

Article

Moving from Niche to Norm: Lessons from Food Waste Initiatives

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Abstract: For a transition to a circular economy to take place, behavioural change from people who are part of the transition is a key requirement. However, this change often does not occur by itself. For systemic behavioural change, policy instruments that incentivise behaviour supporting circular food systems play a key role. These instruments need to be aligned with the environment in which the behaviour takes place. In this study, we scrutinise a case study with five initiatives on the reduction of food loss and waste (FLW) contributing to a circular food system, to understand how specific, well-targeted combinations of instruments as well as other contextual and personal factors can fuel the transition to a circular economy and the reduction of FLW. All the initiatives are taking place under the umbrella of the Dutch initiative “United against food waste” (STV). We use a behavioural change perspective to assess how initiatives that support circular food systems arise and how they can be further supported. Based on the case-study analysis, we arrive at five common success traits and barriers, and five key needs for upscaling. We conclude that motivated, inspiring frontrunners are of key importance in the initial phase of a transition process. However, once a niche initiative is ready to be scaled up, the enabling environment becomes increasingly important.

Keywords: food waste; circular economy; case study; behavioural change



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1. Introduction

We live in an era of climate crisis and steep global population growth, combined with inefficient resource use and food distribution systems, as well as high levels of food losses and waste globally (e.g., [1]). The linear “take, make and dispose” model, which has been underpinning industrial society, relying on large quantities of cheap, easily accessible materials and energy sources, is reaching its limits [2]. For these reasons, the transition from a linear towards a circular economy and climate-neutral or even climate-positive society is one of the most vital challenges of our time.

In contrast to a linear economic system, a circular economy is “restorative and regenerative by design” [2] (p. 19). Circular economy mainly emerges in the literature through three main “actions”, i.e., the so called 3R Principles: Reduction, Reuse and Recycle. A circular economic model aims to decouple economic growth from the consumption of finite natural resources. Hence, the policy aims for economic development, and job creation is combined with an aim for a reduction of the pressure on the environment, including the reduction of carbon emissions, use of water, land and production inputs [2].

For these reasons, the Dutch government aims for a fully circular economy (CE) in the Netherlands by 2050, according to the following 3R principles:

1. Efficient use of raw materials (reduce)

2. Use renewable resources to produce new raw materials (reuse)
3. Develop circular production processes and products (recycle)

To this end, the Dutch government collaborates with local, national and international public authorities, knowledge institutions and environmental organisations, the industry, trade unions, financial institutions and other civil society organisations [3].

In this paper we integrate the concept of circular economy (CE), the food system approach [1] and a behavioural change perspective to explain what can drive the transition towards a circular food system, with a specific focus on the reduction of food loss and waste (FLW).

Food systems include all elements and activities related to the production, processing, distribution, preparation and consumption of food and other biomass-based products, the market and governance structures, and the socio-economic and environmental outcomes of these activities (In this paper, when referring “circular food systems”, we mean circular “food and biomass-based systems”. Hence, in this view, food systems not only produce food for human consumption, but also biobased products with non-food applications). The food systems analysis considers some of the key variables and their major potential interactions as underlying factors influencing dietary choices (by consumers) and allocative choices (by producers and processors). A circular food system is a food system where all actors engage in coordinated action to reduce the amount of waste that is generated within the food system, to re-use and utilise by-products and food waste, to recycle nutrients and to shift diets towards more diverse, more efficient and, subsequently, more healthy food patterns [1].

For the transition to take place, behavioural change from people who are part of the transition is needed. However, behaviour change often does not occur by itself. For systemic behavioural change, where we move from new social norms that emerge among niche group towards new shared social norms that are embraced by a majority, the support of instruments that incentivise behaviour supporting circular food systems plays a key role. These instruments need to be aligned with the environment in which the behaviour takes place.

In this paper, we use a behavioural change perspective to assess how initiatives that support circular food systems arise, and how they can be supported further. To explain this, we used the elements from the Behavioural Change Wheel, developed by Michie et al., in 2011 [4]. This model is currently used extensively in behaviour change interventions in the scientific literature and is a unique model which connects behavioural factors with interventions. Furthermore, we scrutinise five initiatives on the reduction of food waste in the Netherlands taking place under the umbrella of the Dutch initiative “United against food waste” (STV), to understand how specific combinations of instruments, as well as other contextual and personal factors, can fuel the transition to a circular economy.

The remainder of this paper is organised as follows. Section 2 explains the methodology used. Section 3 presents the framework, building on the food systems approach and the literature on behavioural change. Section 4 discusses the case studies involving five initiatives on Food Waste (United against Food Waste). Based on the insights from the case studies, Section 5 discusses the results followed by a discussion, conclusions and steps for future research in Section 6.

2. Materials and Methods

This study is carried out using the four-step approach depicted in Figure 1:

- A comprehensive literature review has been carried out to identify personal and contextual drivers and barriers affecting the transition to CE.
- The identified personal and contextual drivers and barriers have been combined with the elements from the Behavioural Change Wheel [4] for an adapted framework which offers a new perspective on behavioural change towards CE.
- For the analysis, a case study on reducing food losses and waste (FLW) has been chosen as part of a circular food system. Within this case study, five initiatives that

aim at food waste reduction in the food supply chain, under the umbrella of the Dutch initiative “United against food waste” (STV), as a part of the national FLW reduction strategy in the Netherlands, have been selected. In total, eight in-depth semi-structured interviews have been carried out with both the initiators and the participants of these five different initiatives.

- The last step provides the analysis of the results and the implications of the findings.



Figure 1. Four steps of the study.

Case Study Approach and Analysis

The five initiatives considered in this study, under the umbrella of the Dutch initiative “United against food waste” (STV), have taken place in late 2018, in 2019 or in the first half of 2020.

Prior to the interviews, an interview guide was developed, based on the theoretical MOA framework [5], an earlier research report on this theme [6] and the Behavioural Intervention Wheel of Michie [4]. Based on these frameworks, the guide included questions such as how the initiative started, which elements it contained, which barriers and success factors came forward and which effects occurred due to the initiative. Qualitative research is valued because respondents can give meaning to their experiences in their own words [6]. The questions formed a trigger for the respondents to tell their story. The interviews were conducted in October 2020 and lasted between 60 and 75 min. Upon request, the respondent could receive the interview guide prior to the interviews to become acquainted with the questions. Due to the Covid-19 pandemic, all interviews were performed via MS Teams. In total, eight interviews were conducted, spread over five different initiatives. Ethical clearance for this case study was obtained from the Social Ethics Committee of Wageningen University. All respondents gave their informed consent to the interview and the recording.

