Collaboration Initiative Food Loss and Waste launched at MACS-G20

2024 update on activities

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With kind support from Cornel Adler (Julius Kühn-Institute Berlin/Germany), Camilla Albrecht (Julius Kühn-Institute Berlin/Germany), Ryan Atkins (Duquesne University/USA), Carmem Priscila Bocchi (Brazilian Ministry of Development and Social Assistance, Family and Fight Against Hunger – MDS/Brazil), Michaela Boehme (Sino-German Agricultural Centre, DCZ/China), Jakob Bogenreuther (University of Bayreuth/Germany), Julia Büchner (Julius Kühn-Institute Kleinmachnow/Germany), Kimberly Deranek (Nova Southeastern University/USA), Alexandra Gruber (Tafel Österreich/Austria), Alicia Guevara (Quito Food Bank/Ecuador), Amanda Cañar (Integrated Food Systems Management Initiative/Ecuador), Clara Cicatiello (University of Tuscia/Italy), Maria-Angeles Fernandez-Zamudio (Universitat Politècnica de València /Spain), Edilson Fragalle (Embrapa/Brazil), Benjamin Fürstenau (Julius Kühn-Institute Berlin/Germany), Sharon Yeukai Mada (Thünen Institute of Market Analysis/Germany), Asela K. Kulatunga (University of Peradeniya/Sri Lanka & University Exeter/UK), Christina Müller-Blenkle (Julius Kühn-Institute Berlin/Germany), Xavier Oña Serrano (National Polytechnic School/Ecuador), Adriana Pazos (National Agricultural Technology Institute Argentina, INTA/Argentina), Roberta Pietrangeli (University of Tuscia/Italy), Gustavo Polenta (National Agricultural Technology Institute Argentina, INTA/Argentina), Gustavo Porpino (Embrapa Foods and Territories/Brazil), Hans Ryckebusch (Impact/Belgium), Jovanka Saltzmann (Julius Kühn-Institute Kleinmachnow/Germany), LI Shiyang (Rare/China), Philip Soladoye (Lacombe Research and Development Centre at Agriculture and Agri-Food Canada/Canada), Jaylin Stotler (Thorton Parks, Recreation and Community Programs/USA), Annika Johanna Thies (Thünen Institute of Market Analysis/Germany), Lucia Toledo (National Polytechnic School/Ecuador), Valerie Verniers (Impact/Belgium), Sébastien Villeneuve (Saint-Hyacinthe Research and Development Centre at Agriculture and Agri-Food Canada/Canada), Oswaldo Viteri Salazar (National Polytechnic School/Ecuador), Janina Willer (Consumer Advisory Centre Lower Saxony/Germany), Bethel Yonas (Consumer Advisory Centre Bremen). Many thanks to Ms Susanne Kendell (Thünen Institute of Market Analysis/Germany) for English proofreading.

Braunschweig/Germany, December 2024

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1 Preface

In 2024, the Collaboration Initiative Food Losses and Waste launched at MACS-G20[1] finished its ninth year. Global food supply chains and food availability were still affected by the Ukrainian war. Fighting both food loss and waste and food security was an issue during the G20 presidency in Brazil. Multistakeholder cooperation along the food supply chain offered a first impression of the potential that can be realised through joint activities. Let´s continue our collaborations for more value!

Mr Stefan Lange, our Thünen Institute research coordinator, had to focus on other important topics and will not be further involved in the preparation of our annual Regional Workshops. Thank you, Stefan, for your support since the beginning of the Initiative! The role of the official Thünen Institute representative at our workshops has now been taken on by Prof Martin Banse who is the director of the Thünen Institute of Market Analysis. Thank you, Martin, for supporting this activity also with respect to the administration side!

By end of 2024, the Thünen President Prof Dr Folkhard Isermeyer who has been president since 2009 retires after decades at the Thünen Institute with different roles and responsibilities. He has supported the Collaboration Initiative FLW in previous years in different ways and we appreciate all his activities to make our work possible and to provide funding! Thank you very much!

In 2025, the FLW cooperation initiative will celebrate its **10th anniversary**. We are working on a series of activities to be organised throughout the year!

As in previous years, Felicitas as coordinator of the Collaboration Initiative FLW invited our Initiative partners to contribute to this present report with a brief summary not only on our joint activities but also on their own or further ongoing national FLW ventures. This approach supports our aim to share knowledge and experiences within our global network. Enjoy the report!

2 Introduction

The Collaboration Initiative on Food Losses and Waste launched at MACS-G20 was founded in 2015 at the MACS-G20 in Izmir, Türkiye. Germany took leadership of the Initiative and from 2015 until mid-2017, Stefan Lange who is the research coordinator at the Thünen Institute and part of the German MACS-G20 delegation, was responsible for the German contribution to that FLW Initiative. Since mid-2017, Germany has been financing the position of a coordinator. The coordinator is located at the Thünen Institute of Market Analysis in Braunschweig (Germany). This position is filled by Felicitas Schneider.

