection procedure in different countries based on the FoodOp approach
Systemic effects	<p>Driver. The programme shows that knowing the amounts of food waste more precisely makes it much easier to reduce food waste; in other words, it acts as a powerful motivational parameter.</p> <p>The intervention shows the strength of the knowledge triangle and the Nordic partnership approach in developing and implementing a cross-cutting and novel technology that adds value for both the municipality and for the technology provider.</p>

M2: Copenhagen municipality

ID	Title: Copenhagen municipality
	Country: Denmark
	Implemented by: Copenhagen municipality
	Experiment: no
	Intervention period: ongoing (started 1 January 2021), reporting 1 January 2021 to 1 November 2022

Intervention design	<p>Implementation. The intervention is monitored using two means. Food waste measurement is carried out in 29 municipal food service units of various types. In addition, a food waste amount estimation is performed in 746 units (daycare institutions, schools, residential institutions, nursing homes and commercial kitchens). In 2022, there were to be reduction targets for food waste and pilot trials based on manually collected weight data on food waste in kitchens were to start. The 2022 measurement is to be the baseline and thereafter food waste will be measured once a year. The data is expected to be made publicly available.</p> <p>Objective. The objective is to halve the amounts of food waste in 746 units (daycare institutions, schools, residential institutions, nursing homes and commercial kitchens) by 2030.</p> <p>Driver. The driver is a lack of knowledge on the specific amounts of food served.</p>
Effectiveness	Since the intervention includes 746 food service outlets, it can be estimated that about 10 000 food service professionals and around 100 000 citizen end users have been affected by the initiative.
Sustainability over time	An important part of this intervention is continuous recording of outreach and dissemination of the progress. The municipality has just reconfirmed its commitment to reaching the 2030 goals of the intervention.
Notes	No specific information was available on transferability, efficiency or systemic effects.

Redistribution interventions

Three interventions were labelled redistribution interventions, which are technically outside the scope of this report. Two of them are apps optimised for mobile devices (R1, R2). R1 uses Olio, a global smartphone app which covers 49 countries. Olio is a citizen-focused sharing app, but it also covers business entities. The Munch app, employed in R2, is a regional device focusing on central and eastern Europe. Munch offers hospitality service providers and manufacturers an opportunity for a last-chance sale of food surplus that is approaching its expiry date or that is not in line with aesthetic standards. As a co-benefit, users can save money by acquiring the foods at reduced prices. R3 is a hospitality service provided by the Hungarian Food Bank Association. This service works together with customers to optimise the portions and think about the utilisation of leftovers to save food. Profits support the food donation organisation activities of the food bank.

Both R2 and R3 are heavily involved in charity-oriented activities.

Quality of intervention design

R1 and R2 are well-designed mobile apps attracting hundreds of thousands of users in many countries. They have had to deal with technology, legislation and business-related issues over the years. Olio has been on the market for nearly a decade. R3 is also a carefully planned service, encapsulating the experience of the Hungarian Food Bank Association working with partners from this sector.

Effectiveness

Information from which to gauge the effectiveness of the interventions is lacking. R1 saves about 100 t of food from becoming waste annually, representing a value of approximately EUR 1 million. Munch (R2) saved about 200 000 meals from spoilage over 2 years, estimated to be equivalent to 30 t annually. Munch covers a community of 40 000 users and regularly shows them news and practices about food waste prevention. R3 has provided approximately 3 000 portions to clients so far, with the level of waste related to the food prepared for the events being under 10 %.

Efficiency

Data on costs is missing. Only R2 disclosed its total budget, which is EUR 150 000. Based on this figure, its efficiency could be estimated to be about EUR 0.75 per meal saved from becoming waste.

Sustainability over time

All three interventions have existed on the market for several years and have long-term business models. However, R2 continuously needs external funding for expansion, which is key for sustainability.

R3 is also dependent on the main activities of the Hungarian Food Bank Association and probably could not exist as a stand-alone service provider.