The collected information from the interviews for each initiative was firstly analysed to reveal the success traits and the barriers affecting the intervention. Then, the success traits and barriers for each initiative were analysed according to personal and contextual factors to reveal which factors contribute to the success of the initiative and which factors hamper the implementation of the initiatives. The results were analysed for commonalities between the initiatives, as well as for specificities that occurred by particular initiatives, to explore a broad range of factors that facilitated or hindered implementation.

3. Theory: Incentivising Behaviour Change for a Circular Economy

3.1. Behaviour Change in the Systems Perspective

To design and implement the right intervention, that is effective in changing behaviour, it is crucial to understand what individual and context factors are determining the specific behaviour. Human behaviour is the outcome of many different personal and contextual factors that are at play at once. In this paragraph, we first draw from the food systems approach, as outlined—amongst others—by van Berkum et al. [7], and then, in Section 3.3.2, we introduce the behavioural change wheel as developed by Michie et al. [4].

The food system model outlined in Figure 2 shows that food system activities (i.e., the production, trade, processing and consumption of food), socio-economic drivers (i.e., science and technology, markets, individual factors) and environmental drivers (i.e., land, water, fossil fuels) are closely interconnected. The interplay between them leads to specific food system outcomes, regarding the level of food security, safety and composition of diets, inclusiveness and the distribution of benefits, and the level of sustainability and resilience.

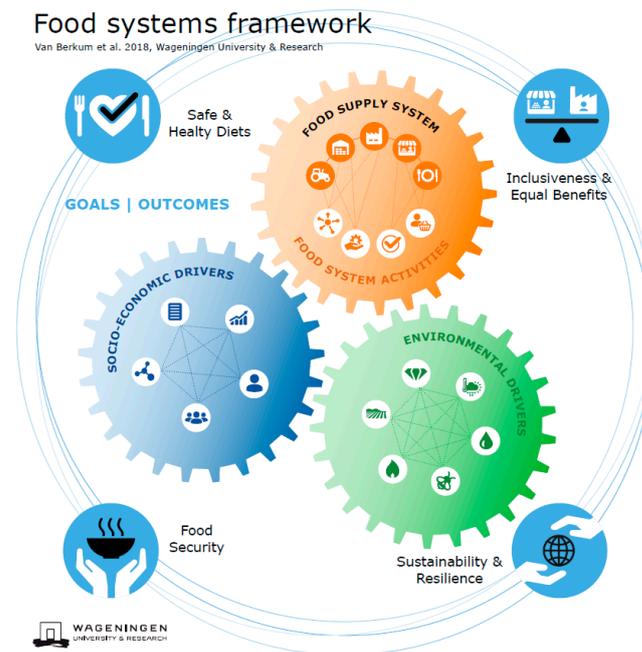


Figure 2. Food systems framework [7].

Although individual behaviour is part of the food system activities, the model does not clearly show the drivers of individual decision-making, nor ways for incentivising the desired behaviour. According to the behavioural change wheel by Michie et al. [4], human behaviour (B) is the result of a mix of capabilities, opportunities and motivations (COM)—hence the COM-B system. Capabilities, opportunities and motivations facilitate or hamper behavioural change. This means that a clear understanding of the underlying drivers of behaviour will allow policy makers to better tailor and target a specific mix of instruments and tools to incentivise the desired behaviour.

3.2. Transition to a Circular Economy: Transition Thinking

As with any systemic change, the transition to a circular economy requires pressure on the right levers to trigger a system redesign. This requires that the different disciplines should work simultaneously, instead of having single point interventions [8].

Despite the efforts to advance a CE, the transition towards a CE is still in an early stage due to the globally dominant linear economy structure and mindset [9–11]. In Europe—where, compared to other countries, transition efforts towards CE are the most documented [12]—materials security has been one of the main drivers giving a boost to the transition to CE due to a high dependence on imports of raw materials [13]. A transition started as a private sector initiative with a focus on financial benefits [14], following a bottom-up approach where the actions of the private sector have gradually been supported by policies and governmental institutions [10,12,15]. Despite many efforts in Europe towards the transition to CE, the maturity level (i.e., from niche to mainstream) of these efforts regarding the CE in different sectors varies enormously [16,17]. Moreover, within the same sectors, the maturity level of the CE transition can vary for different applications. Thus, when analysing the transition to CE in a certain sector, it is relevant to unravel how mature a certain application is.

3.3. Transition to a Circular Economy: Drivers and Barriers

The transition to a circular economy (CE) has gained considerable attention from researchers and practitioners due to its social and environmental benefits. However, limited attention has been given in the literature to exploring the drivers and barriers in CE implementation, especially related to behavioural change. The CE requires that,

as a society, we are able to change our behaviour to accommodate to the so-called 3R principles of the CE described in Section 1, since no transition can take place without the people that are part of the transition changing their behaviour. However, the individual behaviour change is not an isolated element. It is affected by a set of contextual factors such as the surrounding environment, the existence of incentives for a change, policy tools and interventions and internal factors such as personal motivation, knowledge and capabilities, etc. In their work, Parajuly et al. [18], argue that the transition towards a CE is not possible without a fundamental change in consumer behaviour, and this requires addressing not only the extrinsic attributes (e.g., infrastructure and incentives), but also intrinsic attributes (e.g., values and personal norms) of human behaviour. Conventional approaches to addressing this issue include initiatives such as information campaigns, economic incentives and stricter regulations, whereas the use of behavioural insight in such initiatives is still rare [16]. In many cases, the extrinsic and intrinsic attributes are intertwined and affect each other. In the following section, we present an overview of personal and contextual factors (which are related to extrinsic and/or intrinsic attributes) and indicate how they may affect the transition to CE. Furthermore, we discuss which interventions could overcome barriers.