The aim of this report is to summarise already completed and ongoing activities derived from our FLW Initiative, to foster the sharing of knowledge and experience and to invite interested G20, further countries and stakeholders to participate in joint activities. The present report **provides a brief update and summarises the activities in 2024**. In addition, we asked our collaboration partners **to provide a brief insight into their activities beyond the Initiative as well as some country news** in order to provide a broader picture.

This report is published at the Thünen project site, at the MACS-G20 subpage of the Collaboration Initiative FLW and in addition sent out per e-mail to a selected group of interested people dealing with the issue of food loss and waste. Most of them participated in the kick-off workshop held from June 20th to 22nd 2017 in Berlin where participants from 17 countries as well as from FAO, OECD and EU-Commission were present. Furthermore, the report is sent out to the subscribers of our Global FLW Expert and Project database. If you are also interested in receiving information on the activities, please do not hesitate to contact the coordinator by writing an e-mail to felicitas.schneider@thuenen.de. You are always welcome!

[1] MACS means Meeting of Agricultural Chief Scientists, more details see here. G20 is the international forum which brings together more than 80 % of world GDP, 75 % of global trade and 60 % of the population of the planet. Further details see here.

If you are interested in learning more about our Initiative and if you wish to contribute, please do not hesitate to contact the coordinator. Furthermore, if you have additional ideas or wish to host a FLW workshop or contribute to the prevention of FLW with any other approach, please contact us!

The activities derived from the Collaboration Initiative FLW launched at MACS-G20 focus on G20 members but are not restricted to them. As the food supply chain is global, our activities also address global interaction and include non-G20 members in order to consider inter- and transdisciplinary issues, interactions between different levels of the food supply chain and the corresponding actors as well as the impact of local framework conditions. We are open for collaboration with any stakeholder along the food supply chain and as you will see in our presented activities in the present report, there are a lot of opportunities to tackle FLW together.

3 Overview on activities within the Initiative and beyond

Our activities - finished within this year as well as ongoing - are briefly described according to the main topics of the FLW Initiative (Figure 1).

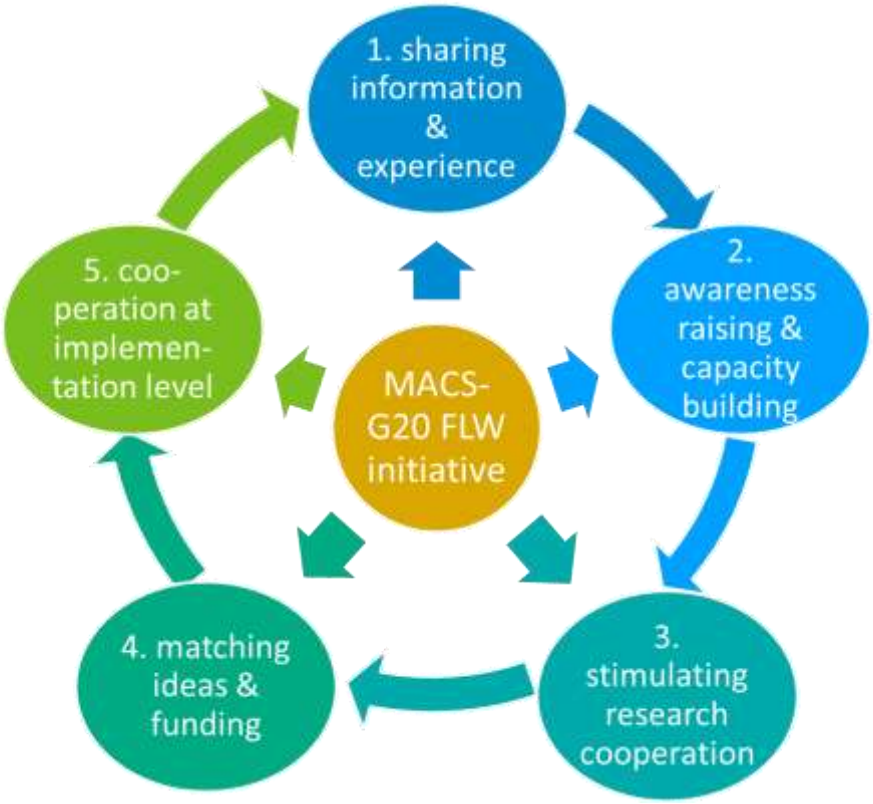

Figure 1 Scheme of the main topics of Collaboration Initiative FLW launched at MACS-G20

3.1 Topic 1: Sharing information & experience

3.1.1 Global Food Loss and Waste Research Platform

The Global Food Loss and Waste Research Platform is an international database where experts register in order to make their contact information and their FLW projects more visible on a global level. Aim of the online Platform is to offer easy access to focused information for policy decision makers, companies and researchers to facilitate network building, knowledge sharing and corresponding action.