Transferability

The two mobile apps (R1, R2) aim for transferability by the nature of their design. However, they face cultural and language issues and a diverse regulatory environment. R3 could be transferred easily to other service providers, even in other European countries. Its basic principles are open to anyone.

Scalability

For R1 and R2, scaling up (attracting more users and more business entities as partners) is a key issue for financial sustainability; scaling down is not really possible due to the critical level of restaurants/shops and users needed for satisfactory logistical efficiency and financial performance to cover costs. For R3, scaling is not a challenging issue, because similar principles apply to different events, such as workplace parties and illustrious gala dinners.

Systemic effects

All reviewed interventions have delivered some positive systemic effects by raising the awareness of companies and consumers regarding food saving. In addition to positive systemic effects, negative ones have also occurred due to the increased number of car rides occurring to pick up leftover food, especially in less densely inhabited areas.

Box 14 presents the challenges identified for these interventions.

Box 14. Identified challenges in redistribution interventions

For the food saving apps (R1, R2), expansion is difficult in many countries due to the lack of financial incentives for businesses to donate food instead of throwing it away (value added tax is often due on donated foods). For these apps, it is also challenging to predict daily consumption, which sometimes makes it impossible for users to find suitable offers, thus potentially decreasing their engagement.

The key takeaway messages are as follows.

- Apps seem to be practical solutions for food waste prevention, but in reality several challenges remain. The biggest one is that the apps should acquire a satisfactory number of users and businesses involved to operate efficiently and be maintained in the longer term.
- Apps for redistribution do not give any information on whether the saved surplus food is actually consumed or is wasted downstream in the food supply chain.
- The time and attention invested by the users must be minimised, while the benefit of using the app must be immediately clear and convincing.
- A hospitality service provided by a food bank is a great way to extend the focus of action and may be able to generate income and attract more donors, volunteers and other supporters.

R1: Olio app

ID	Title: Olio app
	Country: United Kingdom
	Implemented by: Olio app
	Experiment: no
	Intervention period: ongoing
Intervention design	<p>Objectives. The objectives are to fight food waste in households and local communities with an app that facilitates sharing surplus food and helps food businesses achieve zero-waste locations by collecting and redistributing their surplus food and to increase the convenience of reducing food waste.</p> <p>The Olio app aims to make it easier for its users to distribute leftover food items to other people instead of letting them go to waste. Thus, it makes the reduction of food waste more convenient for people and increases their perceived control over this reduction. While between April 2017 and October 2018 alone 90 t of food waste</p>

	<p>with an equivalent retail value of up to GBP 750 000 have been saved with this app, the intervention has also created additional environmental costs through increased numbers of car and bus rides to facilitate exchanges, which decreases the (still positive) environmental impact of the reduced food waste to between 90 t and 175 t of CO₂eq. Additional evidence also suggests that what users do with the additional savings they get through this app must be taken into account. The savings can further reduce the environmental benefits.</p> <p>A positive additional outcome of this app is that it can reduce the cost of food for its participants, thus potentially alleviating financial problems for some of its users.</p> <p>Drivers. Drivers are the high levels of effort required of households to give food leftovers to others instead of throwing them away and the high levels of effort required of retail / distribution / restaurants / food services to redistribute food leftovers instead of throwing them away. The app targets ability factors because they make redistribution, and thus food waste reduction, easier for stakeholders (consumers and companies).</p>
Effectiveness	<p>1.7 million food items were redistributed in 2022.</p> <p>The target for 2022 (1.9 million) had not yet been met at the time of reporting. The overall target for 2025 is 14 million (12 % of this overall goal has been achieved).</p>
Efficiency	NA.
Sustainability over time	Factors in the intervention's sustainability are ensuring organisational support; ensuring the availability of the human resources, infrastructure and technology needed in the long term; ensuring the economic sustainability of the initiative; training staff; and setting up a long-term strategic plan.
Transferability and scalability	EU expansion is very difficult due to the lack of financial incentives for businesses to donate food instead of throwing it away (value added tax is often due on donated food and donated food must often be recorded as a sale rather than a loss). When incentives do exist, they are only applicable to donations made to charities, even though there is far more surplus food than charities can possibly handle. More harmonisation is needed between countries to level the playing field and boost donations.
Systemic effects	A recent study showed that Olio is having a very strong impact on the mental and financial well-being on those who request food on the app. Researchers analysing this app (Makov et al. 2020) underestimated the positive impact on mental health of helping people and helping to save the planet. The study showed that, if food requesters could no longer access Olio, they would be exposed to significant financial worries, would feel more detached from their local community and would feel disappointed that they could no longer have a positive environmental impact. Using apps as means to create a digital sharing economy with the goal of reducing food waste appears to be a timely and good approach. More and more people from different socioeconomic backgrounds have the technologies required to participate in a sharing economy. However, there are probably risks of abuse (e.g. supplying food that is no longer good for consumption, setting up a market to sell products that are not fit for consumption) if it is left unsupervised. In addition, evaluations of these interventions need to consider the additional CO ₂ emissions caused by travel to pick up food items and other rebound effects. An additional weakness of the evaluation of the available data using statistical models is that these evaluations rely on several assumptions (outlined in the papers). These need to be taken into account.
Notes	<p>The Olio app is available on the Google Play store.</p> <p>For more information, see Makov et al. (2020).</p>