3.3.1. Personal and Contextual Drivers and Barriers of CE

In the literature, various barriers are discussed which prevent the transition towards CE. These barriers can be rooted in the personal and contextual sphere. In 2014, a scoping study of the European Commission [19] identified several personal and contextual barriers to the transition to a circular economy, such as:

- Lack of skills and investment possibilities;
- Current pricing levels which do not provide incentives for efficient resource use;
- Lack of incentives, for example due to insufficient internalisation of externalities through policy or other measures;
- Lack of alignment of power and incentives between system actors;
- Limited consumer and business acceptance of circular business models;
- Limited information, know-how and economic incentives on technical/practical options for circular food systems;
- Lack of consumer awareness (e.g., perishability of food products);
- Insufficient investment in new infrastructure, innovation and technologies (partly due to a lock-in of existing technologies and infrastructure);
- Challenges in obtaining suitable financing for such investment;

After 2014, quite a few studies have been devoted to general barriers to the transition to a circular economy. Some of the barriers identified overlap with the above-mentioned barriers. Agyemang et al. [20] presented the following barriers to the transition to CE: “no sense of urgency and company culture,” “lack of data,” “current governmental legislations and ruling”. Mont et al. [21], in turn, identified barriers such as “difficulties to collaborate with other companies” and “lack of consumer awareness”. Several authors proposed economic and/or financial barriers such as “risks with product performance, and increased liabilities for reconditioned products or materials” [21]; “high upfront investment costs” [20]; “unpredictability of returns and difficulties with financial forecast” [22]; “financial system of organisations are focused on rapid returns on investments and cost saving, while transition into CE requires long-term system with uncertainties in revenue flows” [23]. Next to the above-mentioned barriers in the literature, many other barriers can be found, and they are often connected to each other and prove the complexity of CE. A few authors [23,24] suggested a categorisation of barriers to CE. Ritzen & Sandströma [23] summarised the barriers for moving towards CE into five main categories:

- Financial –measuring financial benefits of CE, financial profitability (e.g., difficulties in measuring benefits, since the shift towards CE requires far-reaching changes which take time and investments, while the logic in the financial system is focused on rapid returns on investments and cost-savings);

- Structural—exchange of information, unclear responsibility;
- Operational—infrastructure/supply chain management;
- Attitudinal—perception of sustainability, risk aversion;
- Technological—product design, incorporation into production process.

Kirchherr et al. [24] categorised barriers into four categories related to culture, regulatory, market and technology, as summarised in Table 1.

Table 1. CE barriers from Kirchherr et al. [24].

Barriers	Description of Examples
Cultural Lacking awareness and willingness to engage with CE	Hesitant company culture Limited willingness to collaborate in the value chain Lacking consumer awareness and interest Operating in a linear system
Regulatory Lacking policies in support of a CE transition	Limited circular procurement Obstructing laws and regulations Lacking global consensus
Market Lacking economic viability of circular business models	Low virgin material prices Lacking standardisation High upfront investment costs Limited funding for circular business models
Technological Lacking (proven) technologies to implement CE	Lacking ability to deliver high-quality remanufactured products Limited circular designs Too few large-scale demonstration projects Lack of data, e.g., on impacts

Research into barriers to CE has also revealed the key drivers of CE, which can also be either personal or contextual.

Many researchers within the CE field suggest that collaboration is the key component in achieving successful CE practices (i.e., [25–27]). Lewandowski [28] suggests that collaboration is an accelerator towards CE and proposes a new framework with collaboration as a key pillar. This is also true when it comes to circular food system. All food system actors play an important role in the transition towards circular food systems. Closing nutrient loops should happen simultaneously on the consumption side (by minimising food waste and by adopting more environmentally friendly diets), and on the production side (by closing nutrient cycles on the farm or in the supply chain, and by minimising post-harvest losses throughout the entire production process). Hence, a circular food system—and a circular economy in general—requires cooperation towards a common goal. Mishra et al. [29] provided several so-called system enablers towards CE, such as new forms of partnership and collaboration across the value chain, digital transformation, rethinking internal incentives, working with regulators and policy makers, access to finance, building on existing systems and organisational characteristics. Govindan and Hasanagic [30] have carried out a systematic review on drivers, barriers and practices towards CE and identified five categories of drivers:

- Policy and economy—governmental laws in different countries promoting cleaner production, consumption, and end of life management in order to secure resources, health and safety;
- Health—refers to increasing animal and public health. “Health is not everything, but without health, everything is nothing”. Many people suffer from illnesses caused by dirty air and water;
- Environmental protection—Climate changes due to the waste produced, greenhouse gas emissions, losses of unique landscapes, bad air and water quality;

- Society—on one side, an increasing global population, resulting in increased consumption demanding more resources; on the other side, consumers' environmental awareness places pressure on industries to develop CE;
- Product development—improves the efficiency of the materials and energy use in the supply chain and increases the value of products by increasing their quality.

Table 2 below summarises the drivers and the barriers of CE mentioned by various authors.

Table 2. Barriers and the drivers of CE from the literature.

Barriers	Sources
Financial	[19–22]
Structural Operational Attitudinal	[23]
Technological Regulatory	[23,24]
Cultural	[20,24]
Market	[24]
Drivers	
Collaboration	[25–27]
Policy and economy	[29,30]
Health Environmental protection Society Product development	[30]
Digital tools	[29]

3.3.2. Behavioural Perspective

The complex nature of human behaviour is explained by several theoretical frameworks from different fields of study. According to Parajuly et al. [18], more than 80 different theories of behaviour and behavioural change exist across the field of psychology, sociology, anthropology and economics. According to the meta-analysis review [31], the theory of planned behaviour (TPB) introduced by Ajzen [32] in 1985, was selected as the theoretical backbone in 39% of the published paper studying environmental behaviour in the field of water reservation, recycling and public transportation. Yet one of the critical comments is that TPB merely considers how cognitive factors (subjective norms, attitude, perceived control of behaviour) determine behaviour, neglecting the contribution of non-cognitive factors. To fix the dissonance that exists in TPB, the Motivation-Opportunity-Ability (MOA) model, proposed by Ölander & Thøgersen [33], can be considered a more suitable framework, as in this framework, behaviour is not solely dependent on cognitive factors. In 2011, Michie et al. [4] have used the elements from MOA and developed the behavioural change wheel (BCW), which is currently adopted by many behavioural researchers and policy makers. The BCW is centred around the key notions of Capability, Opportunity and Motivation (COM) (Figure 3), which underlie behavioural outcomes (hence the COM-B system).

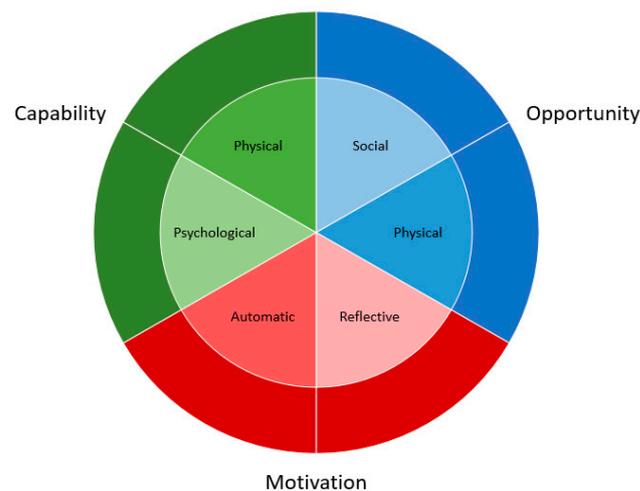


Figure 3. COM-Model [4].