Since its launch in spring 2016, 181 researchers from 46 countries entered their contact data into the database (Figure 2). In the past year, the number of researchers could be increased by 8 %. It can be seen that some countries such as Germany, Italy and Türkiye are very well represented while most countries contribute with one or two experts only. Our goal is to reach more experts in those countries and motivate them to register which could also foster national networks. Most of the 129 registered projects deal with the question on how to reduce FLW by quantity (72). The most targeted food product groups are vegetables (92), fruit (90) as well as cereal products (86).

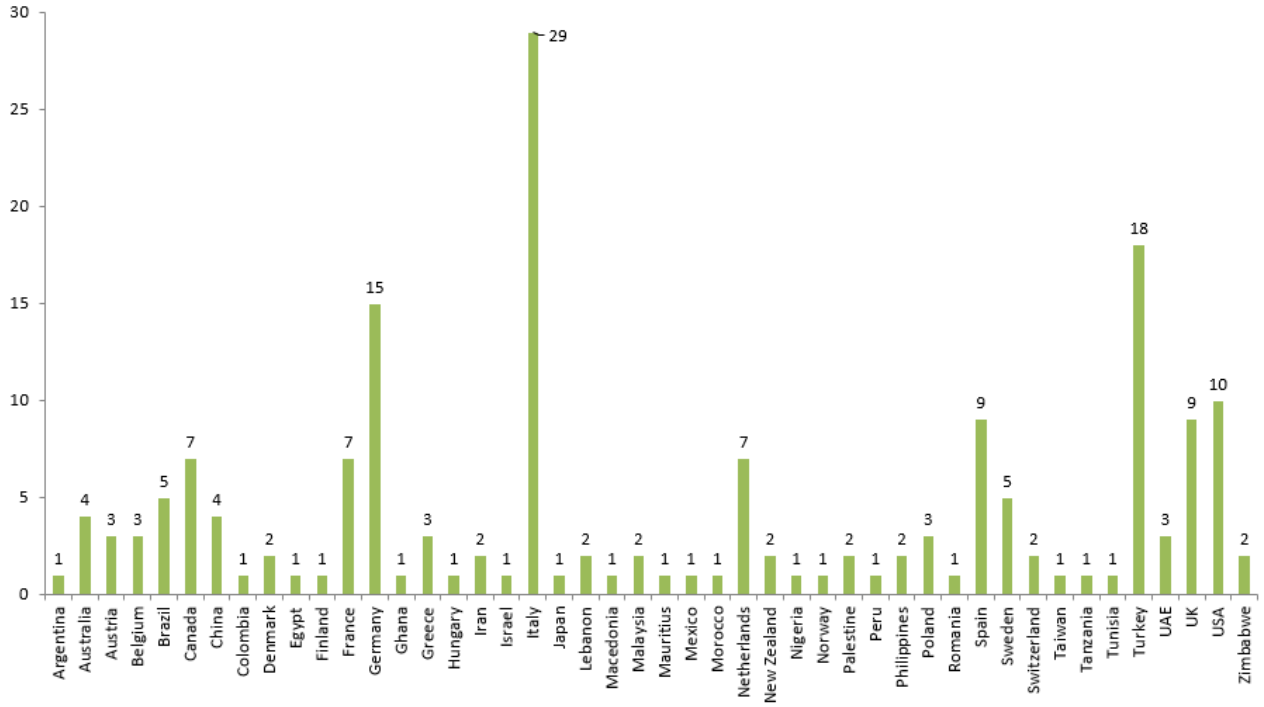

Figure 2 Countries and number of registered experts per country in the Global Food Loss and Waste Research Platform (as of mid December 2024)

In order to obtain evidence of the Platform's recognition at global level, a set of facts were assessed in relation to the website's access rates. From early December 2023 to early December 2024, 1,543 accesses from 92 different countries were counted for the website in total which represents a 34 % decrease of access compared to recent years. This is the first time since the development of the data base that a decrease was recorded. One reason could be that social media platforms become more and more relevant for searching for FLW experts. Figure 3 shows the visitors' countries of origin wherever this could be tracked. The majority of the visitors came from USA, China, Germany, Spain, Brazil, Canada, UK, Japan, and Italy with more than 40 different counts each. Looking at the origin of users by continents, the American continent ranks prior to Europe and followed by Asia. In total, all continents are represented by at least 34 unique accesses.

