

Food waste prevention strategies in global food chains

Conclusions and recommendations from the SIANI Expert group on food waste 2016

Karin Östergren, Emma Holtz

SP Technical Research Institute of Sweden



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Karin Östergren, Emma Holtz,

SP Technical Research Institute of Sweden

Project group:

Anna Richert, WWF Sweden (co-coordinator)

Björn Bergenståhl, Lund University

Mattias Eriksson, Swedish University of Agricultural Sciences

Ulrika Franke, Swedish Board of Agriculture

Jan Lundqvist, SIWI – Stockholm International Water Institute

Lisa Mattson, Karlstad University

Ingegerd Sjöholm, Lund University

Olof Sköld, Swedish Board of Agriculture

Åsa Stenmarck, IVL Swedish Environmental Research Institute

Pernilla Tidåker, SP Technical Research Institute of Sweden

Louise Ungerth, Konsumentföreningen Stockholm

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SP Sveriges Tekniska Forskningsinstitut

SP Technical Research Institute of Sweden

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Preface

Sustainable food chains and food waste prevention is a burning issue from both a resource perspective and environmental perspective.

The SIANI Expert Group "Food waste prevention strategies for Global Food Chains" was initiated 2015. The task was to gather expertise and collaborate in devising food waste prevention strategies for increased food security and resource efficiency by exploring:

1. Terms and conditions for how to work together within the food supply chain to reduce food waste
2. Collaboration for innovative technical solutions for reduced food waste
3. Measures for increased sustainability in global food chains (e.g. appropriate labelling, appropriate business models, consumer information etc).

The main focus has been identifying opportunities for the Swedish stakeholders to support in the effort to reduce food waste in global food chains.

The current report summarizes the findings. Many examples are provided since it is our belief that the actual practical solutions for reducing food waste needs to build on the collected experience and the knowledge carried by the actors in the supply chains and the researchers actually working with concrete problems relating to food and food waste prevention. To limit the study, we have mainly focused on the food chains of fruit and vegetables since they are more challenging due to perishability and seasonality, however many of examples provided are generic as well as the recommendations given..

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Karin Östergren, SP Technical Research Institute of Sweden
Anna Richert, WWF Sweden

Summary

Around 1/3 of edible food produced is wasted and when converted into calories this loss corresponds to 1/4 of the nutritional energy from food. Reducing food waste is a “triple win” activity: as it saves money since less resources are needed, as less waste is equal to the opportunity to feed more people in the future, and furthermore reduced waste decreases the pressure on climate, water, and land resources. The need to reduce food waste is also a part sustainability goals (SDG12.3). The success in reducing food waste is highly dependent on an effective communication across the supply chain since the true cause of food waste many times is found in an other parts of the supply chain than it where it actually happens. Such circumstances are in particular challenging in *global food chains* in particular food chains starting in developing countries ending in high income countries due to the geographic distance and the involvement of many actors.

The aim of this project, coordinated by the “Siaini” Expert group on food waste preventions strategies in global food chains” was to gather current knowledge and experience, as well as best practice on how to manage food chains starting in developing countries ending in high income countries with focus on vegetables and fresh fruits. This was done by taking a multi-stakeholder perspective, by a survey and a workshop, to identify knowledge gaps and opportunities:

The specific questions raised in the project were:

- How can our way of managing global food chains support the farmer in low income countries?
- How can best practice in high income countries (e.g. Sweden) decrease the food waste of imported food by e.g. appropriate labelling, appropriate business models, consumer information etc.?
- How can best practice in our (Swedish) food chains be transferred to low income countries, improving the local food chain to the benefits of the local actors? Since global and local food markets are communicating vessels the hypothesis is that a well-functioning local food chain will lead to less overall food waste and more income to the farmers.

The gap analysis shows that there are large knowledge gaps on how the supply chains function, how much food is wasted and the causes of the food waste. The survey carried out also shows that there is a demand for political action, and resources are needed in order to make a change:

- To facilitate and enable actions directed towards minimising food waste, recourses are needed for: education and training, technology implementation, better infrastructure and communication in the food system. This is important in particular when trading with developing countries and poor farmers with low educational background.
- The transparency, particularly in long supply chains, is problematic as information seems to be lost the longer the chain is; this is especially challenging when working with developing countries where the knowledge gap and the ability to be a strong partner compared to the large industries and retailers is challenging. Other aspects of transparency that needs to be addressed is the sharing information on e.g. campaigns, and other activities having an influence on the demand along the food supply chain.
- The survey shows that there is much knowledge in place that is not shared along the supply chain. Round table discussions and knowledge sharing within different

sectors may be a first step in making use of current know-how, and to set up an agenda on needs and how to collaborate

- To facilitate and enable actions directed toward minimising food waste, recourses are needed for: education and training of all those in the early stages of the supply chain, technology implementation, better infrastructure and communication in the food system. This is important in particular when trading with developing countries and poor farmers with low educational background

Much research is ongoing relating to sustainable food production without taking into account the research question being central for reducing food waste. Food waste research still suffers from that it is a quite new research area that is under development. Research focus on global food chains is currently focusing on quantification of food waste, impact of information activities and awareness raising activities and is focused on the situation in high income countries. Addressing food waste in global food chains as defined in this report shows that research adapted to the needs in the local food chains in developing countries are needed. For example how can a farmer make use of IT in a simple way (almost every farmer has a mobile phone), are there packing solution that can be used tropical fruits so that a desired even quality can be delivered, how to handle the waste that still happens in the best way (feed, new product, biogas etc.) and how to take care of the inedible parts (leaves, stems, peels etc.). Process technologies suitable for small scale applications, e.g. by processing fruits having a low quality it can be preserved and sold as exported as processed fruit instead of being unsold or sold to the local market to a much lower price.

The Swedish resource base and research network could contribute to more sustainable and fair food chains with less waste by sharing their knowledge and take actions according to:

- Swedish Universities and Institutes could take a role in educating students and hosting visiting researchers to cover the knowledge gaps.
- NGOs could take the important role as facilitators and educators in developing countries on site.
- The actors in the food supply chain can advance their position by dialogue, collaboration and information sharing; also by hosting trainees from developing countries learning Swedish best practice and serve as food “waste ambassadors” when they return back home.
- Researcher and innovators could contribute to technology development, in particular simple, robust technological solutions to be used in developing countries.
- The key is however that Swedish actors we collaborate (researchers, innovators, food processors, retailers, authorities and policy makers) and share our knowledge and experience in an organised way.

The actual practical solutions for reducing food waste needs to build on the collected experience and the knowledge carried by the actors in the supply chains and the researcher actually working with concrete problems relating to food in different aspects. A bottom up approach is needed being supported by appropriate policy intervention.

Finally, although the field is hampered by the unclear owner ship of the question and lack of collaboration, there is always a” working window” for each actor in the supply chain where improvements can take place right now. Numerous of examples and ideas are provided in the report and its annex.

1 Introduction

Around 1/3 of edible food produced is wasted (FAO, 2011) and when converted into calories this loss corresponds to 1/4 of the nutritional energy from food (Kummu et al, 2012). Reducing food waste is a “triple win” activity: as it saves money since less resources are needed, as less waste is equal to the opportunity to feed more people in the future, and furthermore reduced waste decreases the pressure on climate, water, and land resources (Kummu et al, 2012; Lundquist et al, 2008). Through the United Nations Sustainable Development Goal (SDG) 12.3 a global target has been set to reduce food waste. SDG 12.3 states that by 2030, we need to “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses”.

Food waste and losses differ over the world; in low income countries, production losses and logistics are of importance, in high income countries food is lost in the retail and consumption parts of the food chain. In Europe and North America the highest level of food waste occurs at consumer level compared to other part of the food supply chain while consumers in Sub-Saharan Africa and South-eastern Asia waste significantly less food (FAO, 2011). Looking closer at the estimated percentages (Gustavsson, 2013) for “Fruit and vegetables”(Table 1,) it is worth noting that in the agriculture step the losses are small but appear in the distribution and packaging and processing step in Sub Sahara and North Africa /central Asia compared to Europe.

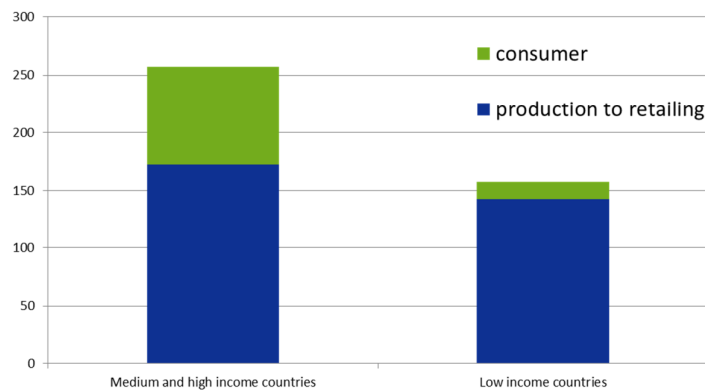


Figure 1 Waste (edible parts, kg/capita and year) in medium and high income countries compared to food loss & waste) in low income countries (FAO, 2011).

Table 1 Food Loss and Waste percentages (edible parts) for Fruit and vegetables (Gustavsson, 2013)

	Europe (%)	Sub Sahara (%)	North Africa, West & Central Asia (%)
Agricultural Production	20	10	17
Postharvest handling& storage	5	9	10
Processing & Packageing	2	25	20
Distribution	10	17	15
Consumption	19	5	12

There is a multitude of literature on food waste, as well as an international consensus among researchers, politicians, businesses and civil society organizations, stating that food waste is an important area. Although all efforts, there is still a need to identify and initiate specific measures and actions to fulfil the goal that has been set. Specifically, to gather stakeholders from different parts of the food chain – from production to consumption; to define measures in one area of the food chain that is dependent on activities undertaken in another part of the food chain to

- analyse terms and conditions for how to work together within the entire food supply chain
- collaborate for innovative technical solutions and
- communicate these efforts along the food supply chain.

for reducing food waste.

The success in reducing food waste is highly dependent on an effective communication across the supply chain since the true cause of food waste many times is found in an other parts of the supply chain than it where it actually happens. For example, if a fruit is damaged during transport it might not become bad until it reaches the retailer and consumer step. Such circumstances is particular challenging in *global food chains*, starting in developing countries ending in high income countries” due to the often “less connected” and long supply chain involving many actors. This report focuses on global food chains *starting in developing countries ending in high income countries* and are for simplicity just referred to as global food chains.

The questions which answers are sought for in this project are

- How can our way of managing global food chains support the farmer in low income countries?
- How can best practice in high income countries (e.g. Sweden) decrease the food waste of imported food by e.g. appropriate labelling, appropriate business models, consumer information etc.?
- How can best practice in our (Swedish) food chains be transferred to low income countries, improving the local food chain to the benefits of the local actors? Since global and local food markets are communicating vessels the hypothesis is that a well-functioning local food chain will lead to less overall food waste and more income to the farmers.

The aim of this project was thus to gather current knowledge and experience, as well as best practice on how to best manage products originating in developing economies.

This was done from a multi-stakeholder perspective having the specific goal to deliver:

- Case studies illustrating successful approaches illustrating important concepts inspiring to action.
- A list of prioritized needs and possible solutions, that can guide Swedish stakeholders to taking a global perspective in their effort in reducing food waste along the entire food chain by addressing research, innovation, communication, collaboration and policy needs.
- Three international processes, where the Swedish resource base can contribute with experiences.
- A scan of international conferences, where the results of the expert group can be presented.
- An investigation of the interest to establish a coordinated Swedish expert network on the connection between food waste, food security/resource efficiency, and development of cooperation in a global setting.

- A SINAI policy brief, condensing the most important outcomes of the work.

Food waste can be both edible parts and its associated inedible parts. The focus in this report is how to prevent the edible food from becoming waste. It is however important to stress that any food waste (edible or inedible parts) that cannot be prevented should be valorised in a as resource efficient way as possible, e.g. other (food) products then intended for, feed or biogas for example. What is most feasible needs to be determined from case to case.