Capability refers to the fact that a person needs to have adequate knowledge and skills to be able to engage in an activity. *Psychological capability* refers to the knowledge or psychological skills, strength or stamina to engage in mental processes that are necessary for the behavioural change to come about, while *physical capability* refers to physical skill, strength or stamina.

Motivation refers to brain processes that motivate decision making—which is often not driven by rational choices. Motivation can be automatic or reflexive. *Automatic motivation* refers to emotional responses, desires (wants and needs), impulses, inhibitions, habits and reflexes, whereas *reflexive motivation* involves analytical decision-making processes.

Finally, **opportunity** refers to the enabling or hindering environment that allows a person to engage in a specific behaviour. Opportunity is split up in social and physical opportunity. *Social opportunity* involves the role of social networks and cultural norms that influence the way that humans think about things. *Physical opportunity* involves the environment humans are part of, including time, resources and locations.

Depending on the specific capabilities, motivations and opportunities of a person (or group of people), different types of instruments are suitable. Hence, the selection of specific instruments aiming at behaviour change, depends on “what the behavioural target would be, and what components of the behaviour system would need to be changed to achieve that” [4] (p. 4).

3.3.3. Transition to a Circular Economy: Interventions

Michie et al. [4] recognised that there is a near infinite number of ways of classifying interventions. In order to identify the most effective intervention types, it is important to consider the full range of options available and use a rational system for selecting among them [4]. Besides, the authors have linked the components of the “COM-B” model of behaviour and the intervention. Table 3 summarises the interventions that Michie et al. [4] distinguish in their work and combine them with the COM components. These interventions can be implemented one at a time or they can be combined. A commonly held view is that multifaceted interventions (i.e., an intervention with two or more components) are more effective than single-component interventions [34].

Table 3. Definitions of interventions combined with the COM-B model adapted from Michie et al. [4].

COM	Interventions	Definitions	Examples
C-Ps * M-Re	Education	Increasing knowledge or understanding	Providing information on the amount of food wasted every year
M-Re M-Au	Persuasion	Using communication to induce positive or negative feelings or stimulate action	Giving examples of how to decrease household food waste
M-Re M-Au	Incentivisation	Creating an expectation of reward	Using challenges to incentivise entrepreneurs to come with innovations
M-Re M-Au	Coercion	Creating expectation of punishment or cost	Introducing Pay-as-You-Throw (PAYT) Waste Program to reduce food waste at households
C-Ph C-Ps	Training	Imparting skills	Offering training on ways to conserve vegetables
O-Ph O-So	Restriction	Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing the opportunity to engage in competing behaviours)	Ban supermarkets from throwing away or destroying unsold food, forcing them instead to donate it to charities and food banks (French Law).
M-Au O-Ph O-So	Environmental restructuring	Changing the physical or social context	Collaborations between industry and retail parties on solutions for upgrading residual streams for human consumption
M-Au	Modelling	Providing an example for people to aspire to or imitate	Having TV cooks using food leftovers to create new dishes
C-Ph C-Ps M-Au O-Ph O-So	Enablement	Increasing means/reducing barriers to increase capability or opportunity	Offering small portions in the restaurant, small packages in the supermarkets

* C-Ps = Psychological capability, C-Ph = physical capability, M-Re = reflexive motivation, M-Au = Automatic motivation, O-Ph = Physical opportunity, O-So = Social Opportunity.

3.4. Behaviour Change Perspectives: A New Framework

Although Michies' [4] framework is useful for selecting appropriate interventions, based on the personal and contextual drivers of behaviour, it does not consider potential feedback-loops of changing behaviour back into the environment that people are part of—which is a central element in the food systems framework. Therefore, taking the elements from the Behavioural Change Wheel [4] discussed above and combing them with personal and contextual barriers and drivers of CE, based on the food systems framework, we propose an adapted model which offers a new perspective on behavioural change towards CE. This model depicts a behaviour change tree, rooted in a soil that is nurtured by its environment, as depicted in Figure 4. This behaviour change tree shows that personal factors are closely interlinked with the environment they are part of. The environment affects the growth of the tree (or: the behaviour), while at the same time the growth of the tree affects its environment. The tree may represent the behaviour of an individual consumer, an entrepreneur, a firm or an entire society. Below, we briefly comment on the various elements of the model.

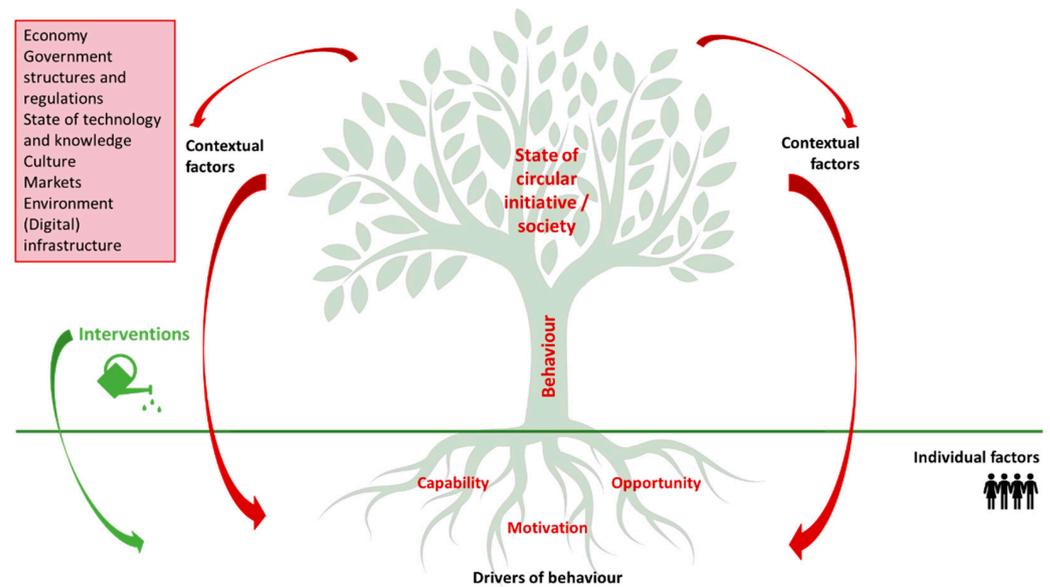


Figure 4. Behaviour change tree: behaviour change in a systems perspective.