R2: Munch app

ID	Title: Munch app
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	Countries: Czechia, Hungary and Slovakia
	Implemented by: Munch Europe Kft
	Experiment: no
	Intervention period: ongoing (started 7 June 2022), reporting 1 September 2020 to 1 July 2022
Intervention design	<p>Munch is a mobile app where food businesses can sell their surplus food for a discounted price. It has been downloaded by more than 240 000 users in Hungary.</p> <p>Driver: The driver is food that cannot be sold in food businesses due to expiry dates, packaging problem or beauty defects.</p> <p>Levers: Levers are that businesses cannot sell food after its best before date, the issue of seasonality and that it is hard to predict daily consumption in the hospitality industry.</p>
Effectiveness	<p>Food reduction. A total of 185 669 meals have been saved (the production of which resulted in about 500 t of greenhouse gas)</p> <p>Education and awareness. There are more than 40 000 community members in the Facebook groups, where food waste best practices are shared.</p> <p>Order frequency. Munch customers save food 2.3 times per month.</p> <ul style="list-style-type: none"> — In total, 27 000 people have bought surplus food with a 40–60 % discount. — There are more than 600 participating businesses. — In total, 12 000 people have received surplus food.
Efficiency	The total budget is EUR 150 000.
Sustainability over time	There is a direct impact until the app is used and then an indirect impact after use. Munch use is usually a habit. Urban citizens aged 18–65, with 65 % being women, are the target group for dissemination.
Transferability and scalability	<p>Potential barriers for transferability are cultural and language differences, physical distance and hiring challenges.</p> <p>Barriers to scalability. Barriers are the number of partners open to collaboration and partner density.</p> <p>Enabler of scalability. The enabler is having the capital to scale up the intervention.</p>
Systemic effects	<p>Drivers. Drivers are expiration dates, the ever changing demand, large number of food options and low levels of education.</p> <p>Levers. Levers are education, leveraging the green trend and money saving.</p> <p>Synergies. There are possible synergies in collaborations with non-profits, food banks and multinational chains</p>
Notes	For more information, see the Munch website .

R3: Food saving event catering

ID	Title: Food saving event catering
	Country: Hungary
	Implemented by: Hungarian Food Bank Association
	Experiment: no
	Intervention period: ongoing (started 2018)
Intervention design	This is a redistribution initiative for food from catering activities.
Effectiveness	The intervention has redistributed approximately 2 000–3 000 portions so far. The level of waste is below 10 %. The intervention has reached approximately 10 000 people.
Notes	No specific information was reported on efficiency, sustainability over time, transferability or scalability.