To limit the study, the focus has been on fruit and vegetables since they are more challenging due to perishability and seasonality.



Photo: SP

A typical fruit and vegetable section at a Swedish the retail –store

2 Approach

The purpose of this project is to highlight actions that can be taken within the current “operational window” on microscale, i.e. to highlight in what way stakeholders can take action today; as well as identifying issues that need to be addressed on macroscale as described in the introduction above. The task has been approached by a short literature review identifying the current situation and current challenges in global food chains. To further collect knowhow among the Swedish stakeholders, a survey was carried out March –May 2016. The responses (in Swedish), together with the literature survey, were used as background for a workshop. The workshop, with Swedish stakeholders, was held April 22, 2016, aiming to identify challenges, solutions and knowledge gaps. The results from the survey and workshop were further processed and the insights gained are summarized in Chapters 4 and 5.

3 Food waste –an overview

Food waste was put on the political arena by The Waste and Resources Action Programme (WRAP) in the UK 2007 by its Love Food Hate waste Campaign (WRAP, 2007) and 2009 Tristram Stuart published the book *Waste: Uncovering the Global Food Scandal* (Stuart, 2009) and shortly after that the FAO reported that 1/3 of all edible food produces is lost or wasted (FAO, 2011). EU published a non-binding target of a 50% reduction of food waste 2011 and food waste has now become a part of the sustainability goal SDG12.3 and is a part of the COP2030 signed in Paris. In Scandinavia

Konsumentföreningen Stockholm carried out the first Swedish study 2009 (KfS,2009) and the Norwegian project ForMat started 2009.

Food waste is now developing towards a cross disciplinary research field as well as a field engaging innovators and policymakers. The sections below are meant to provide the reader with an overview as well as a hand full of useful key references and websites. The over view is not conclusive rather presenting a “snapshot” of the research field and current activities.

3.1 Quantification of food waste

Not until recently has a general methodology for food waste quantification, in mass, has been presented: Food loss and waste protocol (WRI, 2016). The method also gives references on how to estimate edible parts of various food products using tabulated “refuse factors” so that true loss in calories and nutritional values can be estimated. Recently, specific recommendation for EU on how to collect and report data has also been provided by the FUSIONS project (FUSIONS, 2016a). The two reports mentioned are harmonised.

A brief overview of different methods and challenges associated with some of the methods for collecting primary data has been provided by FUSIONS (2014a, 2014b). Different definitions that have been used are: Food Loss and Waste (FAO, 2011), considering edible parts, including feed originally intended for food, and some specific fractions under agriculture (e.g. dead animals); The often cited report by BIOIS(2010), includes edible and inedible parts of food waste excluding primary production, feed and liquid food poured into the drain; The FUSIONS data set (FUSIONS, 2016b) includes edible and inedible part of food leaving the food supply chain excluding feed and valorised products (bio-based products), any flow used for energy heat production is considered as waste as it is to be considered as an end of life treatment, while feed and bio based products re-enters different material supply chains.

The reason for applying different definitions has been the purpose of study; while FAO focuses on food supply (edible food), EU focuses on resource efficiency and also recognises the inedible parts of food as a resource. So far it has not been possible to agree on a single definition of food waste due to different perspectives and special interests of the actors in the food supply chain which hampers the quantification efforts.

3.2 Impacts of food waste reduction

A reduction of food waste in developing countries does not imply that more people are fed, with the exception of people being undernourished and receiving the surplus food by charity.

However, by decreasing food waste fewer resources as *land* and *water* are needed per kg of food produced globally. These are important factors in order to produce food with limited resources, as for example agriculture counts for 70% of water allocation worldwide (Lundquist et al, 2015). Thus, an over production of 30% to compensate for current food waste is a huge waste of water.

Food production and in particularly agriculture is responsible for 20-30% of the GHG-emissions. Greenhouse gas emissions will contribute to the global warming and thus directly influence the global food production (see e.g FAO, 2013; HPLE, 2014; FUSIONS, 2015; Kummu et al, 2012).

Different foods contain different amounts of calories, and therefore the mass of food wasted needs to be recalculated on a different base e.g. calories (Lundquist et al 2008 and Lundqvist et al 2015, Kummu et al 2013) to be comparable in a health perspective. The same is valid for nutrients and micronutrients (e.g. FUSIONS 2015). This means also that impact on health considering food waste needs to be linked to the nature of food wasted.

The economic impact of food waste is substantial. The value of food wasted as such is estimated to be 750 billion US dollars globally (FAO 2013). Nahman and de Lange (2013), among others, have investigated the economic impact of food waste in South Africa. It is important to recognize that large changes in food waste levels will influence the market (demand, supply, prices, and trade) as well (FUSION 2015). In FUSIONS (2015) a comparative qualitative analysis of current studies was undertaken to examine the socioeconomic impacts of reducing food waste and in the same report different macroeconomic modelling approaches were reviewed with respect to their ability to quantify the potential socio-economic impacts of food waste. Although the numbers obtained from the different models differed quite substantially, the trends were similar for the models and based on that it was concluded that combining econometric modelling with a value chain analysis is an effective approach for identifying hotspot points along the food supply chains to facilitate effective solutions for food waste reduction, encompassing needed investments in the short, medium and long term.

3.3 Drivers of food waste

Mapping food waste is about understanding the drivers of food waste in different steps of the supply chains. Within the FUSIONS project (FUSIONS 2014c), 271 food waste drivers were collected and categorised based on context category and causes according to Table 2

Table 2 Grouping of identified drivers of current food waste causes (after FUSIONS 2014c)

Context categories	Food waste causes		
<i>Technological</i>	Drivers inherent to characteristics of food, and of its production and consumption, where technologies have become limiting	Drivers related to collateral effects of modern technologies	Drivers related to suboptimal use of, and mistakes in the use of food processing technology and chain management
<i>Institutional (business management)</i>	Drivers not easily addressable by management solutions	Drivers addressable at macro level	Drivers addressable within the business units
<i>Institutional (legislation and policy)</i>	Agricultural policy and quality standards	Food safety, consumer health, and animal welfare policies	Waste policy, tax, and other legislation
<i>Social</i>	Drivers related to social dynamics which are not readily changeable	Drivers related to individual behaviours which are not readily changeable	Drivers related to individual behaviours modifiable through information and increased awareness

By referring to the identified food waste causes in Table 1 one can distinguish between (cited from FUSIONS 2014c):

- A. Food waste related to the inherent characteristics of food products and the ways through which they have to be produced and consumed (e.g. perishability of food and limited predictability of supply and demand);
- B. Food waste related to social factors and dynamics in population habits and lifestyles that are non-readily changeable (e.g. single-person households, young age of household members, young couples with small children, increased consumption of meals out-home, etc.);
- C. Food waste related to individual behaviours and general expectations of consumers towards food that are non-readily changeable (e.g.: good aspect, freshness, possibility of acceding to broad quantities and varieties of food independently on places, season, and time);
- D. Food waste related to other priorities targeted by private and public stakeholders (the possibility of generating food waste may be a minor concern with respect to other priorities of private and public stakeholders: like cost reduction, sales increase, product safety, quality standards, etc.);
- E. Food waste related to non-use or sub-optimal use of available technologies, organisational inefficiencies of supply chain operators, inefficient legislation, and bad behaviours of consumers depending on unawareness, scarce information, and poor food skills.

Table 1 also illustrates the complexity. At a high level, policy decisions set the frames but in each situation there is a window for the individual actor to take actions. These opportunities/windows for taking action look very different in developing countries and highly developed countries. Actions/interventions need to be addressed accordingly, since food waste can only be prevented at microscale by the actors in the food chain. Policy makers on the other hand, can facilitate the decrease in food waste and loss by different interventions.

3.4 Food waste in developing economies

Reports on food waste in low income countries are fewer than for high income countries; however, the FAO report (FAO, 2011) provides estimates also for low income countries. Although, the figures are uncertain, also different drivers are discussed.

An important policy document is the ‘Food losses and waste in the context of sustainable food systems’, a report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome (HLPE (2014)). The report covers various aspects of food waste and identifies three major challenges to the prevention of food waste: (1) The lack of a common definition and reliable data; (2) The multitude of causes; and (3) The multitude of impacts at different system levels. The report concludes: to reduce food waste there is a need for improving data collection and knowledge sharing on Food Losses and Waste (FLW), developing effective strategies to reduce FLW at appropriate levels, taking effective steps to reduce FLW, and improve coordination of policies and strategies in order to reduce FLW (HPLP, 2014). This is valid both for high income and low income countries, but maybe most challenging for high income countries, and maybe most important for fast developing countries in order to avoid a steep increase in food waste as the consumer behaviour may change resulting in increased consumer waste.

The difficulty of designing data collection systems and the need to look into the details to understand the causes of food waste on a micro level is discussed by Kaminski and Christiansen (2014). Their discussion is based on maize in Sub-Sahara, but provides important insight for any product. It was shown that the major losses reported were concentrated to only 1/5 of the households studied; further, by looking into data the

authors could conclude that post-harvest losses increases with humidity, and temperature, and decreases with market access, post primary education, high seasonal price differences, and possibly with improved storage conditions.

The microscale reality versus the macro scale policy goals is a challenge which is also demonstrated by Goldsmith et al. (2015) looking at grain production in Brazil. Based on economic theory they investigate the trade-off between costs for investing in post-harvest loss mitigation and the economic gains for increasing post-harvest losses. The authors conclude that in their case, complexities of tropical grain production promote tactics which include a certain level of post-harvest losses in order to maximize the economic benefits of double cropping.

Original data and evidence of causes in microscale in developing countries are provided by Underhill and Kumar (2014, 2015); they have mapped the food waste of selected horticultural products in Fiji. They conclude that the losses were due to a combination of post-harvest diseases, poor pre-market grading and desiccation. On-farm and transport stresses were major factors for losses at markets. In an another study Kereth et al (2013) conclude that, in the view of the findings post-harvest handling practices of fruits in Tanzania, the knowledge of stakeholders "... are not good enough to prevent the losses. It is therefore imperative to improve educational knowledge. None of the 142 farmers interviewed had knowledge of post-harvest losses and management, showing the need of reaching out with even the most basic information. In a review on post-harvest losses Wakholi (2015), reviews different technologies used for fruit and vegetable processing in East Africa covering harvesting transportation, cleaning, sorting and grading, drying and storage; it was noted that small scale farmers use very simple and inexpensive techniques and there were many opportunities for addressing and reducing post-harvest losses, as well as changes in policy, infra structure and market strategies. They conclude that most problematic is the lack of knowledge on how to develop, implement, use and sustain the proper recommended handling of different technologies and to close this knowledge gap needs to be prioritized.



Photo Jenny Gustavsson

Bana store at Tshwane Fresh Produced market; Pretoria

3.5 Initiatives relevant for global food chains

There are numerous ongoing initiatives and projects aimed to reduce food waste. In the UK, WRAP¹ has done pioneering research on how to measure, quantify and prevent food waste; and has published numerous reports and tools, supporting actors and consumers in their effort to reduce food waste. Feedback² is one of the pioneering campaign organization on food waste, also having a focus on global food chains and was facilitator of the case of Kenyan beans as well as a study of the consequences of unfair trading practice of bananas in Costa Rica³. In the USA, Rockefeller foundation has put food waste on their agenda through their yield wise initiative focusing on fruits, vegetables, and staple crops in Kenya, Nigeria, and Tanzania⁴.

The **Think.Eat.Save**⁵ campaign of the Save Food Initiative is a partnership between UNEP, FAO and Messe Düsseldorf and 16 other partners in support of the UN Secretary-General's Zero Hunger Challenge. The aim is to catalyze action in different sectors aiming to reduce food waste and provide hands on advice as well as being a platform for exchanging ideas and good examples for those players already involved in different project and actions. The **Think.Eat.Save** website is aimed to be a showcase of these ideas to provide a one-stop shop for news and resources. FAO has established a Technical Platform on the Measurement and Reduction of Food Loss and Waste⁶

Champions 12.3⁷ is a coalition of 30 leaders representing CEOs of major companies, government ministers, and executives of research and intergovernmental institutions, foundations, farmer organizations, and civil society groups aimed to mobilize actions to reduce food loss and waste globally by:

- Leading by example on how to reduce food loss and waste;
- Motivating others to meet SDG Target 12.3;
- Communicating the importance of food loss and waste reduction;
- Showcasing successful food loss and waste reduction strategies; and
- Advocating for more innovation, greater investment, better information, and increased capacity to reduce food loss and waste.