- **Roots and stem**—Observed behaviour (stem) is the result of a combination of capabilities, opportunities and motivations (roots). This combination is person- and context-specific, as it contains both personal factors (i.e., motivation, drive) as well as context-related factors (i.e., opportunity, such as the means to make certain choices);
- **Soil and environment**—The mix of capabilities, opportunities and motivations is largely a result of the system of which an individual is part. This system consists of socio-economic as well as environmental drivers. People’s capabilities, opportunities and motivations are affected by the social networks they are part of, coming with a shared culture and norms, as well as by the market infrastructure, the state of science and technology, political economy and the climate—to name only a few.
- **Tree-top**—behavioural change leads to observed behavioural outcomes. When shared by a critical mass, these outcomes may lead to (new) shared norms. The behavioural outcomes are not isolated from the environment but will in turn affect socio-economic as well as environmental conditions. These, in turn, will nurture future decision making, in an ongoing cycle.
- **Inputs & instruments**—Once the drivers of behaviour are clear, and it is understood what the bottlenecks for the desired behaviour are, it becomes clearer what instruments could be effective for incentivising the desired behaviour. These instruments can be tailored to serve capabilities, opportunities or motivations, or a combination of these. It is important to realise that the instruments will always interact with the existing socio-economic and environmental conditions.

4. Food Losses and Waste (FLW) as a Case Study

FLW Reduction Strategy as a Transition Pathway towards a Circular Food System

Worldwide, about a third of all the food that is produced for human consumption is never eaten [35,36]. This phenomenon is known as food loss or food waste (FLW). It is widely acknowledged that FLW has a detrimental impact on the economy, the climate and society, which has led to an increasing societal and academic interest in food loss and food waste reduction. There is a clear aim set in the UN Sustainable Development Goal 12.3: halving the world’s food loss and waste by 2030 (<https://www.unep.org/thinkeatsave/about/sdg-123-food-waste-index>) (accessed on 10 June 2021). Both the EU and the Netherlands have committed themselves to this target and the EU Farm to Fork Strategy (2020) (https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en) (accessed on 10 June 2021). Reducing FLW presents a challenge. It is a complex and multifaceted problem, to which no straightforward solution exists. Meeting these

targets requires the cooperation with food producers and research organisations, as well as functional tools for the continuous monitoring and reduction of food waste across the entire food chain.

To achieve the above-mentioned target, in 2017, the “Taskforce Circular Economy in Food” was launched in the Netherlands, aiming to prevent and reduce food waste and become an international frontrunner in the valorisation of agri-food residual streams. The Taskforce, an initiative by Wageningen University & Research, in collaboration with the Ministry of Economic Affairs and the Sustainable Food Alliance, connected initiatives against food waste. It was leading the transition towards the acceleration and the development of a circular economy. In 2018, an initiative called “United against food waste” (Samen Tegen Voedselverspilling—STV) was founded, thereby formalising its predecessor, the “Taskforce Circular Economy in Food”. STV has stakeholders who contribute a yearly fee, in addition to receiving financial support by the Ministry of Agriculture, Nature and Food Quality. Its main aim is to reduce food waste in The Netherlands by 50% by 2030 (SDG12.3) together with Dutch companies, organisations, universities, the government and consumers. STV launched a National Agenda 2018–2021 on FLW prevention in December 2018 and formulated activities and piloting action on (1) measuring and monitoring FLW on the organisational, sectorial and national level, (2) stimulating business innovation action across the agri-food chain, (3) awareness raising and specific interventions for consumers and (4) changing regulation, legislation and business agreements to remove barriers for FLW prevention and reduction. About 73 organisations, including representation from the whole agri-food chain, have committed themselves as members of the STV, and their number is rising.

STV is an innovative approach to develop and implement voluntary agreements for FLW prevention, based on the Framework of Action model developed within the H2020 REFRESH project (See <https://eu-refresh.org/>) (accessed on 10 June 2021). Focusing on the value of collaboration and creating trust relations between major stakeholders in the food system, all stakeholders within STV are committed to taking the next step to go beyond business as usual and create multi-sectorial interventions.

The technical aspects of innovation and systemic changes for reducing FLW are quite well known, and applications are available in practice. However, the adoption and scaling of these technical innovations as a successful, scalable and impactful new practice is not self-evident: an important reason lies within social and personal (human) factors, the awareness and willingness to change, the willingness to implement changes and to commit stakeholders involved in the supply chain and food system. A transition requires insights into the behaviour and incentives/drivers of the stakeholders involved. In the case of STV, we generate knowledge in the behavioural dimensions of reducing FLW. We try to understand how specific combinations of instruments, as well as other contextual and personal factors, can fuel the transition to a circular food system to prevent and reduce FLW, hence contributing to a climate-neutral society.

5. Results

5.1. Analysis of Initiatives

The interview results revealed numerous factors affecting the initiation and the implementation of the interventions. These factors have been categorised within three different categories, namely, success traits, barriers and needs for upscaling. Table 4 describes the initiatives and categorises them by different types of interventions, based on Michie et al. [4], while Table A1 in Appendix A (see Appendix A) presents the success traits and barriers for each type of intervention categorised according to personal and contextual factors. The initiatives provided in Table 4 have been directed to different actors in the food supply chain. The needs for upscaling are presented in Section 5.4.

Table 4. Description of the interventions from the FLW study.