Most of the visitors we lost in comparison to the previous period were those who directly contacted our website (1,098 in 2024 instead of 1,854 visitors in 2023). In contrast, visitors redirected from other websites increased (from 17 % to 21 %), and those who found our website by using search engines also increased (from 5 to 8 %). For our activities we conclude that we are on a good way with citations of our website on websites of partnering organisations but that we should connect our Platform in our activities such as LinkedIn posts, press releases etc. to a larger extent in order to again increase our range and visibility.

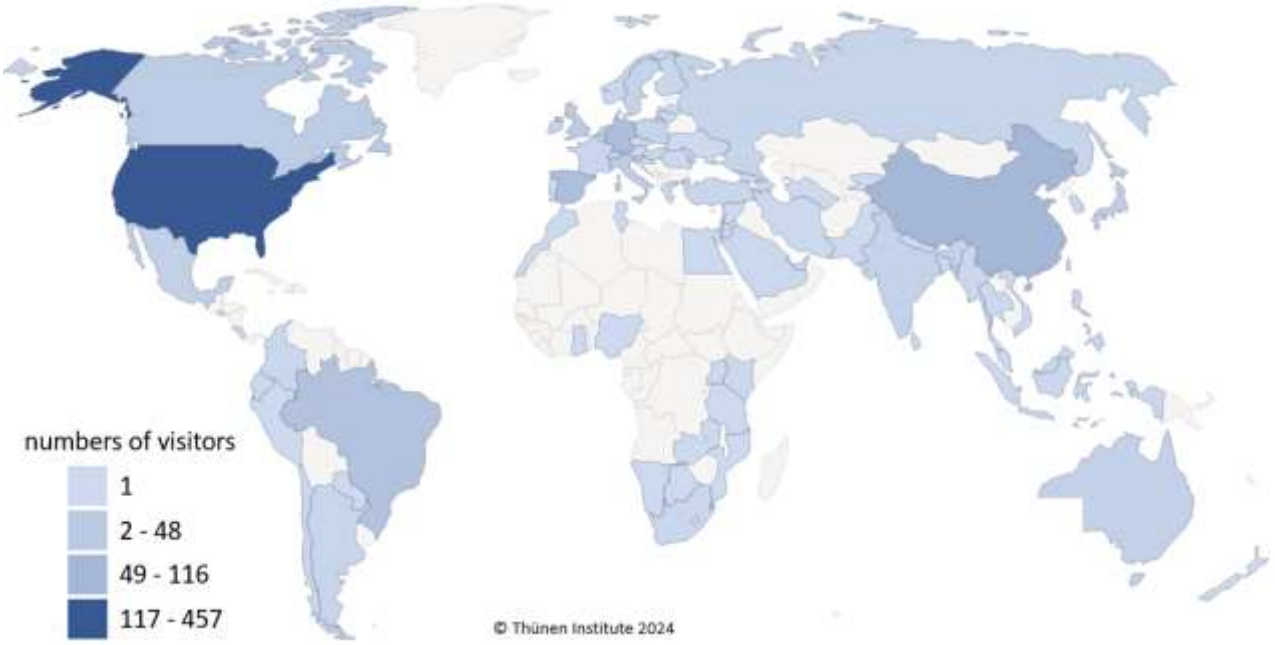

Figure 3 Numbers of visitors at the Global Food Loss and Waste Research Platform in 2024

3.1.2 G20 under the presidency of Brazil

The Brazilian G20 presidency in 2024 was promoting the slogan "building a more just world and a sustainable planet". The Meeting of Agricultural Chief Scientists of G20 (MACS-G20) took place from May 15 to 17th, 2024 in Brasilia. Stefan Lange as one of the German delegates and as Thünen research director connected to the Collaboration Initiative was invited to provide an update on the Initiative´s activities. You can find his presentation together with the inputs of other MACS-G20 delegates here. Please read more about our valuable cooperation with our Brazilian colleagues in chapter 3.2.1.

3.1.3 European Platform on Food Losses and Food Waste and European Food Waste reporting

The third year of the EU Platform FLW term 2022 to 2026 was characterized by interesting developments and joint meetings with other stakeholder groups. For more detailed information e.g. on agendas, recordings and presentations of all platform meetings or the list of members for the different sub-groups, please see the official website. Our coordinator Felicitas represents the Thünen Institute on the EU Platform as well as the sub-groups “monitoring”, “action and implementation” as well as “consumers”. In the last plenary meeting, the decision was communicated that the subgroup “date marking” will end by end of 2024 and the tasks will be handed over to the subgroups “action & Implementation” as well as “consumer FW prevention”.