The Circular Economy Package (EU) in relation to Food Waste very clearly addresses food waste and to support achievement of the SDG targets for food waste reduction in the EU⁸, the Commission will:

- elaborate a common EU methodology to measure food waste consistently in co-operation with Member States and stakeholders
- create a new platform involving both Member States and actors in the food chain in order to help define measures needed to achieve the food waste SDG, facilitate inter-sector co-operation, and share best practice and results achieved

¹ <http://www.wrap.org.uk/>

² <http://feedbackglobal.org/about-us/>

³ <http://feedbackglobal.org/reports/>

⁴ <https://www.rockefellerfoundation.org/our-work/initiatives/yieldwise/>

⁵ <http://www.thinkeatsave.org/>

⁶ <http://www.fao.org/platform-food-loss-waste/en/>

⁷ <https://champions123.org/>

⁸ http://ec.europa.eu/food/safety/food_waste/eu_actions_en

- take measures to clarify EU legislation related to waste, food and feed, and facilitate food donation and the use of former foodstuffs and by-products from the food chain for feed production, without compromising food and feed safety
- examine ways to improve the use of date marking by actors in the food chain and its understanding by consumers, in particular "best before" labelling.

On the website relevant information on current initiatives, legislation, reports and presentations from meetings can be found, as well as hands on advice on how to reduce food waste.

3.6 Swedish initiatives

Between 2013 -2015 the Swedish Board of Agriculture, the Swedish Environmental Protection Agency, and the National Food Agency Sweden were given a three-year assignment to find ways in which to reduce food waste. Focus areas have been

- Identifying knowledge current gaps and barriers to reduce food waste.
- Producing dedicated information to consumers
- Increased collaboration between the actors in the food chain by starting up a Collaboration group on food waste (SaMMA)
- Provide good examples
- Stimulate the production of biogas from food waste that that cannot be prevented
- Provide recommendation for future work

The final report⁹ includes links to all reports and background material developed during this three year assignment by different experts in Sweden. A long term future strategy is proposed addressing

- Communicate a food waste reduction target
- Collaboration in the food chain,
- Build-up of a knowledge base (including the investigation “of ‘exported’ food waste to ensure that unnecessary food waste is not generated in producer countries as a result of actions taken by companies in Sweden”),
- Development of communication tools and material for different target groups
- Regulatory aspects including the dialog on maximum temperature in Swedish cold chain.

SaMMA, a Swedish collaboration group against food waste is an open forum for sharing information on food waste. The group was originally a part of the three year assignment, but it has been decided to make it permanent with biannual meetings¹⁰.

One of the pioneers on Food waste in Sweden is Konsumentföreningen Stockholm (KfS), which is a Swedish source of easy accessible information, guidance documents, and educational material¹¹. KfS also monitors food waste initiatives nationally and internationally making good examples visible¹².

⁹ <http://www.naturvardsverket.se/upload/stod-i-miljoarbetet/vagledning/Matavfall-minska%20svinnet/slutrapport-matsvinn-160321-slutversion.pdf>

¹⁰ <https://www.naturvardsverket.se/upload/miljoarbete-i-samhallet/miljoarbete-i-sverige/avfall/matsvinn/SaMMA-programforklaring-20150730.pdf>

¹¹ <http://slangintematen.se/>

¹² <http://louisekonsumentkoll.se/vad-hander-pa-matsvinnnsfronten-en-uppdatering/>

4 Survey

The survey was sent out to the members of the SaMMa network consisting of approximately 150 email contacts. The survey was also shared with a handful of selected experts on a European level. The survey included the eleven questions below:

1. Can you give some concrete, positive examples of actions that have been taken to reduce food loss and waste in global food chains that can serve the purpose of the project?
2. How is your business related to the food chain?
3. Do you perceive you have sufficient transparency upstream in the food chain to work proactively with food loss and waste?
4. What are, according to your opinion, success factors for collaboration along the food chain, for example, with suppliers?
5. What are the difficulties in ensuring low levels of food losses and waste upstream in global food supply chains?
6. Give concrete examples of ideas and/or activities that can lead to reduced food loss and waste in global food chains in the future.
7. What is needed to implement the suggested ideas and activities in order to reduce food loss and waste along the chain?
8. What role can NGOs play?
9. Can certification of products / businesses help to ensure that low food loss and waste is taken into account? How can such systems be designed? Please, comment!
10. From your perspective, how can cooperation work in a good way in global food chains?
11. Do you have any other additional comments or ideas, in relation to the topic of the project, which you would like to share?

4.1 Results

Twenty four responses were received, which were distributed according to: Academia/Research Institutes (6); Businesses and business associations (8); Non-governmental organizations NGO (4); Governmental (4) and Municipalities/Cities (2), including one response provided from the European expert network (UK), all other responses were from Swedish stakeholders.

The list of concrete action suggested by the respondents, on question 1 are listed in the green boxes below, while Annex 1 provides the responses given on question 3-10 of the survey.

The responses from each question were analysed and categorised (Table 3) in order to create a structured discussion and to provide recommendations on actions and to prioritise these.

4.1.1 Analysis of actions to reduce food waste

The examples provided as a result of question 1: **Can you give some concrete, positive examples of actions that have been taken to reduce food loss and waste in global food chains that can serve the purpose of the project?** were categorized based on the driver(s) of food waste being addressed and with the intervention described (Table 3 **Fel! Hittar inte referensskälla.**):

- Management
- Communication
- Technology
- Policy (national, local, corporate)
- Education/Awareness raising

Table 3 Analysis of good examples collected in the performed survey

	Example	Problem addressed	Coverage of supply chain	How the solution connects to different drivers for a food waste reduction in <u>global chains</u> .					Estimated impact on food waste reduction	Potential for reducing food waste in developing countries	
				Management	Communication	Technology	Policy	Education Awareness raising		Direct impact	Indirect impact
i	Fairtrade certification. Addresses social economic and environmental from the farmer perspective	The farmers' vulnerability and poor working conditions.	Farms and pack houses in developing countries	Assured criteria	Via label		Guaranteed minimum price + a premium is provided to the farmer		By improved farming practice the risk for food waste and food loss is assumed to decrease	Yes (as it provides transparency from farm to fork)	
ii	Supermarket buying policy change	Supermarket procurement policies & cosmetic specifications	Packaging units in developing countries	-	-	Trimming process was changed	Requirement for delivery	-	The waste was reduced with 30%,	Yes	-
iii	Unfair trading practice (UK)	Early cancellations	Farmers and producers	-	-	-	Legislation	-	-	Yes – if it can be made applicable as a general framework	-
iv	Selling ugly fruits/ unclassified fruits	Low acceptance for aesthetic variations of food	-	-	-	-	-	Increase the acceptance of cosmetic variations	-	Yes –less restriction also at farmers, if customers accept variations	-
v	Improved packaging solutions	The packaging solution used generates waste/ does not protect the food well	Farmers/ fishermen and producers	-	-	Packing solutions that leads to less waste	-	-	-	Yes – if applied at farm/storage	-

vi	Dynamic best before date	Temperature changes, vibrations, mechanical damage causes will influence the quality at end-user	From primary producers to fork	New technology open up for new management methods	-	Sensors and soft ware	-	-	-	Yes– if applied at farm/storag e	-
vii	Secured cold chain	Failure in the cold chain leading to poor quality	From primary producers to fork	-	-	Well-func-tioning cold stores/ transports	-	-	-	Yes– if ap-plied at farm /storage	-
viii	Improved forecasting and stock management	Surplus food not eaten /sold Late cancellations	From primary producers to retail	-	Communi-cation with customers	-	-	-	Care needs to be taken so that the food waste is not moved upstream the food chain	Yes-if communicat ion leads to action	Yes –if com-municated
ix	Better understanding of the causes of food waste	Why food is wasted and how much.	From primary producers to retail	-	-	-	-	The knowledge to and how to take action is created	-	Yes-if communicat ion leads to action	Yes –if com-municated
x	Food quality management	Poor quality and food waste. Producer may lose market shares	From primary producers to retail	Poor quality due to poor management	-	-	-	The under-standing of how to handle fruits and vegetables	-	Yes-if communicat ion leads to action	Yes –if com-municated
xi	Strategies for handling food in limbo/surplus food (charity, cook meals, reduce prices)	Surplus food not eaten /sold	Mainly Retail and food service and hospitality sector	Not sold due to poor management	-	-	-	-	-	-	-
xii	Feed from food waste in primary production	Wasted food in primary production	Farming/Aqua culture/fisheri es in Sweden	Not harvested due to quality reasons	-	Left due to imperfect harvesting technology	Not harves-ted due to low price	-	-	-	-

The potential to reduce food waste was further assessed regarding whether the upscaling of the example would have a direct impact on the global food chain, with respect to food loss and waste, or if the expected impact would be more indirect and finally, if the action can serve as inspiration in a more developed food chain. Examples of indirect impacts are when an activity improves the local food chain in such way that higher quality products will be obtained, benefitting the farmer who can sell more to a higher price and by that invest in better production methods; which in turn leads to less waste, generally assuming nothing else changes. Worth noting is that the saving of food waste for the specific actions in the examples was only validated in one of the cases, being the Tesco case addressing the trimming of Beans in Kenya carried out by Feedback¹³.



Photo: D MacLean

Fairtrade labelling

Fairtrade address the farmers' conditions in developing countries. Farmers aligning to the FAIRTRADE certification scheme receives a guaranteed better price that covers the cost of a more sustainable production as well as a Fairtrade premium that they can use to improve production efficiency, switching to organic production, and improving the standard of living and develop the local community. Many use the premium to ensure that there are cold stores nearby, or to improve and coordinating the transports or improve the production step as such, for example the set-up of a cable car that transports the bananas in a way that they are not destroyed on the way to the packing houses. These actions leads to less food wastage but also enable marginalized farmers and owners of packing houses to increase production and sell more. A problem that growers often brings up are three EU rules that allow, for example, some bananas are good but due to the bureaucracy cannot be sold to the EU and are instead sold on the local market to a lower price. Producer networks have begun to work on the issue to influence legislators in the area.

Supermarket buying policy change

Feedback (NGO, UK) previously challenged Tesco to stop buying French beans from Kenya that had been 'topped and tailed', a practice that leads to up to 40% of French beans in Kenya going to wasted. As a result Tesco changed their buying policy, instead opting for just topped beans. Feedback interviewed an exporter who supplies Tesco and therefore had become a beneficiary of this change in purchasing policy. The exporter, now only having to trim one end of the bean, had reduced their waste by a third. This reduction led to annual savings of seven million shillings (approximately £50,000), which also had a knock-on effect for farmers. As the exporter paid their farmer per packability, the farmer could expect a higher price as more of their produce was being exported. Since Feedback's initial challenge to Tesco, at least three major UK retailers are now only trimming one end of their French Beans rather than both. For more details see 'Food Waste In Kenya' here: www.feedbackglobal.org/reports.)

Examples collected from the survey (i-ii)

¹³ http://feedbackglobal.org/wp-content/uploads/2015/07/Food-Waste-in-Kenya_report-by-Feedback.pdf

Solutions directed towards global food chains(i-ii): Fairtrade labelling (i) and changes in supermarket buying policy(ii), exemplified by a change in trimming procedure of beans from Kenya, are examples that have a direct impact on the production in developing countries. Fairtrade labelling provides traceability all along the supply chain and the impact of food waste is assumed to be a result from better farming practice among the certified farmers, in combination with a better income from Fairtrade certified products. A change in supermarket trading policy was in this case initiated by Feedback recognizing the waste generated by the trimming procedure. Tesco agreed on the change– to trim only one end of the bean. This led to a 30% cut in waste and a 30% increase in income for the farmers who were paid by weight for the beans¹³.