Initiatives	Short Description	Food Supply Chain Actors	Intervention Type
Initiative 1	<p>This initiative was a food waste challenge in the hospitality sector and consisted of two parts. Part one was a campaign to recruit participants from the hospitality sector. Part two consisted of an intake and food waste baseline measures at the participating hospitality organisations. Subsequently, location-relevant activities to reduce food waste were implemented for four weeks. After these four weeks, there was a post-measurement of food waste. One of the participants made use of a competition between the 17 participating hotels. Results of all participants have been shared at a big hospitality event.</p>	Hospitality sector	<p>Persuasion/ Enablement * <i>Modelling</i> <i>Education</i> <i>Incentivisation</i> <i>Environmental restructuring (social)</i></p>
Initiative 2	<p>This initiative consisted of two parts. Part one: “Insight in the chain”. An overview of data was made about food losses and food waste in the bread and dough chain. Part two: Discussion session of two hours, where part one’s results were presented, and possible solutions were discussed in smaller groups.</p>	Manufacturing/processing, wholesale and retail **	<p>Education <i>Modelling</i> <i>Enablement</i> <i>Environmental restructuring (social)</i></p>
Initiative 3	<p>This initiative involved a food waste challenge between different teams of secondary vocational education students (mainly from food, hospitality and marketing educations). The student teams worked on a business case for 10–20 weeks, in which they had to look for a solution for reducing food waste. The final product was a short movie of two minutes, where the solution was presented. The movies were judged by a professional jury, and the top 10 movies were invited to participate in a large event at the end of the challenge.</p>	Entire food supply chain ***	<p>Incentivisation Education Training <i>Persuasion</i> <i>Modelling</i> <i>Enablement</i></p>
Initiative 4	<p>This entrepreneur worked on upgrading the residual product brewer’s grain to an ingredient for the food industry. This ingredient can be used as a replacement for flour. The entrepreneur made use of a knowledge exchange STV voucher, which enabled the participants to optimise their production processes using the knowledge of scientists. As a result, a new product was created with the direct application of this ingredient in a product. The product was launched at a supermarket chain in The Netherlands during the “Future Goods week”.</p>	Manufacturing/processing and Retail	<p>Enablement <i>Environmental restructuring</i></p>
Initiative 5	<p>This initiative is a baseline measurement of food waste generated at the retailer level. Five supermarket chains in the Netherlands (~78% of the Dutch market) self-reported their food waste numbers. Independent researchers analysed these numbers. Due to this initiative, reliable insights are now available on food waste numbers at the retailers’ level, specified for five product categories.</p>	Retail	<p>Persuasion Education <i>Enablement</i> <i>Training</i></p>

* Bold text refers to main intervention types, while italic text refers to elements from different interventions. ** The activities of this initiative were focused on these target groups (collection of data and discussion session); these activities can be positioned as the “stage before” the implementation of food waste reduction activities. *** Whether the solutions that the students worked on during this challenge were implemented in the chain was not assessed/measured.

From Table 4 and Appendix A, several general observations can be made. First, all studied initiatives consist not of one but a combination of multiple types of interventions (Table 4). While some intervention types are clearly present in the initiatives (e.g., enablement in Initiative 1), it can also be noted that these interventions carry out some elements from other types of interventions (e.g., education, modelling persuasion, incentivisation and environmental restructuring). Furthermore, from Table A1 (Appendix A), it becomes obvious that Motivation and Collaboration are at the heart of all interventions and are driving forces for all the types of interventions. These two factors came back repeatedly in different contexts for the studied interventions. The factor Opportunity in terms of “practical and easy solutions” and/or “availability of resources” is the next important factor, applicable for all the interventions and often interlinked with contextual factors such as the Financial and Operation factors. The factor Capability is more often connected to the Enablement or Education types of intervention, which is logical, since enablement refers to interventions that increase means/reducing barriers to increase capability or opportunity.

Summarising the results of the interviews, several common success and barrier traits among the initiatives can be identified. These are described in Sections 5.2 and 5.3.

5.2. Common Success Traits among Initiatives

For the initiatives that are part of this study, we can distinguish five common success factors: (1) Presence of a motivated initiator, (2) Awareness of a societal problem for spurring motivation, (3) Having the right external partners and internal collaboration, (4) Availability of financial and/or operational resources, and (5) Capability (Management skills, Knowledge and Experience).

Presence of a motivated initiator: Through all the initiatives, there have been single or multiple person(s) who were intrinsically motivated to carry out the project. These individuals were able to motivate others either through personal enthusiasm or by creating other factors that motivated individuals to participate in the initiatives, for instance by convincing the management of the organisation to participate in the initiatives. Thus, for a successful start of the intervention, it is very important to have one or more intrinsically motivated individuals who will also motivate others throughout the initiatives, to actively engage and bring the initiative to a successful end.

Awareness of a societal problem for spurring motivation: While some initiatives tried to create awareness among participants, for other initiatives a “pre-awareness” already existed. This “pre-awareness” has helped to further stimulate awareness to the problems in the sectors where the initiatives took place. Awareness is a driver for motivation. For instance, one of the respondents mentioned that the awareness of food waste was a motivating factor to start the initiative. Thus, by creating awareness by showing the relevance of the problem and by showing inspiring examples, people can be motivated to take action. Some of the initiatives aimed to motivate people to take action by creating awareness of the food waste problem.

Having the right partners and internal collaboration: Overall, it can be observed that having the right partners and collaboration are key aspects for making initiatives happen. The network of the different actors participating in the initiatives makes it possible to cooperate with a wide range of actors. This leads to the availability of resources, as explained in the next paragraph. Next to external collaboration, internal collaboration is a key requirement as well. As one of the respondents mentioned: “getting everyone on the same page is an important part of the work and success of initiatives”.

Availability of financial and/or operational resources: Often, the collaboration creates opportunities. These opportunities can be of a financial and/or operational nature. For instance, in one of the initiatives, the collaboration with the right partners enabled the initiator of the initiative to offer the participants the least possible effort in implementing the initiative. Some initiatives provided the capacity to make food waste measurements possible or to guide specific interventions that were implemented at the hotel locations. Hence, the participants avoided investment costs and the uncertainty related to it. Due to

the availability of manpower and/or financial support and the organisations' willingness to collaborate, some initiatives could be executed on a larger scale than others (e.g., Initiatives 1, 3 and 5 vs. Initiative 2).

Capability (Project Management skills, Knowledge and Experience): Most of the initiators had to deal with different stakeholders and a team in order to make the initiative a success. Organising a well-functioning team and keeping a good relationship with the stakeholders requires certain capabilities, such as the right project management skills. Capabilities such as knowledge (e.g., in product development) and experience (e.g., entry to the market) are also considered as important factors for initiatives to succeed.

5.3. Common Barriers among Initiatives

Apart from these key success factors, based on the analysis of the initiatives, five main types of bottlenecks were distinguished. Not surprisingly, these are often the antidote of the success factors: (1) Dependence on a single motivated person, (2) Opposing interests of stakeholders, (3) Challenges of a frontrunner position, (4) Lack of a common understanding of problem definition, and (5) Small investment margin.

Motivation makes initiatives vulnerable: Most initiatives are initiated by highly intrinsically motivated people. The disadvantage of this, is the fact that the initiative might become very dependent on this/these person(s), which can lead to a failure of the entire initiative when the person stops being involved in the initiative due to unexpected circumstances. For instance, in one of the initiatives, the (temporal) leave of two key persons imposed challenges for the continuation of the initiative.