The subgroup “monitoring” was co-chaired by the German Ministry of Food and Agriculture and Harokopio University in Greece in 2024. In the online meeting of the subgroup on July 11, 2024, our colleague Manuela Kuntscher presented the reporting methodology applied within the German voluntary agreement wholesale and retail (called Pact) to the European auditorium.

The European Consumer Food Waste Forum finished its work in June 2024 with a public event Let’s reduce consumer food waste! and the launch of the Toolkit website in Brussels.

The third obligatory European food waste reporting for the year 2022 showed a stable food waste generation per capita, with 132 kg per inhabitant (2020: 127 kg/cap.yr, 2021: 131 kg/cap.yr) according to European Statistical Office (Eurostat). In addition, the share of the different levels of the food supply chain did not vary significantly: households contribute with 72 kg/inhabitant (54 %), food processing with 25 kg/inhabitant (19 %), primary production with 10 kg/inhabitant (8 %), food service with 15 kg/inhabitant (11 %) and finally retail and other distributions with 11 kg/inhabitant (8 %). Those figures have been rounded.

It has to be mentioned that only two members states (Greece, Lithuania) did not submit new data for 2022, thus data sets from 2021 were used to calculate the European averages. Romania is the only MS who did not submit any data so far. Iceland reported its FW data for the first time. More information can be found at the corresponding website of Eurostat.

The Joint Research Centre (JRC) presented an update of the European food use and waste hierarchy which specifies clearly which actions and technologies are accounted as prevention or waste treatment options. More information related to the hierarchy and further reports can be found here. The discussion about an amendment to the European Waste Framework Directive, which provides for mandatory food waste reduction targets for the member states of the European Union, has not yet been finalised. An update can be found here.

3.1.4 Update on FLW activities in Argentina[2]

In addition to the traditional work of the National Agricultural Technology Institute Argentina (INTA) on specific activities related to the Prevention and Reduction of Food Loss and Waste, researchers from different locations participated in a nationwide project approved in 2019 addressing this topic. The name of the proposal is "Strategies to prevent and reduce food losses and waste (PDA) - Rescue of non-marketed foods and valorisation of co-products", and it aims to develop and implement strategies to significantly reduce food loss and waste (FLW) in the agri-food sector. By focusing on prevention, recovery, and valorisation of food and by-products, the project seeks to contribute to a more sustainable food system. The key objectives are:

- **Reduce food loss**: Develop methods and technologies to minimize food losses at every stage of the food supply chain.
- **Valorise by-products**: Transform food waste and by-products into valuable products, promoting a circular economy.
- **Foster collaboration**: Encourage cooperation among government, industry, civil society, and academia to address FLW collectively.

The project acknowledges the significant global issue of food loss and waste, citing the FAO's estimate that one-third of all food produced is lost or wasted, and aims to address the underlying causes of FLW, including:

- **Lack of coordination**: Insufficient collaboration among stakeholders.
- **Need for tools**: A shortage of specific methods and technologies for food waste management.
- **Missed opportunities**: Underutilization of food waste and by-products.

The four main components are:

1. Research and development: generating new knowledge and technologies
2. Training and education: building capacity and awareness among stakeholders
3. Partnerships: collaboration with key stakeholders to implement solutions
4. Innovation: development of innovative approaches to address FLW.

[2] This section was provided by Dr Gustavo Polenta and Adriana Pazos from National Agricultural Technology Institute Argentina (INTA).

The project proposes different actions, divided in strategies of Prevention: implement measures to prevent food loss at all stages of the supply chain; Recovery: develop technologies to recover food that is still safe for consumption (Figure 4); Valorisation: transform food waste and by-products into new products or ingredients (Figure 5); and Knowledge Transfer: generate and disseminate information to promote innovation and best practices. It takes a comprehensive approach, considering the economic, environmental, and social dimensions of FLW. By involving various stakeholders and promoting innovation, the project aims to achieve a more sustainable and efficient food system.

Figure 4 Use of carrot discards from produce not attaining commercial standard for transformation into food for mass consumption (Credit: Nora Aimaretti, EEA Rafaela, Province of Santa Fe, INTA).

The expected benefits are ambitious, seeking a significant reduction in food waste (less food will end up in landfills), an improved efficiency (optimized resource use and reduced costs in the supply chain), a contribution towards the economic growth (creation of new business opportunities and job creation) and towards the environmental sustainability (reduced environmental impact of food production and consumption) and a social impact (contribution to food security and poverty reduction).