Both these initiatives have a strong policy dimension and build on bilateral agreements with the producer/farmer in developing country. In the Fairtrade case, a third party organization stands as guarantee for the agreement using a certification approach, and in the second case, the trimming of beans, the agreement rests on the retailers buying policy.

Solutions in Swedish/European food chains that, if implemented, could have a direct impact on global food chains (iii-x): The following initiatives are currently applied in the domestic part of the supply chain, but can be technically transferred. They will, however, require investments in technology and training of the staff in developing countries as well as political agreements.

Unfair trading practice (UK) (iii) is forbidden by law in the UK (Groceries Supply Code of Practice (GSCOP)) and is governed by the Groceries Code Adjudicator (GCA). The effect of this regulation has been reported to have decreased the frequency of unfair trading practices experienced by suppliers. If such regulations/institutions could be established globally, late cancellations may decrease which would have an impact on food losses as well as on the income of the farmers in the developing countries.

Selling ugly fruits (iv) may be seen as a local activity, but it is also a statement that these fruits can be eaten. By increasing this awareness about food waste due to aesthetical reasons a more relaxed attitude to aesthetical defects may be transmitted through the food chain and in the end give benefits to the farmer in a developing country.

Improved packaging solutions(v), Dynamic best before date (vi), and a Secured cold chain (vii)– are all technical solutions that can be transferred, but will require investments in technology and training of the staff in developing countries.

Improved forecasting (viii) and stock management (ix), better understanding of the causes of food waste(x), and improved quality management can be seen as pre-requisites for any improvements. This is valid for any food chain. The food chains' complexity and the lack of transparency are large problems for domestic chains and an even larger problem for global food chains.



Photo: Jenny Gustavsson

Unfair Trading practices

Unfair trading practices (UTPs) increase risk within the food supply chain leading to unpredictable order forecasts, last minute order cancellations and other malpractice. These practices increase uncertainty within supply chains leading to farmers having to overproduce in order to ensure they can meet demand. When there is no secondary market for produce farmers have no choice but to waste it. In order to prevent UTPs, the UK government established the Groceries Supply Code of Practice (GCSOP), a law that is governed by the Groceries Code Adjudicator (GCA). The GCA regulates the relationship between UK supermarkets and their direct suppliers and since their establishment in 2013 there have been reported changes in the frequency of UTPs experienced by suppliers.

Examples of the handling unclassified fruit:

Retailers in France and Sweden among others have made a business case of selling “ugly fruits “ as just “ugly fruits” to raise awareness. Another example is taken from Kenya where “broken bananas” were used to produce banana meal or banana chips.

Examples of the improved packaging solutions

v. Improved packaging solutions

By improving the packaging solutions in global food chains food becomes better protected and there is less risk for damages and losses of food. Consumer packaging, secondary packaging as well as transport packing solutions need to be looked into depending on the local situation. E.g. a bags may be more efficient and flexible than a tray under certain circumstances

A specific research projects in Sweden look into improved packing solutions for a set of products focusing on food waste reduction.

Dynamic best before date

Temperature mechanical impacts on food during transportation have a large impact on its final quality. If a food products transport history can be monitored along the chain, the handling of the product can be adapted. For example if a product having experienced a high temperature along its logistic chain this product can be handled differently in a “fast track” to reach the consumer earlier than products having a non-broken cold chain. By dynamic best before dates the food chain can be better controlled based on the history of a product and margins added when setting best before may be decreased. By dynamic best before date food waste is expected to decrease along the supply chain as wells at consumer level.

Examples collected from the survey (iii-x)



Photo: Jenny Gustavsson

Secure cold chains

A good control of the cold chain and control of products upon arrival so that product out of specification is removed and handled separately assures quality a food waste further on in the supply chain.

Improved forecasting and stock management

Improved forecasting routines will decrease the amount of food wasted in the retail sector and food service sector. By accurate specifications of orders including degree of ripening a distributor can assure that fruits and vegetables have the required quality. Another example is internal educational programs within retail organizations on how to expose food in an attractive way without driving waste. Industries state that by collaborating better with suppliers the waste can be decreased in production.

Understanding the causes of food waste

A pre-requisite for a better management is that the amount of food waste is monitored. In addition the causes need to be understood. By applying routines including the follow up of quantities and why it has been wasted will increase the knowledge on the causes and action can be taken for preventing waste. The follow up of food on Food waste is an obligatory requirement within Nordic Swan Ecolabel of Grocery Stores along with a set of point requirements on activities aimed for reducing food waste (the part of food aimed for consumption, excluding bones and trimmings etc.) Most municipalities in Sweden have programs for preventing food waste in schools and pre-school kitchens. In some cases the municipality has developed their own action programs and ways for monitoring food waste in school and pre-school kitchens e.g. the "Göteborg model" and the "Örebro model" and other municipalities have clauses in the procurement agreements setting limits on how much waste external entrepreneurs delivering school meals are allowed to generate to force them taking their responsibility (e.g. Upplands-Väsby). Research is another important activity carried out to deepen the understanding of amounts and causes for different product groups (e.g. fruit and vegetables).

Food Quality management

Routines ensuring a good hygiene will prevent spoilage and improve shelf life. (Education and management)

Examples collected from the survey (iii-x)

Solutions that can serve as inspiration in later stage of the food chain and the more developed food systems (xi-xii): Strategies for handling food in limbo/surplus food (charity, cook meals, reduce prices) (xi) are mainly effective in the very last part of the supply chain and are very much adapted to the social context in the country where the end consumer is. These solutions may serve as inspiration depending on context, in particular in situations where the food chain has developed and the consumer and retail waste is essential. Feed from food waste (xii) in primary production also requires local solutions. The issue is important but European solutions may not be directly applicable in global food chains; they may, however, serve as inspiration.

Drivers for food waste due to surplus food at retailers, restaurants, and municipal kitchens (and consumers) is due to that forecasting of sales have failed. The reason for waste in primary



Photo: SP

Strategies for food in limbo/surplus food

For retailers there are three common strategies to handle food in limbo and foods items approached their best before date. (1) marked down price (2) Make ready to eat food that can be bought by the consumers (Resurskocken (<https://www.ica.se/butiker/kvantum/lund/ica-kvantum-malmborgs-tuna-2780/resurskocken/>), Coop) (3) Donations, Social Supermarkets (<http://www.svd.se/ny-butik-ska-salja-billig-mat-till-socialt-utsatta>)) Axfood has for example developed an established collaboration with social organizations, and currently 33 units donate their surplus food for charity

School restaurants have improved greatly when it comes to take care of left overs. New meals are created and served as a part of a "buffet day" or a "vegetarian buffet day". The buffets are very highly appreciated by the pupils as they can pick what they really like the most these days.

On the supply side there are also examples where municipalities collaborate with local food suppliers taking care of fruit and vegetables that cannot be sold any longer in order to and make jam or smoothies.

In Finland there are also examples of schools that are donating left overs for charity but also making 'lunchboxes' which are sold to parents and teachers

Feed from food waste in primary production

One particular area looked into in Sweden from a legal perspective is the possibilities to use food waste from primary production as feed

production could be e.g. that the market price is too low, the harvesting technology is poor, or the quality is poor so the produce cannot be sold with profit. The solutions have a strong policy and management dimension.

4.1.2 Transparency in the food chain

Question 3: Do you perceive you have sufficient transparency (regarding information) upstream in the food chain to work proactively with food loss and waste?

The general agreement among the stakeholders who responded to this question (see Annex 1) was that there is some transparency, in particular about the origin of meat and dairy products, but seldom for vegetables and fruits. Furthermore, the transparency seems to decrease up-stream from the processor (retail) and in particular at end users, as for example school restaurants (municipalities) perceive that they do not have the transparency needed (not even the origin of foods) to actively make a sustainable selection of products and to avoid driving food waste in global food chains.

An important aspect that was pointed out was that it is not the traceability itself that is important for waste generation later on the chain, it is *how* the product has been handled/stored (e.g. temperature history, humidity and mechanically handled) and how long it has been transported.

According to authorities the import and export of food is well documented and strictly regulated (in particular for animal based products) and thus there is a transparency. The documentation on import of fruit and vegetables is kept by Swedish Board of agriculture¹⁴.

¹⁴ Overview of regulations for importing food (in Swedish)

<https://www.tullverket.se/download/18.4ab1598c11632f3ba9280005515/1435582961704/livsmedel%2C+import+av+tv790.23.pdf>

Worth noting is that traceability is regulated by law, as well as the information to be sent along¹⁵ (e.g information on classification, if ecologic products special criteria needs to be fulfilled etc.) but the ‘back pack’ of information does not contain the actual history of the product, for example how it has been handled, or sustainability and social aspects.

4.1.3 Success factors for collaboration

Question 4: What are, according to your opinion, success factors for collaboration along the food chain, for example, with suppliers?

From the stakeholder perspective (see Annex 1) a close dialog in the chain is necessary to identify mutual understanding of the needs in the supply chain and what the common problems are. Joint workshops to learn from each other and education on “best practice” on how to handle the products from farm to fork, are suggested. Further, it was pointed out there is a need to set aside funds to be able to invest in projects and new systems. Important, concrete success factors captured in the survey were:

- The ability to think outside the box and find new solutions e.g. sell small potatoes (that have been sorted out) at a higher price to restaurants; use class 2 whenever possible in kitchens
- Good stock management principals
- When main causes for food waste is known from farm to consumer
- When the farmer has knowledge and ability to communicate on the characteristics of the product
- When state of the art technologies for harvest and storage are used
- Well educated suppliers that know how to handle different products
- Fair distribution of costs for investments in the supply chain
- Fair trading practice as a way to avoid late cancellations
- Engagement in the difficulties, in combination with respect for different opinions
- Collaboration on packing size and degree of processing needed
- Whole crop purchasing to avoid waste due to late cancellations and waste due to cosmetic classifications.

4.1.4 Challenges to reduced food waste

Question 5: What are the difficulties in ensuring low levels of food losses and waste upstream in global food supply chains?

The responses to this question (see Annex 1) very much mirror the difficulties to pave the way forward when aiming to reach what was identified as “success factors” in the previous section. The loss of information along the chain is pointed out as one difficulty, as well as the fact that we actually do not know where the problems arise and how much is wasted. Furthermore, it is difficult for the actors in the food chain to trace where an error has occurred, and thus it is difficult to establish mitigation strategies. The costs for establishing good information protocols, in particular for global chains, are recognized as a challenge. Another challenge is that the quality of the raw material (vegetables, fruits) varies depending on season, weather, temperature, amount of rain. Yet

¹⁵ Overview of import rules for vegetables and fruits (in Swedish):
<http://www.jordbruksverket.se/amnesomraden/handelmarknad/handelsguiden/varainisverige/varankommerfranettlandutanforeu/varanskanvandasforkommersielltbruk/fruktochgronsaker.4.37e9ac46144f41921cd8007.html>

another challenge is the availability vs demand that, if not matched may lead to poor stock rotation and poor quality of the imported products. Variation in demand can be hard to predict, many times it is difficult to really understand why a buyer cancels an order (of already produced food) or why customers at restaurants stop coming, which deepening on lead time and volumes can have an impact all the way back to the supplier and farmer. Producers (e.g. farmers) generally do not know the destinations and what the product is to be used for and therefore cannot not provide the most suitable products (e.g. maturity of fruits) for the purpose. In summary, information exchange is a key issue which needs to be tackled.

4.1.5 Ideas on how to improve

Questions 6 & 7: Give concrete examples of ideas and/or activities that can lead to reduced food loss and waste in global food chains in the future? What is needed to implement the suggested ideas and activities in order to reduce food loss and waste along the chain?

As in the previous section, the responses (see Annex 1) highlighted the need for increased knowledge and communication.