Opposing interests of stakeholders: Getting internal and external consensus on interventions is not always easy, since different stakeholders have different interests and different priorities. In addition, some parties are reluctant to share data/participate, as they may not do so well on the topic of food waste. At last, the changing habits and patterns of employees proves to be challenging. To overcome this challenge, some initiators first had to prove that the initiative could work, and a pilot was sometimes used in order to convince the board or managers to give permission to the initiative.

Challenges of frontrunner position: Some initiatives have a relatively novel approach, which means that sometimes not everybody is ready for it. Therefore, being a frontrunner has disadvantages as well, since it brings insecurity, which makes it hard to find collaborations. Besides, when an initiative is related to the development of new products, market entry barriers exist related to a non-existing market for a new product.

Lack of a common understanding of problem definition: Communication and a common understanding are barriers in several cases. Lacking a common understanding of the problem can hinder and delay the implementation of the initiative. For instance, in the Initiative 5, related to Baseline measurement, a clear internal definition of what exactly food waste is, was necessary in order to be able to compare the FW numbers among different supermarkets. In some cases, a delay in the communication of results was perceived as a hindering factor. Although communication and common understanding are barriers, they can turn into success factors with a good organisation. Some examples have been mentioned during the interview, such as having regular updates on the process, keeping communications not too long and not too complicated, coming together with employees for discussion and inspiration (getting out of the daily routine).

Lack of resources: For a larger implementation and larger investments of time, manpower and budget are needed, and some actors in the food value chain do not have access to these resources. The small room for investment makes actors risk-averse, and can thus be one of the main bottlenecks in the implementation of the initiatives.

5.4. Key Needs for Upscaling

The impact of initiatives is determined by their potential for upscaling, to move beyond a niche into a new norm. Therefore, based on the analysis of the initiatives, we distinguish five key needs for upscaling: (1) Development and stimulation of new business

models, (2) Integrated sector approach, (3) Continuous attention for a long-term vision and impact, (4) Agenda-setting and public awareness, and (5) Stimulation of collaboration and partnerships.

Development and stimulation of new business models: For the commercial participants, the voluntary implementation of an initiative should lead to a profitable business. This is especially relevant when it comes to big players in the market, who can play an important role in upscaling the initiatives. The development and stimulation of new business models, that can illustrate the profitability of a certain initiative, can contribute to the upscaling of interventions.

Integrated sector approach: In order for the initiatives to take place on a large scale, an integrated sector approach is required, having partners on board who can finance it, instead of focusing on small-scale entrepreneurs only, who do not have access to the financial resources that are needed.

Continuous attention for long-term vision and impact: To be able to seize opportunities for upscaling in order to shift social norms in a wider population, it is important to keep a continuous attention for the long-term vision of the initiative and the impact of the activities that are being undertaken within the initiative. Inattention creates a loss of know-how and positive energy, that must be rebuilt when starting again, and consequently may lead to a loss of momentum.

Agenda-setting and public awareness: Creating public awareness and concern for salient issues, for example by attracting publicity, can help to influence public opinion on the topic that the initiative wants to address. Some initiatives in this study received unexpected positive publicity, resulting into a momentum, motivation or more customers: "a lot of publicity which led to a different position in the sector", "lots of positive attention from outside world, which led to enthusiasm among the employees", "interest from German hotels to work on the topic", "positive advertisement for the organisation, leading to new customers".

Stimulation of collaboration and partnerships: Collaboration is one of the most important aspects for the success of the initiatives themselves, as well as for their potential for upscaling. The success of an initiative depends on the collaboration with the right stakeholders. Thus, creating an enabling ecosystem of companies and public organisations that join forces to achieve a common goal (such as STV), and that can help create the right supporting enabling environment, is of key importance and can contribute to the upscaling of the initiatives.

6. Discussion

6.1. Reflection on the Behaviour Change Tree

In this paper, we endeavoured to integrate the food system approach from Van Berkum et al. [6] with a behavioural change perspective, based on Michies' behavioural change wheel [4], to better understand how the transition to a circular economy can be effectively supported. To this end, we scrutinised various initiatives that were undertaken under the umbrella of the foundation "Samen tegen Voedselverspilling": a collaboration initiative that strives to decrease food waste in the Netherlands, representing governmental, private-sector, knowledge and societal organisations.

We proposed a framework that visualises how the interaction between personal drivers and contextual drivers shape the observed behaviour. The framework is illustrated by a tree, where the observed behaviour (the stem of the tree) is the result of a combination of capabilities, opportunities and motivations (the roots of the tree). This combination is person- and context-specific, as it contains both personal factors (i.e., motivation, drive) and context-related factors (i.e., opportunity, such as the means to make certain choices). The mix of capabilities, opportunities and motivations that form the drivers of behaviour are not exogenously determined. They are largely a result of the system of which an individual is part. This system consists of socio-economic as well as environmental drivers, as clearly outlined in the food systems framework [6]. People's capabilities, opportunities and moti-

vations are affected by the social networks they are part of, coming with a shared culture and norms, as well as by the market infrastructure, the state of science and technology, political economy and the climate. Finally, the decision making that results from this set of personal and contextual drivers leads to certain observed (behavioural) outcomes.

Initially, these outcomes may form a niche environment—as could be the case for the initiatives undertaken within the foundation “United against food waste-STV”. However, when these new behaviours are shared and adopted by a critical mass, these outcomes may contribute to the emergence of new or adapted shared norms. The behavioural outcomes are not isolated from the environment but will in turn affect socio-economic as well as environmental conditions. These will, in turn, nurture future decision making, in an ongoing cycle, and hence nurture new behaviour and newly shared norms.

Once the drivers of behaviour are clear, and it is understood what the bottlenecks for desired behaviour are, it becomes more clear what instruments could be effective for incentivising the desired behaviour. These instruments can be tailored to serve capabilities, opportunities or motivations, or a combination of those. It is important to realise that the instruments will always interact with the existing socio-economic and environmental conditions.