Annex 2. EU survey for data collection

Food waste prevention initiatives along the food supply chain

Fields marked with * are mandatory.

Introduction

Thank you for participating in this survey on food waste prevention initiatives. This survey aims to collect relevant information on both ongoing and concluded food waste prevention initiatives in order to analyse their efficiency, effectiveness, and impacts. This information will allow us to identify those initiatives that delivered the best results.

Initiatives collected through this survey may be of any scope and size (that is, individual initiatives or multiple initiatives integrated as part of a broader food waste prevention programme) and should have data available on the impacts on food waste levels (using a Target-Measure-Act approach).

You may have already contributed to the two surveys launched by the Commission between March and April 2022 to inform a modelling exercise developed in the context of the Impact Assessment to set food waste reduction targets. If this is the case, please indicate the title of your initiative at the beginning of the form and you will only be asked for a few extra information. The survey has a dynamic format, adapting to the answers received.

The submitted initiatives will be evaluated in order to contribute to the development of 'best practices' in food waste prevention. Through this assessment, the European Commission aims to support all actors in defining effective measures needed to prevent food waste and facilitate sharing of experience and best practice in order to accelerate the EU's progress towards Sustainable Development Goal (SDG) 12.3 targets. The information provided will also support the work of the [European Consumer Food Waste Forum](#), which aims to gather data and identify a variety of evidence-based, practical solutions to reduce food waste at consumer level, including household and food services.

All food waste prevention initiatives submitted through the survey will be evaluated for their efficiency and effectiveness by the Joint Research Centre (JRC). Thus we encourage you to submit information as complete as possible to be able to assess whether your initiative is a 'best practice'. The most efficient initiatives will be published in a report by the JRC, similar to the assessment of food waste prevention initiatives carried out in 2019 where selected initiatives were presented in factsheets (Annex 6 of [report](#)). Furthermore, 'best practices' will be promoted in meetings of the [EU Platform on Food Losses and Food Waste](#) and as part of the monthly newsletter of the [EU Food Loss and Waste Prevention Hub](#). The dissemination of information submitted through the survey will be done only with your explicit approval.

- In case you represent a trade association, please forward the survey to your members, so that the survey can be filled in directly by those implementing the food waste prevention initiatives (in case your members are national associations, please ask them to forward it to their members, for the same reason). The replies to the survey will be sent directly to the Commission: if you wish to view your members' replies, please ask them to save a PDF version of their contribution after finalizing the survey.
- Clicking on icons with question mark will provide you with further information to answer some questions.
- Please note that the survey was designed for a range of different stakeholders and types of initiatives. Therefore, not all questions will apply to your specific case.

Please make sure you submit the survey by October 10th

Should you have any questions regarding the survey, please send us an e-mail at: JRC-FOOD-WASTE@ec.europa.eu

*Except for personal data, the information provided through this survey will be analysed and made publicly available in a report, similar to the exercise conducted in 2019 and reflected in the report "[Assessment of food waste prevention actions](#)". If you agree to this, select YES. Otherwise, your information will be used as aggregated data and will not be published in a disaggregated

form. Data will be used within the European Commission and will not be transferred to third parties. Personal data are processed and protected by the Commission in line with this [privacy statement](#).

- Yes
- No

Overview

Have you already reported your initiative(s) through the survey on food waste prevention launched by the Commission in March/April?

Between March and April 2022, the European Commission launched two surveys to collect data on food waste prevention initiatives, one for national actions taken by Member States and the second for actions taken by stakeholders. Both surveys aimed to inform a modelling exercise developed in the context of the Impact Assessment to set food waste reduction targets. This is the third survey which aims to collect relevant information on both ongoing and completed food waste prevention initiatives in order to analyse their impacts, efficiency and effectiveness.

If the answer is yes, we would be grateful if you could fill in this follow-up survey, designed to capture additional information about the food waste prevention initiative.

Please specify the name of the initiative

Entity of the respondent

- A private sector organisation
- A public sector organisation
- Other
-

If you selected other, please specify

Can we contact you for some follow-up questions on the answers provided, if necessary?