From the actors perspective the following activities were found to be the most pressing:

- Agreements must be held – ban cancellations of already produced food.
- Increase the transparency and traceability so that clients actively can select suppliers working on reducing food waste.
- Mapping every step in the supply chain and find the root causes of food waste and identify actions that can be taken.
- Include sustainability, food production and resource efficiency and how to prevent food in the Swedish curriculum from year one in primary school.
- Work directly together with small farmers. Commercialize the non-perfect fruits and vegetables.
- Undisrupted cold chain from producer too retailer with an optimal temperature for each product.
- Follow up on quality and don't import fresh produced when quality is starting to decrease towards the end of the season. Towards the end of the season quality may be lower and not sufficient to allow the produce to reach an overseas market – in such cases end of season products should be sold on local markets, or processed.
- Measure physical impact and temperature of vegetables and fruits during transport to be able to develop solutions preventing damage /predict durability of the products at arrival.
- By increasing the transparency between retail and processor forecasting, production planning and delivery to customer can be made more accurately.

And from the research point of view the sharing of knowledge was stressed as well:

- Information on the importance of appropriate packing solutions to reduce waste – which is something consumers don't ask for today. Increased price of food
- Share the current knowledge that exists among those working with vegetables and fruits e.g. optimal temperature, humidity and how to handle different vegetable and fruits.
- Although the situation looks very different in different parts of the world sharing technology to find solution is important

And the NGOs added:

- Proving the effect of good examples and informing about them
- Education of farmers in developing countries
- Relaxation of cosmetic specifications of fruit and vegetables
- Prevention of unfair trading practices
- Abolishing unnecessary processing practices, such as topping and tailing of French beans, to maximize the amount of crop that is sold for consumption to consumers.
- Encourage the use of food waste that cannot be prevented as livestock feed to offset the environmental impact of meat production that arises from the use of conventional cereal based feed.

From the governmental organisations the results from the Swedish Government commission (2013-2015) was stressed (see section 3.6)⁹.

From the responses it can be concluded that the general opinion is that the issue of food waste needs to get higher attention and that it needs to be put on the political agenda. Actors, scientists/consultants, as well as NGOs have highlighted that there is a need for clearly stated political goals on *what* to achieve and *how*. They have also stressed that political decisions/goals need to be coordinated with other actions/decisions taken to avoid conflicting policies. Also, investments in technology in global food chains, educational projects and collaborative projects will require additional resources according to all respondents.

4.1.6 The role of NGOs

Question 8: What role can NGOs play?

In the responses the NGOs were recognized for their role in networking and information sharing and by that, providing inspiration. They were also very much recognized for their engagement in food redistribution by the stakeholders in the supply chain (see Annex 1).

Other tasks and activities that could be linked to the role of NGOs and non-profit organizations was to arrange workshops, collaborate with media, collect information and adapt information to different groups of stakeholders, to interact with members and provide feedback, along with disseminating messages and knowledge, engage members and providing material to be used by members when interacting with consumers and stakeholders.

It was also pointed out that the NGOs are important but should not carry the *main* responsibility for driving the food waste agenda forward; it should be carried by policy makers in cooperation with relevant authorities.

4.1.7 Certification systems

Question 9: Can certification of products / businesses help to ensure that low food loss and waste is taken into account? How can such systems be designed?

Among the actors in the food supply chain there was a general agreement in responses (see Annex 1) that *if* implemented low food loss and waste should be implemented within the current frame works, for example in environmental management (e.g. ISO 14001¹⁶) and in domestic recommendations (e.g. Odling i balans¹⁷), or as a part of the eco labelling system. Several actors

¹⁶ <http://www.iso.org/iso/iso14000>

¹⁷ Odling i balans: <http://www.odlingibalans.com/om-oib-11906865> (in Swedish)

were, however, reluctant and as one of the respondents expressed it “Certification can be done on different levels and there is no guarantee that a certification helps”.

Researchers and consultants highlighted the New Nordic Ecolabel/ Nordic Swan certification as a good example, which addresses food waste explicitly (but not yet as an obligatory requirement)¹⁸. Certification organizations meant that certification is a win-win, as transparency can be assured by such systems and the certification label communicates in an easy way the criteria that are fulfilled. It was also highlighted that food waste is something that concerns the society as a whole and by including food waste as a part of the environmental management systems (like ISO 14000) all types of companies can be reached.

4.1.8 Cooperation strategies

Question 10: From your perspective, how can cooperation work in a good way in global food chains?

We have chosen to present the responses collected from this question without further analysis as a list of concrete ideas:

- Address food waste via industry associations.
- Arrange conference workshops.
- Make sure that good examples are published and communicated.
- Implementing better traceability so the product can be followed to the farmer.
- Important that everyone understands why we need to cooperate to reduced food waste, there is always someone who "loses" in changing their business and for them it must be particularly clear why this is needed. Suggested actions need to be based on thorough research to avoid increased environmental impacts and/or energy consumption!
- In order to learn from each other: Arrange international and national meetings and workshops that could be general or dedicated to different sectors. For example, hospital kitchens from different parts of Europe, cooperate, hotel chains, retailers.
- Working in international or Nordic collaborative projects.
- Look over the range of products being imported and improve the selection in favour of the most well performing products.
- Improve knowledge and communication, challenge students and innovators.
- We need to take a holistic perspective and everybody has to take their share of responsibility.
- Greater balance of power within the supply chain. There is currently a concentration of power held within Europe's supply chain, dominated by major retailers and large brand manufacturers. This imbalance needs to be addressed to ensuring more equal contracting terms and increased selling power for suppliers. In this context particular smaller suppliers and farms are vulnerable

¹⁸ Nordic Ecolabelling: <http://www.nordic-ecolabel.org/>

5 Workshop

5.1 Aim of workshop

The aim of the workshop was to gather actors from a wide range of organizations, with insight in the challenges of global food chains and related food waste, to identify and discuss knowledge gaps, and possible solutions, in order to reduce food waste in global food chains. More specifically, to identify needs for action, as well as research needs.

5.2 Set up of workshop

The workshop was held on April 22 2016 on the premises of the Swedish Board of Agriculture in Jönköping. 23 people, that had expressed interest in the subject and who represented companies, retail, NGOs, authorities and academia, were invited to the workshop-day and 12 participants were finally able to attend. The day was framed by an introduction to clarify the aim of the day, and was followed by presentations to give a setting for the workshop in the afternoon.

The main topic of the workshop was: How can we reduce global food waste? And the workshop discussions were focused on three main questions:

1. What are the existing challenges?
2. Which solutions exist? (How can we meet these challenges based on existing knowledge?)
3. Where do we see knowledge gaps?

The participants of the workshop were divided into three groups and discussed each question in turn. After each discussion, before continuing to the next question, the outcome of the group discussions was shared between the groups and the results were collected using post-it notes on a brown board illustrating the food chain, see Figure 2. The description of the food chain Figure 2 included the steps ‘Transport and storage’ several times to illustrate the possibility of storage of produce at several sites as well as transport local/regionally as well as overseas. Also ‘Processing and packaging’ could be done at several sites and with different purpose.

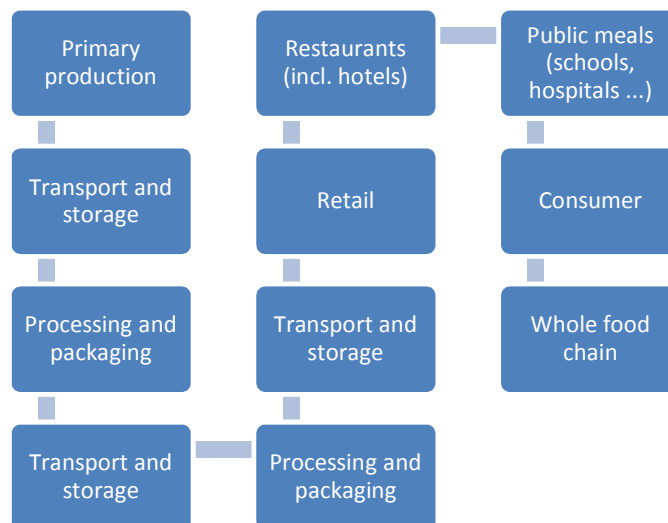


Figure 2. Headings used to describe the food chain on the brown board during the workshop

5.3 Results of the workshop

The 12 participants engaged in the workshop represented companies (distribution systems), NGOs, authorities and academia.

The results from the workshop session that were collected on the brown board were structured in challenges, solutions and knowledge gaps. After this they were translated and adapted and are found in Table 4. All results referring to ‘Transport and storage’ and ‘Processing and packaging’ were grouped under these headings, even though these activities can be done at multiple sites in the actual food chains.

The results from the workshop raise a number of questions/challenge found in the food chain and also give suggestions to possible solutions and areas where increased knowledge is needed. As in the survey the actions implied are on both macro- and microscale of the food system. Table 4 summarises the inputs from the workshop and provides an overview of the solutions and knowledge gaps identified for each step in the supply chain.

Table 4. Results from workshop: Challenges found – listed with possible solutions and existing knowledge gaps to be addressed for reaching the solutions.

Primary production	
	<p>Farmers/producers knowledge about market: Often, many farmers in one area start growing the same crop – this may lead to overproduction</p> <p>Solutions:</p> <ul style="list-style-type: none"> • <i>Model for coordinating farmers/producers so that production and/or harvest is based on demand</i> • <i>IT offers possibilities</i> • <i>Increase responsibility from e.g. retailers in sourcing/production (private or in clusters)</i> • <i>Contract farming in developing countries</i> <p>Knowledge gaps:</p> <ul style="list-style-type: none"> • <i>Local knowledge on cultivation conditions and choice of crops/cultivars</i> • <i>How can farmer's knowledge about reducing waste be made visible/shared</i> • <i>Which innovations/ investments are needed at farm level to reduce waste</i> • <i>How can buyers/retailers create incentives for reducing waste at the farm/producer</i> • <i>What are the actual reasons for waste in low income countries? Is it at farm level or is it in storage and transportation after harvest? This knowledge is needed to take correct measures in reducing waste.</i> • <i>IT solutions: Every farmer has a mobile phone; how can it be used for better planning/control</i>
	<p>Quality classification used in trade standards: Is there a difference for niche and bulk products as to if the classifications may be a driver for food waste? (Is there a difference in demand for various classes? Is the produce that is sorted out from the higher classes used or wasted?)</p> <p>Knowledge gaps:</p> <ul style="list-style-type: none"> • <i>Little knowledge about trade standards role in waste:</i> <ul style="list-style-type: none"> - <i>It is of interest to validate a food chain with and without trade standards applied</i> - <i>Can trade standards be used to reduce waste?</i>
	<p>How to use the produce that has been sorted out? The demand may differ between different quality classes. What can be done with produce of classes in lower demand?</p> <p>Solutions:</p> <ul style="list-style-type: none"> • <i>Technical solutions to handle class 2 products that have no market in the producing country – processing into less perishable product</i> • <i>Effective use of waste that cannot be avoided</i>
Storage/Transport	
	<p>Handling of produce may be poor, optimum storage conditions are not met, especially in primary production: There is often a lack of necessary equipment and or continuous supply of electricity to handle perishable products, for example lack of cold storage or unbroken cool chain)</p> <p>Solution: <i>Various solutions for gentle handling. Solutions may be technical (mechanical handling, cooling,...), but may also be related to increased awareness of how handling conditions affect quality</i></p> <p>Knowledge gaps:</p> <ul style="list-style-type: none"> • <i>What are the actual reasons for waste in low income countries? Is it at farm level or is it in storage and transportation after harvest? This knowledge is needed to take correct measures in reducing waste.</i> • <i>IT solutions: Every farmer has a mobile phone; how can it be used for better planning/control</i> • <i>Can more efficient information systems make a difference?</i>
Processing/Packaging	