6.2. From Niche to Norm: Requirements for the Transition to a Circular Society

Both the case study and the literature on innovation processes analysed in this study stress the importance of the presence of a motivated, inspiring frontrunner to initiate the first stages of an innovation process. A clear understanding of a societal problem by the initiator herself—and ideally a shared awareness of the problem in a wider society—is necessary for an initiative to take place, as this tends to spur motivation. However, motivation alone is not enough: the frontrunners need to seize the opportunity. Opportunity tends to be enlarged by the collaboration with the right external partners, as well as by a well-organised internal collaboration. This means that all stakeholders involved need to be on the same page and have a joint understanding of the problem they are addressing. Collaboration with the right partners will create access to financial as well as operational resources, and may eventually link to the wider enabling environment, including the infrastructure, rules and regulations that are conducive to change. These factors together form the opportunities that are needed. The foundation “United Against Food Waste—STV” is an example of a governance arrangement which aims to provide an enabling environment that supports collaboration, by bringing together relevant public, private and societal stakeholders. This stimulation is especially effective after the first stages of the transition process (the first movers, which form the “niche”), to motivate a “mainstream” audience that might be less intrinsically motivated than the first movers.

Finally, next to motivation and opportunities, people must have the right capabilities to translate motivation into action. These include project management skills, knowledge and experience. Obviously, these qualities do not need to be all present in one single person. They can be brought together through the collaboration between different people.

Note that collaboration may be especially important in the transition towards a circular society compared to a linear system, since there are so many interdependencies between value chain actors to make a circular system work.

Although motivated, inspiring frontrunners are of key importance in the initial phase of a transition process, and the transition towards a circular society should not depend on motivated individuals alone. Once a niche initiative is ready to be scaled up—no longer targeting early adopters alone but a much wider society—the enabling environment becomes increasingly important. For behaviour change to become a new shared norm within society, a combination of instruments is needed that provide the right incentives behaviour. To effectively contribute to a circular society, where niche initiatives turn into new norms, these instruments should stimulate the creation of circular business models. They should take an integrated sector approach, stimulate continuous attention for a widely shared long-term vision, monitor and evaluate the impact of the activities undertaken, aim to be agenda-setting and to increase public awareness, and, last but not least, they should

nurture collaboration and partnerships between a wide range of actors. Figure 5 provides a visualisation of the discussion mentioned above.

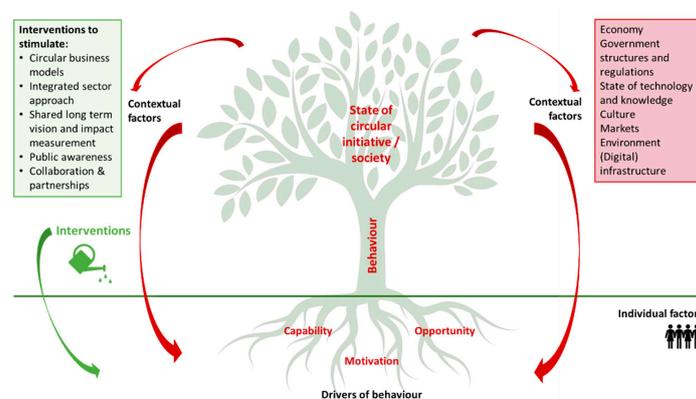


Figure 5. Behavioural change tree and required focus of interventions.

6.3. Limitations and Avenues for Further Research

The key success traits, barriers, risks and requirements for upscaling described in this paper are drawn from the analysis of the initiatives that are part of the case study and supported by the literature. Hence, it is expected that these lessons apply to the transition to a circular economy in general, but accents may differ in different contexts, and especially in different stages of a transition process. The selection of instruments will strongly depend on whether we are closer to a niche or already moving towards a mainstream situation in the transition process.

This study has been limited to one case study comprising five different initiatives to reduce FLW. Future research could explore different types of case studies that aim to contribute to the transition towards a circular food system in different ways. Furthermore, we suggest selecting case studies with different maturity levels, to explore potential differences in common success traits and barriers at different stages of the transition process.

A strength of this case study was the focus on initiatives that were implemented in practice, providing insights into behavioural experiences in the real world. The initiatives were very different: two focused on an assessment of the current situation, two were challenges and one was more technologically oriented. This led to a broad overview and deep insights from various actors' perspectives. On the other hand, comparisons between the initiatives were sometimes difficult to make due to this varied character. Finally, the categorisation has been carried out by two researchers. A structured approach has been used (tabulation of answers~audit trail), and two other researchers cross-checked the data to diminish subjectivity. Nevertheless, subjectivity cannot completely be ruled out.

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Appendix A

Table A1. Synthesis of results.

Category	Description	Factors		Initiatives with Main Intervention Types				
		Personal	Contextual	Initiative 1: Enablement	Initiative 2: Educational	Initiative 3: Education Training	Initiative 4: Enablement	Initiative 5: Education Persuasion
Success traits	Motivating individual employees for a change	Motivation-Re		x	x	x	x	x
	Making use of international and national networks		Collaboration	x	x	x	x	
	Changing social norms which underpin food waste reduction.	Motivation-Re		x				
	Using practical and easy solutions	Opportunity-So		x				
	Hands-on mentality with a focus on action	Capabilities-Ps	Cultural	x		x		
	Whole sector approach	Opportunity-So	Collaboration	x	x			
	Creating awareness by showing the relevance of the problem	Motivation-Re			x			x
	Encourage collaboration: working together.	Motivation-Re	Collaboration	x	x	x	x	x
	Project Management skills	Capabilities-Ps		x		x		
	Availability of resources, such as time, money or manpower	Opportunity-Ph	Financial & operational	x		x	x	x
	Communication problems		Structural	x				x
	Showing inspiring examples	Motivation-Au			x			
	Flexibility in approach (some freedom to adapt)	Motivation-Au		x				
	Skills and knowledge to process and upgrade by-products to a new food ingredient	Capabilities-Ph	Product development				x	
Entrepreneurship	Capabilities-Ps	Market	x			x		

Table A1. Cont.

Category	Description	Factors		Initiatives with Main Intervention Types				
		Personal	Contextual	Initiative 1: Enablement	Initiative 2: Educational	Initiative 3: Education Training	Initiative 4: Enablement	Initiative 5: Education Persuasion
Barriers	Different interests of partners/lack of trust to share data	Motivation-Re	Cultural	x	x			x
	Difficulties to change habits and patterns of employees.	Motivation-Au	Cultural	x				
	Insufficient resources such as budget, manpower and time	Opportunity-Ph	Financial & operational	x	x	x		x
	Lack of commitment from management or partners	Motivation-Re	Cultural	x	x	x	x	
	Market entry barriers/ non exiting market for a new product		Market				x	
	Changes in the teams (main motivator steps)	Motivation-Re	Operational				x	x
	Common understanding of definitions		Structural		x			x

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