- Yes
- No

1. General information

Short summary of the initiative, focusing on its implementation and monitoring of the results

Help: Example: initiative taking place at urban scale, where the surplus food generated by 10 small retailers was delivered to a food bank for re-distribution to charities/civil society organisations. The amounts (tonnes) of surplus food delivered daily were recorded for each main product group.

Classification of food waste prevention interventions ([Caldeira et al., 2019](#))

Type	Sub-type
Redistribution	Surplus food redistribution
	Gleaning
	Digital tools for redistribution
Food valorisation	Value added processing
	Animal feed
Consumers behaviour change	Awareness/educational campaign
	Digital tool for behaviour change
	School programs
	Awards
Supply chain efficiency	Process innovation
	Innovation of products - packaging
	Innovation of products - date marking
	Training & guidelines
	Price discount
	Imperfect product sale
	Certification
	Public procurement
	Digital tools for supply chain efficiency
Food waste prevention governance	Voluntary agreement
	Regulatory framework/policy
	National food waste prevention program
	Fiscal incentives

*the sub-types of actions are just examples and are not considered a comprehensive list of possible prevention actions

According to the image above, select the type of initiative (multiple choice available)

- Redistribution
- Food Valorisation
- Consumer behaviroual change
- Supply chain efficiency
- Food waste prevention governance
- Other

Stage of the food supply chain where food waste was prevented (multiple choice available)

- Primary production
- Processing and manufacturing
- Retail and distribution
- Restaurants and food services
- Household

Geographical coverage

- Municipality
- Region
- Country
- Global (more than one country)

Please specify further (e.g. Municipality - Copenhagen)

Stakeholders taking part in the initiative (multiple choice available)

- Academia/research
- Consumers
- Consumers organisations
- Farmers
- Food banks and other charities
- Food services (e.g. public or private canteen)
- Government (national)
- Government (regional)
- Municipality
- Opinion leaders (e.g. politicians, celebrities, media)
- Other
- Other NGOs (e.g. dealing with environmental protection)
- Processors/manufactures
- Trade associations
- Waste collection companies
- Wholesalers
-

Target audience (multiple choice available)

- Academia/research
- Consumers
- Consumers organisations
- Farmers
- Food banks and other charities
- Food services (e.g. public or private canteen)
- Government (national)
- Government (regional)
- Municipality
- Opinion leaders (e.g. politicians, celebrities, media)
- Other
- Other NGOs (e.g. dealing with environmental protection)
- Processors/manufactures
- Trade associations
- Waste collection companies
- Wholesalers

If the initiative addresses any of the recommendations for action of the EU Platform on Food Losses and Food Waste, please indicate at which stage (multiple choice available)

The recommendations of the EU Platform address action required at each stage of the food supply chain (including food redistribution) and involving all key players from the public and private sectors. They include a set of horizontal or 'cross-cutting' recommendations, which are common across various stages of the food value chain, often involve multiple actors and are needed to achieve the global food loss and waste targets (SDG Target 12.3). The recommendations are addressed to both public and private entities, suggesting relevant actions for specific players and, importantly, calling for cooperation amongst the different actors concerned

- Cross-cutting recommendations for action
- Recommendations for action for primary production
- Recommendations for action at manufacturing stage
- Recommendations for action at retail stage
- Recommendations for action in hospitality/food services
- Recommendations for action at consumer level
- Recommendations for action for food donation
- No, the initiatives does not follow any of the Platform's recommendations for action

What are the objectives of the initiative? Are there specific Key Performance Indicators (KPIs) selected for each objective?

Example of objectives: to reduce food waste per capita, to change of social norms.

Example of KPIs: food waste generated per capita, food waste generated per meal served in a commercial canteen, number of students aware about the environmental impacts of wasting food

Have you set specific targets linked to the objectives listed above? If yes, please provide details

Example: reduce per capita food waste by 20 %, increase awareness of the food waste impact on the environment.