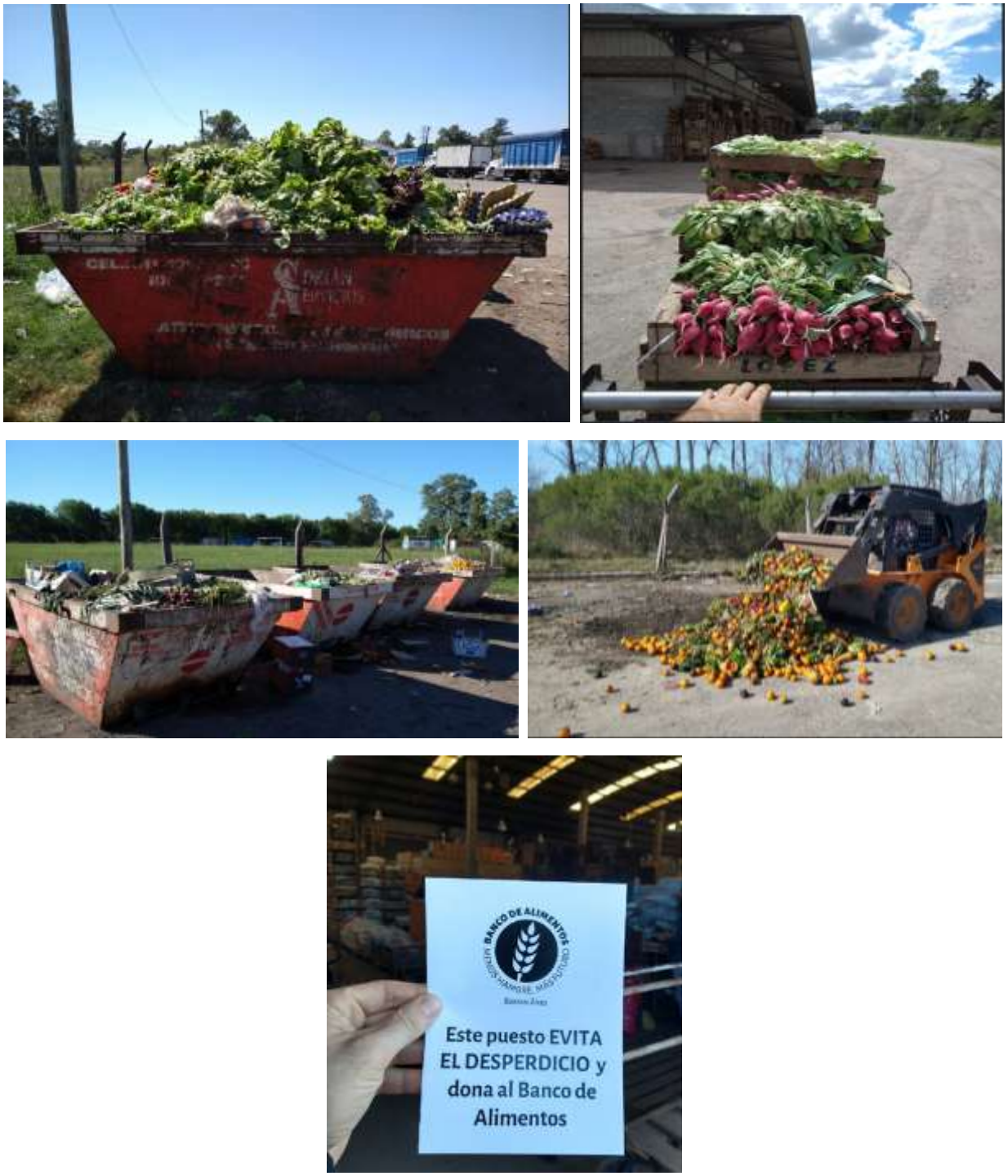

Figure 5 Diagnostic, recovery and valorization of unsold food from the wholesale market Pilar, Province of Buenos Aires (Credit: Martín Bruno, EEA AMBA, INTA).

3.1.5 Update on FLW activities in Brazil[3]

3.1.5.1 Embrapa´s participation in international dialogues on FLW

As part of the celebrations of the 30th anniversary of the SESC Mesa Brasil program, the biggest network of food banks in Brazil, the Social Service of Commerce – SESC and The Global Foodbanking Network (GFN) hold the "International Food Systems Seminar: Opportunities to Combat Hunger and Food Waste in Brazil" at SESC Belenzinho, in São Paulo, on August 6th. Dr Gustavo Porpino, researcher from Embrapa Foods and Territories, presented opportunities for municipalities to foster circular food systems (Figure 6). The seminar highlighted the Global Atlas of Food Donation Policy, developed by GFN and Harvard Law School, through a partnership with SESC, which detailed the legislation and public policies in this area in force in 24 countries, including Brazil, in addition to making recommendations to minimize food waste in these locations.

Figure 6 Dr Porpino presenting at SESC international seminar (credit: SESC).