	<p>Use of optimum packaging: Packing should be designed to protect the produce/food for the conditions in each specific part of the food chain</p> <p>Solution: <i>Packaging solutions for cold storage and shock absorption - adapted to the produce or food</i></p>
Retail	
	<p>'Full' shelves: Retailers adapt to consumers buying patterns to increase sales; however, if larger quantities of perishable products (examples: bread, fruit and veg, milk) are exposed on shelves this may lead to more waste if turnover in the shop is not high enough</p> <p>Low volume, perishable products: Similarly to above, when larger volumes are displayed than bought – the result will be waste</p> <p>Waste from retail is not homogenous/cannot be used as feed: To use waste from retail as feed for farm animals its nutritional content needs be known and hygienic standards need to be met.</p> <p>Storage temp of fruit and veg: Optimum storage conditions differ between products. Retailers may have to compromise depending on storage possibilities; Lights may radiate heat to products.</p> <p>Information about campaigns is not passed on in time to suppliers: When larger retailers decide on campaigns with a supplier of perishable products (for example bread, certain fruit and vegetables) other suppliers experience a sudden drop in demand which they have no possibility to plan for.</p> <p>Solutions:</p> <ul style="list-style-type: none"> • <i>Could campaigns be used to reduce waste, e.g. for seasonal, perishable products, campaigns can increase demand at the right time</i> • <i>Retailers could increase information/cooperation with suppliers to avoid unannounced, sudden changes in their demand</i> <p>Personnel is expensive, fruit and veg is inexpensive: Handling of fruit and veg could be improved, but demands resources (personnel, and possibly investments)</p> <p>Waste in general:</p> <p>Knowledge gap:</p> <ul style="list-style-type: none"> • <i>What is included in company policies? How can incentives be created to reduce world-wide food waste? How can incentives for procurers/buyers be designed to highlight sustainability issues.</i>
Public meals (schools, hospitals...)	
	<p>Waste in general</p> <p>Solutions:</p> <ul style="list-style-type: none"> • <i>Produce with mainly cosmetic flaws could be used in public kitchens to a greater extent (as they are further prepared into meals)</i> • <i>Diversified strategy for individual consumers vs. industrial meal providers</i>
Consumer	
	<p>Food is 'too cheap': The cost of wasting food is not high enough to change actions/habits of the consumer</p> <p>Ignorance of consumers: Consumer behaviour affects food waste</p> <p>Solutions: <i>Increase consumers awareness about:</i></p> <ul style="list-style-type: none"> - <i>How to handle fruit and vegetables to achieve a long shelf-life</i> - <i>How to judge quality of food (e.g. a green patches on a citrus fruit does not mean it is not ripe...)</i> - <i>Nutritional facts, e.g. that vitamins and minerals are associated to parts close to peel and bran</i> - <i>Seasonal variation of foods</i> - <i>How to handle leftovers</i> - <i>As consumers, we have been taught that we need fruit and veg. of class 1; however, we could use class 2 for a large part of our cooking</i> <p>Consumer driven product range? It is generally said that consumer demand decides product range available; However, the individual consumer is also limited to the product range available</p> <p>Communication of added-value: Today there is little possibility for actors in the food chain to communicate their efforts in reducing food waste to consumers</p> <p>Waste in general</p> <p>Solutions: <i>Diversified strategy for individual consumers vs. industrial meal providers</i></p>
Supply Chain	
	<p>The balance of power is uneven along the chain. Need for win-win solutions: Along the food chain farmers, for example, are small scale businesses while their trading partners may be large multinational corporations. It is necessary to focus on win-win solutions along the food chain otherwise the cost for waste is easily pushed in the direction of smaller actors</p> <p>Solution:</p> <ul style="list-style-type: none"> • <i>GOOD/FAIR cooperation models - avoid 'earning quick money'</i> • <i>Create shared value (e.g. Nestlé coffee procurement)</i> <p>Understanding and predicting the market:</p> <p>Knowledge gap:</p> <ul style="list-style-type: none"> • <i>Dynamics in the global food chains and their effect on waste</i> • <i>Possibilities for "green" business opportunities related to waste</i> <p>Large distances and many actors along the food chain/ Communication along the food chain: The distances and many actors of the food chain hampers dialog between actors. Actors are not aware about how their actions affect other actors. It is difficult to understand how requirements that are set up in the later stages of the chain will affect the actors in the producing a</p> <p>Knowledge gap: <i>Quality aspects along the chain; handling in early stages of the food chain will affect quality and shelf-life in later stages</i></p> <p>The 'Bull-whip' or "Forrester effect": Variations in demand at the consumer end are scaled up along the supply chain to primary</p>

	producer affecting the capability to manage the production well in the early supply chain as well. Also, food is unintentionally spoiled or quality is lost due to long storage times. Large intermediate storages, long storage times and high safety stocks add to this effect.
	No existing method for measuring sustainability of changes/improvements: The profits made in later stages of the chain may be related to investments, changes or adaptations made in early stages of the food chain Knowledge gap: <i>How can the added value created in the early stages of the food chain be communicated to the consumer?</i>
	Waste in general Solutions: <ul style="list-style-type: none"> • <i>Better refrigeration and control of temperatures along the food chain</i> • <i>Better systems for documentation</i> • <i>Methods to determine dynamic shelf-life</i> • <i>Mapping of existing certification systems. How can waste reducing actions be enhanced by the existing certification systems; this is especially interesting for eco-products, as they often are niche products with the potential of generating higher proportion of waste. The added value of these products may make it possible to put more resources into waste prevention and to communicate such actions</i> • <i>Contract farming in developing countries and/or distribution contracts</i> Knowledge gap: <ul style="list-style-type: none"> • <i>How can certification systems be used to reduce waste through the whole food chain or through parts of the food chain?</i>
	Many good examples exist, but how can these individual initiatives be scaled up? How can they be made mainstream in global chains?

6 Discussion and conclusions from the work

The gap analysis performed in this study (workshop) shows that there are large knowledge gaps on how the supply chains are working and how much food is wasted and the causes of the food waste. The survey also shows that there is much knowledge in place that is not shared along the supply chain.

Round table discussions and knowledge sharing within different sectors may be a first step in making use of current know-how, and to set up an agenda on needs and how to collaborate. Information on optimal handling and available packing solutions should also be shared. The Courtauld Commitment (UK)¹⁹ is a result of successful round the table discussions..

To facilitate and enable actions directed toward minimising food waste, recourses are needed for: education and training, technology implementation, better infrastructure and communication in the food system. This is important in particular when trading with developing countries and poor farmers with low educational background. This need was also stressed by researchers cited in this report in the section on the current situation.

The transparency, particularly in long supply chains, is problematic as information seems to be lost the longer the chain is; this is especially challenging when working with developing countries where the knowledge gap and the ability to be a strong partner compared to the large industries and retailers is challenging. Other aspects of transparency e.g .sharing information on campaigns, and other activities having an influence on the demand, will contribute to less wasted food, in particular for fresh fruit and vegetables.

“Food waste” is a societal problem; it also deals with a large system where interaction in one end will have implications on other parts of the system. Individual actors cannot address food waste alone, since many activities need to be coordinated across the supply chain. Thus food waste needs to be addressed by policy makers and actors in parallel. A policy framework is needed, stating the direction and goals, and resources are needed supporting the actors to take action. The survey carried out shows that there is a demand for political action, and resources are needed in order to make a change.

¹⁹ <http://www.wrap.org.uk/content/courtauld-commitment-2025>

The list of future projects collected from the survey and the discussions during the final workshop and panel discussion may be a good starting point as a rough understanding of the food chains *including the food systems in developing countries*:

- Address food waste via industry associations.
- Arrange conference workshops.
- Make sure that good examples are published and communicated.
- Implement better traceability so the product can be followed to the farmer.
- Important that everyone understands why we need to cooperate to reduced food waste, there is always someone who "loses" in changing their business and for them it must be particularly clear why this is needed. Suggested actions need to be based on thorough research to avoid increased environmental impacts and/or energy consumption!
- In order to learn from each other: Arrange international and national meetings and workshops that could be general or dedicated to different sectors; for example, hospital kitchens from different parts of Europe, cooperate, hotel chains, retailers.
- Working in international or Nordic collaborative projects.
- Look over the range of products being imported and improve the selection in favour of the most well performing products.
- Improve knowledge and communication, challenge students and innovators.
- We need to take a holistic perspective and everybody has to take their share of responsibility.
- Greater balance of power within the supply chain. There is currently a concentration of power held within Europe's supply chain, dominated by major retailers and large brand manufacturers. This imbalance needs to be addressed to ensure more equal contracting terms and increased selling power for suppliers, in particular small suppliers which are most vulnerable.
- Creating a Food Waste Ombudsman or similar in Sweden, with inspiration from UK and the Groceries Adjudicator Act. The purpose would be to give the mandate to an official process/position to focus on lowering food waste and creating platforms identified in this project and by stakeholders.

The experience from social innovators, NGOs and other social organisations working on the micro level needs to be acknowledged and communicated. They have an important role as facilitators in developing countries (education, setting up projects etc. in collaboration with local organisations) and may serve as a link to policy makers.

The following issues/question were found to be crucial to address by further research in order to develop appropriate solutions (Table 4)

- Farmers/producers knowledge about market: Often, many farmers in one area start growing the same crop – this may lead to overproduction, how to organise/inform farmer to avoid this situation?
- Quality classification used in trade standards: Is there a difference for niche and bulk products as to if the classifications may be a driver for food waste? (Is there a difference in demand for various classes? Is the produce that is sorted out from the higher classes used or wasted?)

- How to use the produce that has been sorted out? The demand may differ between different quality classes. What can be done with produce of classes in lower demand?
- Handling of produce may be poor, optimum storage conditions are not met, especially in primary production:
- Use of optimum packaging: Packing should be designed to protect the produce/food for the conditions in each specific part of the food chain. How can current knowledge help developing such solution and what should the requirement be?
- Information about campaigns is not passed on in time to suppliers, how can this be solved?
- Personnel is expensive, fruit and veg is inexpensive: Handling of fruit and veg could be improved, but demands resources (personnel, and possibly investments)
- Communication of added-value: Today there is little possibility for actors in the food chain to communicate their efforts in reducing food waste to consumers. A better communication could serve those managing their food waste well. How to establish such communication?
- The balance of power is uneven along the chain. Need for win-win solutions: Along the food chain farmers, for example, are small scale businesses while their trading partners may be large multinational corporations. It is necessary to focus on win-win solutions along the food chain otherwise the cost for waste is easily pushed in the direction of smaller actors. How can this be prevented?
- There is no existing method for measuring sustainability of changes/improvements: The profits made in later stages of the chain may be related to investments, changes or adaptations made in early stages of the food chain
- Understanding and predicting the market and the demand is crucial (and very complex).
- Large distances and many actors along the food chain/ Communication along the food chain: The distances and many actors of the food chain hampers dialog between actors. How can we create systems that overcomes this problem?
- Many good examples exist, but how can these individual initiatives be scaled up? How can they be made mainstream in global chains?

Much research is performed relating to sustainable food production, but the research questions being asked are slightly different. Food waste research still suffers from that it is a quite new research area that is under development. Research focus on global food chains has so to large extent been focusing on quantification of food waste, impact of information activities and awareness rising activities. Numerous of apps to support the European consumer have been developed. Addressing food waste in global food chains as defined in this report shows that also research adapted to the needs in the local food chains in developing countries are needed. For example how can a farmer make use of IT in a simple way (almost every farmer has a mobile phone), are there packing solution that can be used tropical fruits so that a desired even quality can be delivered, how to handle the waste that still happens in the best way (feed, new product, biogas etc.) and how to take care of the inedible parts (leaves, stems, peels etc.). Process technologies suitable for small scale (fruits having a low quality can be processed and sold as processed fruit instead etc.).

Another issue that deserves attention is the business model between retailers and their suppliers. Many of the solutions to the food waste problem demand changes in business models, for example the issue where bread is taken back from retailers by retail suppliers at a low cost, giving low incentives for improvements in the retail sector.

From the literature review it can also be concluded that there is a tremendous interest in the food waste field. Few disagree on what need to be done but, but the problem is complex and the drivers

on macroscale are different from the drivers on microscale. Much more research is needed to understand which interventions are effective in different situations; in particular research springing from local knowledge and understanding of the actual economic context for a given situation may give new insight.