Did the initiative achieve the targets set?

- Yes
- No
- No targets have been set
- The initiative is on going

Provide further details below regarding results achieved (if relevant)

Was a baseline measurement established?

Indicate if a baseline was set or a measurement of food waste was carried out before the initiative. Such pre- measurements can consider quantitative data (e.g. kg of food wasted before the initiative) or qualitative data (e.g. assessing the motivation to reduce food waste in a target group before the initiative).

- Yes
- No

When was the baseline established and which method was used?

Was there a monitoring system put in place to track the progress for each Key Performance Indicator (KPI) selected?

- Yes
- No

If yes, please describe the monitoring system method as well as the frequency of measurements

Example of monitoring method: recording certain habits, quantifying food waste levels

Example of frequency of measurement: one measurement 2 weeks after the start of the initiative

If any specific food category was monitored, for example fruits or meat, as part of the food waste measurement, please provide the general information. Detailed information may be asked in a later section.

Did you identify a driver of food waste generation while running your intervention?

Example of driver: in an "all you can eat" buffet, the plate size might be a driver of food waste generation.

- Yes
- No

Please, include the driver you found

Were there any unexpected positive or negative outcomes resulting from this initiative?

Examples: a positive outcome could be the reduction of food waste in food categories with high environmental impact, while negative outcome an increase of food waste in other segments of the supply chain by addressing consumer food waste

- Yes
- No

Please, provide any relevant detail

Key learning points: Please introduce the positive elements, difficulties, challenges that you have encountered in the implementation of the initiative and what was done to overcome them.

In addition to reducing food waste, did the initiative measure consumer behavioural change?

Example: a behavioural change identified in the motivation to reduce food waste as reported in a survey before and after the initiative; increased food management skills as reported during a test before and after the initiative which might lead to food waste reduction.

- Yes
- No

What were the results?

Could you describe the method for measuring these results?

Example of methods: survey, exam, number of people receiving a training and learning about how to prevent food waste

Were there any behavioural change theories and models considered during the design of the initiative, such as the Motivation-Opportunity-Ability theory or the COM-B model?

- Yes
- No

Which one(s)?

Were experiments included in the intervention?

An experiment is a scientific method to make observations under controlled conditions.

- Yes
- No

If yes (multiple choice available)

- The test included at least one experimental group and a control group
- Participants were randomly allocated to experimental and control group(s)
- An expected effect was measured on a dependent variable

Which type of experiment did you use (lab, field, online)? Please, indicate

Have you carried out an audience segmentation to support the initiative?

Segmentation is understood as dividing a group of individuals into sub-groups (or clusters) based on specific characteristics of individuals forming that group (e.g. socio-demographic, attitudinal/behavioural criteria).

- Yes
- No

When did the initiative start?

For long-lasting initiatives, this would be the date of establishment

If concluded, when did it end?

Was the initiative affected by Covid-19 related restrictions or any other particular circumstances that could alter the expected results? Please, select the most appropriate options

- Yes, the whole initiative took place during particular circumstances
- Yes, part of the initiative took place during particular circumstances
- No

2. Quantitative and qualitative information

This section collects information on the cost and the results (e.g. food waste prevented) of the food waste prevention initiative. It is very important that all the quantitative data provided refer to the same reference

time/reporting period (e.g. you are reporting the results of one week intervention, or one month, 12 months).

Please specify the reference period to which all data provided are referred. In case of long-lasting initiatives, the reference period can either be the full duration of the initiative or the last year/n years

Example: if an initiative has been running for the past 3 years but you prefer to report its operational costs and its results only for the last year, here you can specify that the reference period is 1 year. Please, make sure that all the information reported through the survey is from the same reference period.

Information on costs and resources

A - What was the cost to set up the initiative (expressed in €)?

In case of long-lasting initiatives, the reference period can either be the full duration of the initiative or the last year/n years.