The governance of urban food systems and good practices to catalyse circularity were also the focus of a debate at the Lake Week, held at the Future of Food campus from ZHAW (Zurich) in January 2024. Dr Porpino presented results of the Cities and Food project which involved five Brazilian cities and the European cities of Valencia, Barcelona, Turin, Milan and Ghent (Figure 7).

[3] The following section was kindly provided by Gustavo Porpino (Embrapa Foods and Territories/Brazil), Carmem Priscila Bocchi (Brazilian Ministry of Development and Social Assistance, Family and Fight Against Hunger – MDS) and Edilson Fragalle (Embrapa).

Figure 7 Dr Porpino shared Cities and Food project results at ZHAW conference (credit: ZHAW).

The Institute of Development Studies (IDS) in Brighton (UK) also hosted international seminars on food security, food sovereignty and inequalities involving several Brazilian, Canadians and British researchers in June 2024. Food waste and hunger were topics debated with public agents, NGOs and researchers. Gustavo Porpino discussed the role of public policies to foster sustainable urban food systems (Figure 8).

Figure 8 Dr Porpino presenting at international seminar in Brighton (credit: IDS).

Furthermore, a lecture on "Food Losses and Waste" was given by Embrapa researcher Dr Gilmar Henz at the IX Brazilian Armed Forces Food Seminar, held in Brasília-DF on June 2024. Murillo Freire, a researcher from Embrapa Food Technology, joined a seminar with food banks in Santiago (Chile) in September.

3.1.5.2 Embrapa's post-harvest course wins Latin American education award

The online Post-harvest Technology Course for Fruits and Vegetables, organized by Embrapa Instrumentation (São Carlos – SP), was the winner of the 1st edition of the "GS1 Latam Excellence Award", in the Academic and Professional Excellence category. The ceremony was held on October 23rd, 2024 during the GS1 Latam Regional Forum in Bogotá (Colombia), which brought together representatives of the GS1 Latin American and GS1 Global

Organizations (Figure 9). The award ceremony included four other categories: Entrepreneurial Strategies, Innovation and Digital Transformation (won by representatives from Brazil); Logistics Excellence (Argentina) and Sustainability (Peru).

Offered on Embrapa's distant learning platform e-Campo, the free course trains rural producers and extension workers in techniques to improve post-harvest practices aimed at reducing food losses and improving quality. It has reached 9,055 registrations from all Brazilian states and 11 other countries in Latin America - there are registrations from Argentina, Colombia, Ecuador, Honduras, Paraguay, Peru and Uruguay.

Figure 9 Embrapa´s post-harvest course wins Latin American education award (credit: Edilson Fragalle).

The Traceability module is the most accessed, with 5,016 registrations and also the one with the highest completion rate - around 60% - with 2,977 certificates already issued. “In practice, with the support of GS1 Brazil and the Ministry of Agriculture and Livestock, the result is the transfer of technology of traceability itself, of how it works, of legislation, of how to apply GS1 standards to small, medium and large producers”, explains researcher Marcos David Ferreira, coordinator of the training.

3.1.5.3 Brazil develops new food waste mitigation strategy

In 2024, the Ministry of Development and Social Assistance, Family and Fight Against Hunger (MDS) and Embrapa coordinated the Working Group responsible for updating the Intersectoral Strategy for Reducing Food Losses and Waste in Brazil. The WG is part of an effort from the Brazilian Interministerial Chamber of Food Security and Nutrition (CAISAN) to expand the offer of healthy foods and to accelerate the implementation of circular food systems.

The group was divided in the following thematic areas: food production and post-harvest; distribution and wholesale; retail and food services; cities; consumption; food redistribution and legislation. The work resulted in a Presidential Decree formalizing the document and several implementation strategies are outlined to be conducted from 2025 to 2027.

3.1.5.4 Call for Proposals for the Modernization of Brazilian Food Banks

In October 2024, the Brazilian Ministry of Development and Social Assistance, Family and Fight Against Hunger (MDS) published a call for proposals for the modernization of food banks. With investments of R$8 million, the initiative aimed to promote the modernization of these facilities linked by public administration agencies (states,

municipalities, the Federal District or public consortiums), prioritizing those located in Food Supply Centers and in municipalities participating in the “Alimenta Cidades” strategy (Feeding Cities), a new program that involves 60 cities and includes the reduction of food waste as one target.

The initiative selected 13 food banks to receive financial support. The support will finance projects that include the preparation of architectural and engineering plans, execution of renovation and expansion works. It will also be possible to acquire permanent materials, equipment and vehicles.