Although the field is hampered by the unclear ownership of the question and lack of collaboration between actors, there is always a "working window" for each actor in the supply chain where actions can be taken right now to improve. The actual practical solutions for reducing food waste needs to build on the collected experience and the knowledge carried by the actors in the supply chains and the researcher actually working with concrete problems relating to food and food waste prevention. Thus much needs to be done but much can already now be done for reducing food waste in global food chains.

Further on it is of great importance that everyone understands why we need to cooperate to reduced food waste. There is always someone who "loses" in changing their business and for them it must be particularly clear why changes are needed. Suggested actions need to be based on thorough research to avoid increased environmental impacts and/or energy consumption.

7 Recommendations

Food waste in global food chains needs to be address as a part of food waste problem in general as well as part of the research carried out improving resource efficiency in developing countries. Based on the results of the Expert networks activities 2015-2016 the following recommendations are given. Those recommendations in bold specifically address the *additional* needs for addressing global food chains, starting in developing countries ending in high income countries. The recommendations are formulated from a Swedish perspective and are listed below:

- Food waste needs to be taken to the political agenda. SDG12.3 has created an incitement
 - Clear directives, ownership is still missing
 - **The global aspects need to be included in the political agenda from both the perspective that food chains are global but also the we do have the resources to support developing countries with our know how to promote a development toward resource efficient food chains also bringing in the research dealing with food waste and the specific knowledge gaps identified.** A national information hub is needed linking to other hubs creating a one-stop shop arena for National actors
- Resources are needed to cover the initial investment in new systems and for education. (consumers, food producers and other actors in the food supply chains) , since these investments generally go outside the businesses and usually require investments in new working processes and possibly also technology as well as education).
- Include food waste in educational programs relating to food handling/agriculture in Sweden.
- The sector should consider initiating **round the table discussions** to agree on key priorities on how to reduce food waste , and **there also take into the specific problem relating to the global food chains**
- **Collaboration platforms on a sector basis and across our national boards, in order to learn from each other need to be initiated**

- **Good examples and demonstration project needs to be initiated.** This link to the need for resources for getting started, round the table discussions and coordination of activities and research. Only by working practically we can make a difference.
- **Create a Swedish knowledge hub for sharing knowledge and for creating new projects with a global perspective, this could be a part of SaMMA.**
- **Include different certification organizations in the dialog on food waste.**

8 Opportunities for Swedish actors

- Swedish Universities and Institutes could take a role in educating students and hosting visiting researchers to cover the knowledge gaps.
- NGOs could have an important role as facilitators and educators in developing countries on site.
- The actors in the food supply chain can advance their position by dialogue, collaboration and information sharing; also, hosting trainees from developing countries learning Swedish best practice who can serve as food waste ambassadors when they return back home (where relevant).
- Technology development, in particular simple, robust technological solutions to be used in developing countries.
- The key is however that we collaborate and share our knowledge and experience.

9 International processes relating to food waste

Five important international processes where Swedish resources can contribute to preventing food waste in global food chains have been identified:

European Platform on Food Losses and Food Waste

The platform was established 2016 to support the SDG12.3 bringing together “all relevant actors and international organisations and actors in the food supply chain including consumer and other non-governmental organizations such as FAO , UNEP. OECD .The platform will supervise the European commission on issues relating to Food Waste.

Although this forum is focused on EU, international organisation are actively participating and decision taking will be of indirect importance for also global food chains. The platform will also offer first-hand information on ongoing initiatives and know how.

http://ec.europa.eu/dgs/health_food-safety/dyna/enews/enews.cfm?al_id=1686

Global Initiative on Food Loss and Waste Reduction (Save Food)

The platform was launched 2011 and it aims for capacity building and networking world wide. It had four pillars i) advocacy; ii) collaboration and coordination; iii) policy, programme and strategy development based on evidence; iv)technical support to investment projects and programmes. The platform has run a selection projects which are published on their website.

The network is of interest since FAO is an important global player and may serve as facilitator for demonstration projects and a platform for communicating new findings and projects.

<http://www.fao.org/save-food>

EAT forum

EAT is a network of world leading academic institutions spanning across the fields of food, health and sustainability sciences having the goal to carry out solution-oriented interdisciplinary research enabling policy-makers, food business leaders and consumers to make better decisions.

Food waste is covered under the theme Economics of Food System.

<http://www.eatforum.org/>

Horizon2020

Horizon 2020 is a seven year Eu research and innovation program (2014-2020) of great importance as building research and innovation capacity. Strategic alliances are developed with selected countries allowing these to participate under specified conditions (e.g. China, Japan, selected African countries) covering different areas of research. The program may offer opportunities to collaborate with other European countries as well as selected countries in e.g. Asia and Africa)

<https://ec.europa.eu/programmes/horizon2020/>

YieldWise

YieldWise is a \$130 million initiative from Rockefeller foundation, with the goal of demonstrating how the world can halve food loss by 2030. The initial focus is on fruits, vegetables, and staple crops in Kenya, Nigeria, and Tanzania, where up to half of all food grown is lost.

<https://www.rockefellerfoundation.org/our-work/initiatives/yieldwise/>

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ANNEX 1 Responses to question 3-10 in the survey

Note that all but one response, was given in Swedish, these are translated by author, nothing has omitted but in some cases long answers have shorten down to only include the key point.

Question	Responses			
	Processors /Municipalities/Packing providers/Retailers	Scientists/Consultants	NGO/Certification organizations	Authorities
Do you perceive you have sufficient transparency upstream in the food chain to work proactively with food loss and waste?	<p>Municipality</p> <ul style="list-style-type: none"> - We know the origin for meat and dairy products but seldom the origin of grain and vegetables and fruits. We order from a larger company handling all contracts - Lack of transparency is perceived by many Municipalities. <i>To improve the collaboration between kitchen and wholesaler this organization carry out a survey to evaluate the how well the different wholesaler collaborate. The survey is published</i> <p>Retail</p> <ul style="list-style-type: none"> - We have some transparency upstream but not as much as we should need - Partly we do not have the resources needed <p>Packaging</p> <ul style="list-style-type: none"> - We deliver boxes for vegetables that are used from field to retail and thus the origin of these boxes and content is traceable - We believe from a waste perspective that it is the length of the transport that is important. The longer transport the higher is the risk that the product is damaged or that the cold chain is broken. There are many 	<ul style="list-style-type: none"> - Partly - Yes - Upstream for some Swedish vegetables like salad, potatoes and carrots 	<ul style="list-style-type: none"> - No - We have from primary producers and the transports to Sweden 	<ul style="list-style-type: none"> - Within Sweden we have a good transparency and we know the origin also in global chains

Question	Responses			
	Processors /Municipalities/Packing providers/Retailers	Scientists/Consultants	NGO/Certification organizations	Authorities
	<p>good packaging solutions e.g. having ventilation for hampering maturation, protection against mechanical impact etc</p> <p>Processor</p> <ul style="list-style-type: none"> - We have a good transparency up stream. We see that there are problems further downstream the food chain (from retailers' central storage to consumer). - Main problems are temperature variations as the products are loaded and unloaded. 			
What are, according to your opinion, success factors for collaboration along the food chain, for example, with suppliers?	<p>Municipality</p> <ul style="list-style-type: none"> - Meetings , workshops etc. to learn from each other - To use first class vegetables only when needed and 2 class vegetables for soups salads etc. - Producers, processor and retailers need to meet in order to create a mutual understanding on each other's needs <p>Retail</p> <ul style="list-style-type: none"> - Food waste reduction needs to be recognized as a prioritized field and resources are set aside to accomplish something - A close dialog in the chain - Daring to test and evaluate different strategies for reducing food waste - Investments in projects - Investments in logistics <p>Packaging</p> <ul style="list-style-type: none"> - We need to identify the common 	<ul style="list-style-type: none"> - Fair distribution of costs for investments in the supply chain - Improved clarity on requirement and specifications from the customer side - Better cold chains and better information to consumers how to store products - Dialogue between the actors in the supply chain - Producers, processor and retailers need to meet in order to create a mutual understanding on each other's needs - Dialogue e.g by arranging a "potatoes school" involving suppliers/farmer, those peeling the potatoes and municipal kitchens, the quality was increased considerable resulting in less waste in the kitchens 	<ul style="list-style-type: none"> - Collaboration on packing size and degree of processing needed - Engagements in combination with respect for the difficulties and different opinions - Certification is a win-win. - Relaxation of cosmetic specifications: In some cases 'minor blemishes', detected by laser machinery rather than the human eye, are the cause for seemingly 'perfect' fruit and vegetables being discarded. Whilst this wastage is a critical issue, these standards also lead to entrenched overproduction as farmers systematically produce more than they will ever sell to ensure that they have the right volume of cosmetically perfect produce. As with whole crop purchasing, products of various specifications can be included in separate products lines. - Abolition of exclusivity clauses in contracts: Some suppliers are bound by clauses in their contracts with their clients meaning that any unsold produce they produce 	<ul style="list-style-type: none"> - Use the collected expertise with the traditional mandate given (remark: to the authority) and address food waste when relevant

Question	Responses			
	Processors /Municipalities/Packing providers/Retailers	Scientists/Consultants	NGO/Certification organizations	Authorities
	<p>problems in the supply chain and start working from there – what is the main cause of food waste in a given supply chain and start from there</p> <ul style="list-style-type: none"> - Producers, processor and retailers need to meet in order to create a mutual understanding on each other's needs <p>Processor</p> <ul style="list-style-type: none"> - A good stock management and the possibility to order just the right quantity according to production plan (deliver frequency , packing size etc. need to be adapted) - The farmer knowledge and ability to communicate on the characteristics of product - Short Chains - Education and use of state of the art technologies for harvest and storage 		<p>cannot be sold on to a third party.</p> <ul style="list-style-type: none"> - Accurate forecasting, guaranteed volumes and prices. Forecast amendments and last minute order cancellations result are major causes of food waste, particularly in the global south when supplying European markets. Great effort should be made for buyers to work with their suppliers to generate realistic and accurate forecasts to minimize variance in expected order volumes and price at certain times of the year. - Strict regulation against unfair trading practices like the Groceries Code Adjudicator (GCA) in the UK. - Whole crop purchasing: Farmers should be offered the option of entire crops being purchased regardless of cosmetic specifications and changes in demand from the buyers side. For example, a carrot harvest could be separated into different lines including: whole product; soups and juices; processed ready meals; fresh cut products etc. 	
What are the difficulties in ensuring low levels of food losses and waste upstream in global food supply chains?	<p>Municipality</p> <ul style="list-style-type: none"> - The information is lost between the producer and wholesaler(Municipality) - The transparency from the supplier (wholesaler) is generally insufficient - You know very little about the product when you order <p>Retail</p> <ul style="list-style-type: none"> - The costs for establish good 	<ul style="list-style-type: none"> - The power balance between retailers and suppliers. Waste due refusals and consignment being two examples - To achieve transparency (both supply side and customer side) (- You can earn money on being wasteful - Transparency and the difficulty to really understand why a 	<ul style="list-style-type: none"> - The uneven distribution of resources, most pressure is put on those at the beginning of the supply chain and the end of the supply chain. Without recourses it hard to make a change - Traceability could be an issue but e.g Fairtrade has this due to its certification system - Encouraging retailers and other power brokers in the supply chain to play an active 	<ul style="list-style-type: none"> - There is a need for investments in infrastructure to decrease losses in primary production in developing countries as well as in storage and transport and at the other end of the food chain we also