Help: For example, if an initiative has been running for the past 3 years but you prefer to report its operational costs and its results only for the last year, here you can specify that the reference period is 1 year. Please, make sure that all the information reported through the survey is from the same reference period.

B - What is the cost of maintaining the initiative during the reference period after it has been set up?

In case the initiative coincides with the operations of an organisation, please report on the operational costs of the organisation. Please consider all maintenance costs incurred, including administrative overheads. If some elements cannot be expressed in financial terms (e.g. administration overheads in full time equivalent - FTE) please express the total number of FTEs assigned to this initiative, considering an average of 250 yearly working days for a FTE (average EU value)

If relevant, could you provide an estimate of the total distances covered to carry out the initiative during the reference period reported in this survey as well as the (average) type of vehicle?

Example: for the redistribution activities we used a small truck and traveled a total of 300 km during the reference period

In case the initiative involved printing books, leaflets, posters, merchandising, or other materials, can you provide some details below on the numbers and types of materials printed during the reference period reported in this survey?

Example: a total of 5000 leaflets and 10 posters were printed as part of the awareness campaign

Were there any additional resources used when implementing the initiative? Can you provide some details below on the different resources used and their quantities during the reference period?

Avoided food waste

If available, indicate the amount of food waste generated before the initiative took place (as resulting from the baseline measurement). Please specify the unit used (kg, tonnes, etc.)

If available, indicate the amounts (expressed in mass - kg, tonnes, etc.) and value (€) of avoided food waste during the reference period reported in this survey.

In the case of complex initiatives, please link these amounts to each activity carried out, if possible.

E.g. 100 tonnes of food waste over one year

Composition of the surplus food redistributed / food waste avoided

Answers provided will help assess the environmental benefits linked to the initiative.

	Share of product group over total redistributed amounts / share of product group over total food waste avoided (%). Please leave blank if not applicable
Cereal based products	
Sugar	
Vegetables and pulses	
Fruits	
Dairy	
Eggs	
Fish and seafood	
Meat	
Oils	
Ready meals	
Tea and coffee	
Beer	
Wine	
Tubers	
Nuts and seeds	
Confectionery products	
Legumes	
Legume products (e.g. soy drink, tofu)	
Other	

What is the usual food waste management option used in the context where the initiative takes place?

- Anaerobic digestion
- Composting
- Incineration
- Landfill
- Unknown/Other

If known, can you specify the cost of waste treatment per tonne of waste?

If thanks to this initiative you received some fiscal incentives, please specify the type of fiscal incentive received, its value, and how the incentive was calculated

Example: benefits thanks to kg of food waste prevented; voucher of fixed sum to cover operational costs

Were there any additional economic savings linked to implementing this initiative?

Social benefits of the initiative

In case the initiative relies on the support of volunteers, how many volunteers were involved? How many volunteer-hours were worked during the reference period reported in this survey?

Did this initiative create new jobs? If yes, please specify the number of people employed, specifying if employed with temporary contracts

Did the initiative foresee some training of the staff involved and/or of the volunteers? Which new skills were created as a result?

Are there any additional social benefits linked to this initiative? Please provide some details below

Sustainability over the time

In case of ongoing initiatives, which elements have been put in place to ensure that the initiative can be sustained over time? (multiple choice available)

- Organisational support
- Ensuring availability of human resources, infrastructure and technology needed in the long term
- Ensuring the economic sustainability of the initiative
- Training of staff
- Setting up a long term strategic plan
- Other

In case of concluded initiatives, which elements have been put in place to ensure that the beneficial effects of the initiative are maintained in time? (multiple choice available)

- Monitoring plan to assess the long-term impacts of the initiative
- Plan to run follow-up initiatives
- Dissemination and communication activities
- Other

Transferability and scalability

Was the initiative upscaled (e.g. from a pilot to a real-case scale, from a city to a national scale)?

- Yes
- No

If yes, which were the barriers and the enablers encountered when upscaling it?

Was the initiative transferred to a different context (e.g. from an NGO to a municipality), audience (e.g. from children to teenagers), sector (e.g. from public canteens to restaurants) or location/region?

— Yes

— No

If yes, which were the barriers and the enablers encountered when transferring it?

Thanks for your participation!

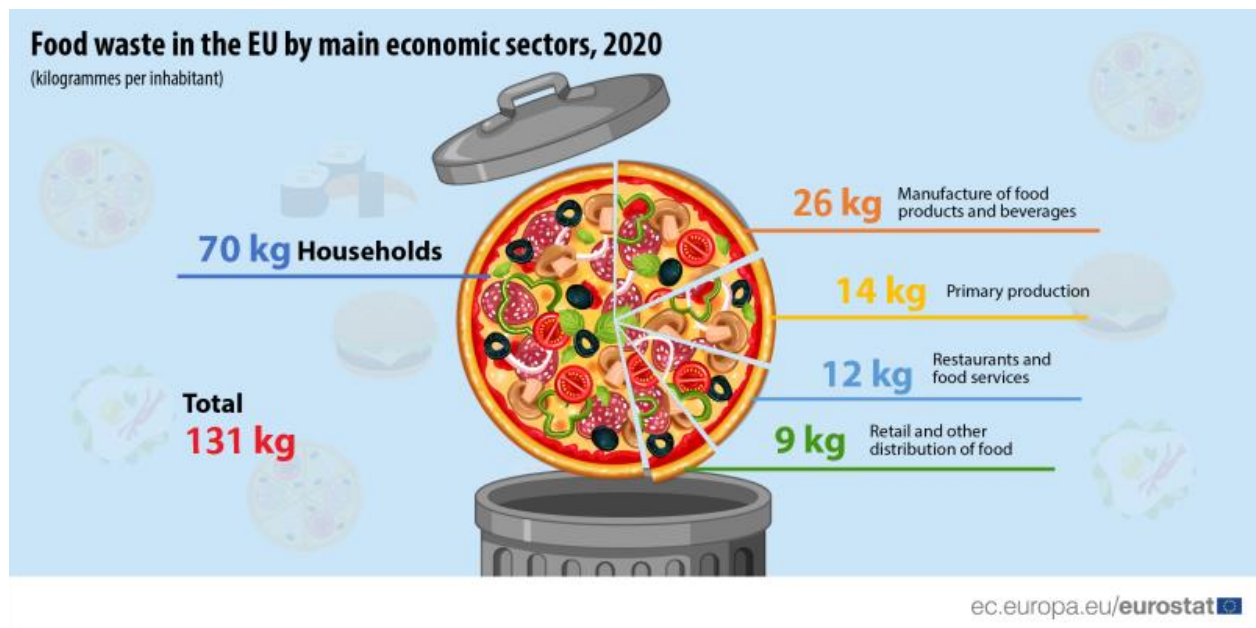
Annex 3. EU data on food waste

Press release from 25/10/2022 data update on 17/03/2023

Food waste: 131 kg per inhabitant in the EU in 2020

In 2020, the first year of the COVID-19 pandemic, around 131 kilogrammes (kg) of food per inhabitant were wasted in the EU. Households generated 53 % of food waste, accounting for 70 kg per inhabitant. The remaining 47 % was waste generated upwards in the food supply chain.

This information comes from a first EU-wide monitoring of food waste published by Eurostat today. The article presents a handful of findings from the more detailed Statistics Explained article.



Source dataset: env_wasfw

Tackling consumer food waste remains a challenge both in the EU and globally. Household food waste is nearly twice the amount of food waste arising from the sectors of primary production and manufacture of food products and beverages (14 kg and 26 kg per inhabitant; 11 % and 20 %, respectively), sectors in which strategies exist for reducing food waste, for instance with the use of discarded parts as by-products.

Restaurants and food services accounted for 12 kg of food waste per person (9 %), while retail and other distribution of food was the sector with the least amount of food waste (9 kg; 7 %); however, the impact of the COVID-19 lockdowns on these two sectors is still being analysed.

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