Question	Responses			
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	<p>information protocol and the ability to think outside the box</p> <ul style="list-style-type: none"> - Logistics and costs <p>Packaging</p> <ul style="list-style-type: none"> - We don't know the problems in the different parts of the supply chain - We cannot for sure trace where an error in handling has occurred upstream. <p>Processors</p> <ul style="list-style-type: none"> - The supply chains are very complicated - A challenge is the quality of the raw material (vegetables, fruits) is keep changing and depends on season, weather, temperature, amount of rain - Availability vs demand , which links to poor stock rotation 	<p>buyer cancels an order (of already produced food) or why customers at restaurants stops coming</p> <ul style="list-style-type: none"> - Classification/sorting based on size (to a lower class) may be contra productive. E.g. small size potatoes can be sold to the double price to restaurants. - The producer (e.g. farmer) do not know the destinations and what the product is to be used for and cannot thus not provide the most suitable products (e.g. maturity of fruits) for the purpose 	<p>role in reducing waste, e.g. publishing their waste data. Effective regulation of buying practices and unfair trading practices of major buyers in Europe without legislation. Ensuring implementation the food waste hierarchy to priorities food waste reduction efforts over redistribution and waste management activities. For example, a number of initiatives have prioritized the use of anaerobic digestion or composting as food waste 'solutions' when neither of these systems reduce the amount of food being wasted. Instead prevention and reduction should be the primary focus of activities, follow by the most effective use of surplus food.</p>	<ul style="list-style-type: none"> - need to work on information and changes in e attitudes
<p>Give concrete examples of ideas and/or activities that can lead to reduced food loss and waste in global food chains in the future</p> <ul style="list-style-type: none"> - And what is needed. to implement the suggested ideas and activities in order to reduce food loss and 	<p>Municipality</p> <ul style="list-style-type: none"> - Agreements must be held- ban cancellations of already produced food. Increase the transparency and traceability so that clients actively can select supplier. Mapping every step in the supply chain and find the root causes of food waste and identify actions that can be taken. <p>Needs: Political decision on local, national and global levels. A concrete goal to work against e.g. .50%</p>	<ul style="list-style-type: none"> - Information on the importance of appropriate packing solutions to reduce waste- which is something consumers don't ask for today. Increased price of food. <p>Needs: Authorities need to initiate such information campaigns and then the producers take the next step</p> <ul style="list-style-type: none"> - Increased knowledge how the food system is working, legislation and information to consumers <p>Needs: We need to understand</p>	<ul style="list-style-type: none"> - Inspire retailers to find new solutions for decreasing food waste <p>Needs: The regulations need to be modified to make it easier to donate food</p> <ul style="list-style-type: none"> - Proving and informing on good examples (e.g in the UK good examples can be taken from Tesco, Sainsbury and Marks and Spencer. - Needs: Engagement and a sense of responsibility - Education is important part in global food chains look at the farmers in developing countries as well as organization, because 	<p>Needs: Possible something like Groceries Code Adjudicator (GCA</p> <ul style="list-style-type: none"> - Needs: Swedish Government commission (2013-2015) concluded the we need to - Dedicated information to consumers - Increased collaboration

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waste along the chain?	<p>reduction of food waste before 2020. Not letting the multinational companies set the agenda. Collaboration across the boards</p> <ul style="list-style-type: none"> - Include sustainability , food production and resource efficiency and how to prevent food in the Swedish curriculum from year 1 Needs: Political lobbying that food waste concerns all citizens and should be included in the Swedish curriculum (Network for municipal school restaurants) - Trust the senses on what are eatable, use good packaging systems and dare to use class 2 vegetables/fruits when possible! Process/cook and sell food risking becoming waste. Needs: Education and Information <p>Retail</p> <ul style="list-style-type: none"> - The challenge is to put the food waste issue on the table and prioritize it. We can for examples lower the prize of much more products before they become waste than we do today e.g. bread. We need to continue to develop our collaboration with social organizations in order to donate more food Needs: Focus on the task (to reduce food waste) and priority from policymakers when it comes to 	<p>who much we waste and the consequences of wasting food</p> <ul style="list-style-type: none"> - Needs. Communication and information - Workshops involving actors from all part of the food chains (local and global), Improved packaging solutions. Solutions preventing food in “limbo” from becoming waste needs to be implemented (e.g donation, food sharing), Although the situation looks very different in different parts of the world sharing technology to find solution is important Needs: Clearly stated policy goals that are followed up globally nationally and locally. Let food waste become a part of the Environment certification systems. An agricultural policy that does not encourage over production of food. Economic support to carry out projects to carry out these actions - There is a lack of knowledge on how the handling of fruits and vegetables influences the durability and no easy way to measure durability. 	<p>some ingredients are grown mostly by small family farms. We need to ensure a payback if investments(education and resources) are done to reduce food waste</p> <ul style="list-style-type: none"> - Needs: Resources and the food waste issue need to get higher on the political agenda , the current focus is on climate impact and reducing food waste should be a part of this (NGO) - Measurement and publication of levels of food waste within major food businesses such as retailers and large manufacturers. Relaxation of cosmetic specifications of fruit and vegetables. Improved forecasting from buyers to their suppliers, coupled with contract that fairly balance the needs of both the supplier and buyer. Prevention of unfair trading practices via the establishment of relevant legislation and associated enforcement bodies. Encouragement of donations of surplus food to charities and institutional bodies (hospitals, prisons etc). Abolishing unnecessary processing practices, such as topping and tailing of French beans, to maximise the amount of crop that is sold for consumption to consumers. Encouragement of sending unsellable food to livestock feed to offset the environmental impact of meat production through the use of conventional cereal based feed. Needs: Measurement and publication of levels of food waste within major food 	<p>between te actors in the Food chain</p> <ul style="list-style-type: none"> - Provide good examples - Stimulate the production of biogas from food waste that that cannot be prevented

Question	Responses			
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	<p>support and increased resources to be able to work focused on reducing food waste</p> <ul style="list-style-type: none"> - Work directly together with small farmers. Commercialize the non-perfect fruits and vegetables, donate more food for charity, cook food locally from food in limbo <p>Needs: Collaboration (retailer) and resources for carrying out projects.</p> <p>Packing</p> <ul style="list-style-type: none"> - Needs: Information and knowledge on what is driving food waste - Measure physical impact and temperature of vegetables and fruits during transport to be able to develop solutions preventing damage /predict durability of the products at arrival <p>Needs: Investments</p> <p>Processors</p> <ul style="list-style-type: none"> - By increasing the transparency between retail and processor forecasting, production planning and delivery to customer can be made more accurate <p>Needs: Competence and technology</p> <ul style="list-style-type: none"> - Undisrupted cold chain from producer too retailer with an optimal temperature for each product . Follow up on quality and don't import 	<ul style="list-style-type: none"> - The first step that need to be taken is to share the current knowledge that exists among those working with vegetables and fruits e.g. optimal temperature , humidity and how to handle different vegetable and fruits are to be handled. <p>Needs: In order to reduce wastage of fruits and vegetables and root crops full traceability along the production chain is needed. Having that current knowledge needs to be implemented by education</p> <p>For example, we store apples today, storing potatoes around six months likewise carrots that can be freshly harvested until march April as straw has been used to protect the field from the cold weather</p>	<p>businesses such as retailers and large manufacturers, Relaxation of cosmetic specifications of fruit and vegetables, Improved forecasting from buyers to their suppliers, coupled with contract that fairly balance the needs of both the supplier and buyer, Prevention of unfair trading practices via the establishment of relevant legislation and associated enforcement bodies. (NGO)</p>	

Question	Responses			
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	<p>when quality is starting to decrease towards the end of the season</p> <ul style="list-style-type: none"> - More locally produced and respect that some products are seasonal and cannot/should not be sold all year around (e.g. as cabbage in Sweden) <p>Needs: A mindset that is based on quality rather than price though the food supply chain, good product knowledge in the whole supply chain, packings solutions fitted for single households.</p>			
What role can NGOs play?	<p>Municipality</p> <ul style="list-style-type: none"> - They are important but should not carry the main responsibility for decreasing food waste - Provide surplus food for those in need - If school in the future can give a way surplus food for charity the help from NGOs will be needed <p>Retail</p> <ul style="list-style-type: none"> - Provide surplus food for those in need - Connect small farmers with commercial farmers. Food donations – how can these be carried out to reach those most in need. <p>Packing</p> <ul style="list-style-type: none"> - Support networking and sharing information on causes in all parts of the food supply chain and focus even more on prevention. - Financially supporting projects needed to address food waste <p>Processors</p>	<ul style="list-style-type: none"> - Foodbanks are good but focus need to on prevention strategies Give attention/publicity to good examples and actor that are working on preventing food waste - Arrange workshops, collaborate with media, collect information and adapt for different groups of stakeholders, interact with members and provide feedback Disseminate messages and knowledge and engage the members and provide material to be used by members interacting with consumers and stakeholders. - Teach consumers that we can eat fruits and vegetables that do not look perfect 	<ul style="list-style-type: none"> - Inspiration and push the market forward. - Provide good examples and demonstrate possibilities, and take the role as opinion maker and carry on an dialogue on food waste - Share good examples and create political opinion. - Research/investigations, communications and awareness raising - breaking complex issues into tangible public messages, engaging high profile individuals to push forward agendas , engaging supporter base to put pressure on businesses and governments 	<ul style="list-style-type: none"> -

Question	Responses			
	Processors /Municipalities/Packing providers/Retailers	Scientists/Consultants	NGO/Certification organizations	Authorities
	<ul style="list-style-type: none"> - None in the current context of global food chains - A source for inspiration 			
Can certification of products / businesses help to ensure that low food loss and waste is taken into account? How can such systems be designed? Please, comment!	<p>Municipality</p> <ul style="list-style-type: none"> - Maybe as a part of the certifications schemes for ecologic certification! (Municipality) - Better to address food waste using terms as profitability and good will (School meal provider) - Interesting though -if so, it needs to be fitted for different sectors and their way of working <p>Retail</p> <ul style="list-style-type: none"> - Needs to be disused - Not sure <p>Packing</p> <ul style="list-style-type: none"> - Certification can be done on different levels and there is no guarantee that a certification helps(Packing provider) <p>Processors</p> <ul style="list-style-type: none"> - No new , waste can be handled within current certification system e.g. ISO 140001 (processor) - No, use those systems being available e.g “odling i balans” (Processor) - 	<ul style="list-style-type: none"> - Yes, see the suggested new Nordic Swan - Include it as a part of the environmental management systems (like ISO 14000) and as company policies then all types of companies can be reached. - 	<ul style="list-style-type: none"> - Maybe, but just to address food waste in companies sustainability report would be a good start - For certain products, in particularly meat products e.g. in Japan Pork exclusively feed by wasted food is advertised as “eco-pork” certification schemes could support consumers to make informed choices 	<ul style="list-style-type: none"> - Yes, see the suggested new Nordic Swan
From your perspective, how can cooperation work in a good way in global food chains? <ul style="list-style-type: none"> - Address food waste via industry associations, - Arrange conferences workshops, - Make sure that good examples are published and communicated, - Implementing better traceability so the product can be followed to the farmer , 				

Question	Responses			
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<ul style="list-style-type: none"> - Important that everyone understands why to we need to cooperate to reduced food waste, there is always someone who "lose" to change the business and for them it must be particularly clear why this is needed Suggested actions need to be based on thorough research to avoid increased environmental impacts and/or energy consumption! - In order to learn from each other: Arrange international and national meetings and workshops, that could be general or dedicated to different sectors. For example, hospital kitchens from different parts of Europe, cooperate, hotel chains, retailers. - Working in international or Nordic collaborative projects. - Look over the range of product being imported to improve the selection in favor of the most well performing product - Improve knowledge and communication, challenge student and innovators - We need to take a holistic perspective and everybody has to take their share of responsibility - Greater balance of power within the supply chain. There is currently a concentration of power held within Europe's supply chain, dominated by major retailers and large brand manufacturers. This imbalance needs to be addressed to ensuring more equal contracting terms and increased selling power for suppliers. 				

ANNEX 2 Dissemination opportunities 2016-2017

Scientific Conferences address sustainable food chains and food waste

- **Global food security conference** Cape Town, October 2017.
<http://www.globalfoodsecurityconference.com/organising-committee.asp>),
- **Seventh International Conference on Food Studies , Rome October 2017**
- <http://food-studies.com/2017-conference/call-for-papers>
- **LCM 2017, Luxembourg,September 2017”**[LCM Conference 2017](#)

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SP Technical Research Institute of Sweden

Box 857, SE-501 15 BORÅS, SWEDEN

Telephone: +46 10 516 50 00, Telefax: +46 33 13 55 02

E-mail: info@sp.se, Internet: www.sp.se

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