3.1.5.5 Brazilian network of food banks

Within the scope of the Brazilian Food Bank Network, coordinated by MDS, several meetings were held (Figure 10) and the Network Operating Decree and the Bank Adhesion Ordinance were updated, with the purpose of improving the network's performance and the articulation between them. The network's management committee involves representatives from municipalities, the NGO Banco de Alimentos, SESC Mesa Brasil and Embrapa.

Figure 10 Brazilian Food Banks meeting (credit: MDS).

3.1.5.6 Alimenta Cidades (Feeding Cities Strategy)

The “Feeding Cities” Strategy is being implemented by the MDS and its main objective is to increase access to healthy food for low-income populations living in the outskirts of large cities. The Strategy has seven axes and one of them is the implementation of food waste reduction plans for local governments. In October 2024, a workshop was held with managers from 60 municipalities in Brasília, where the Intersectoral Strategy for Reducing Food Waste in Brazil was presented and the main measures that municipalities could adopt to address the problem of food waste were discussed (Figure 11). Carmem Priscila Bocchi (MDS) and Gustavo Porpino (Embrapa) debated with Adriana Figueira (Secretary of Urban Agriculture from Recife) and Ronildo Assis (coordinator of the food bank from São João del Rey) opportunities to replicate innovative programs such as "Recolheita", which mitigates the waste generation from street markets in Recife, and "Colheita Solidária", a new model of public food procurement to avoid losses resulting from the lack of market access among smallholders.

Figure 11 Panel (left) and family photo (right) at the Feeding Cities seminar (credit: MDS).

3.1.5.7 Brazilian Pact Against Hunger awards initiatives against food waste

Initiatives that promote food security and reduce food waste were recognized by the “Pacto Contra a Fome” Award at a ceremony held on December 3 in São Paulo. 512 projects from all 27 Brazilian states competed for six R$100,000 prizes to scale up the initiatives and foster new partnerships (Figure 12).

Held by the Pacto Contra a Fome Institute, one of the collaborators of the Brazilian edition of the Workshop on food losses and waste aligned to the MACS-G20 cooperation, the award had the collaboration of four UN agencies: FAO, UNEP, World Food Program (WFP) and UNESCO.

In the Promotion of Food Security category, the following were awarded: “Instituto Kairós Ética e Atuação Responsável”, “Associação Gap Ey” and “Centro de Desenvolvimento Agroecológico Sabiá”.

The first initiative delivered 290,000 high-nutritional meals and 22,000 baskets of produce without pesticides in the outskirts of São Paulo. The Gap Ey Association, which operates in Rondônia, created a production model to eliminate hunger for more than 1,500 people, with an expansion to three other villages.

The Sabiá Center, in Pernambuco, affected 5,000 people by implementing an irrigation system in the Brazilian semiarid region, with 600 agroforestry systems.

In the category of Reduction and/or Reversal of Food Waste, the following were recognized: “Instituto Dragão do Mar”, “Metamorfose” and “Iprede (Instituto da Primeira Infância)” — all from the state of Ceará.

The school of social gastronomy (Dragão do Mar) promotes educational activities that strengthen food culture, impacting 91 thousand people in classes in 22 states. Metamorfose distributed more than 57 tons of fruits and vegetables, which would otherwise be thrown away, to communities that make a living from fishing.

Iprede uses technology to fully utilize surplus food from supermarkets, having impacted 10 thousand people and distributed 190 thousand liters of soup.

"The award reinforces our commitment to giving visibility to initiatives that contribute to promoting positive transformations, collaborating to reduce social inequalities and environmental impacts in Brazil," emphasizes Geyze Diniz, co-founder and president of the board of the Pacto Contra a Fome Institute.

Figure 12 Family photo of initiatives awarded with the Pact against Hunger Prize (credit: Fernanda Scott).

3.1.6 Update on FLW activities in Canada

3.1.6.1 Agriculture and Agri-Food Canada: technological platform for the simultaneous calculation of indicators [4]

The full name of the task conducted by Agriculture and Agri-Food Canada is "Implementation of a technological platform for the simultaneous calculation of indicators of eco-efficiency, food loss and waste, nutritional value, safety and shelf-life resulting from the integration of the Circular Agri-Food Systems concept along the continuum of the Canadian value chain (see also previous annual reports). This project, launched in 2023, is led by Dr Louis Sasseville and co-led by Dr Sebastien Villeneuve. Both are located at the Saint-Hyacinthe Research and Development Centre. This year, the team has worked on the design, development and implementation of a computerized decision- support tool to quantify the benefits associated with the implementation of Circular Agri-Food Systems approaches. A hierarchical decision tree has been elaborated to assess and to quantify the five performance indicators (Figure 13).

[4] The following section was written by Dr Sébastien Villeneuve from Saint-Hyacinthe Research and Development Centre in Quebec, Canada.

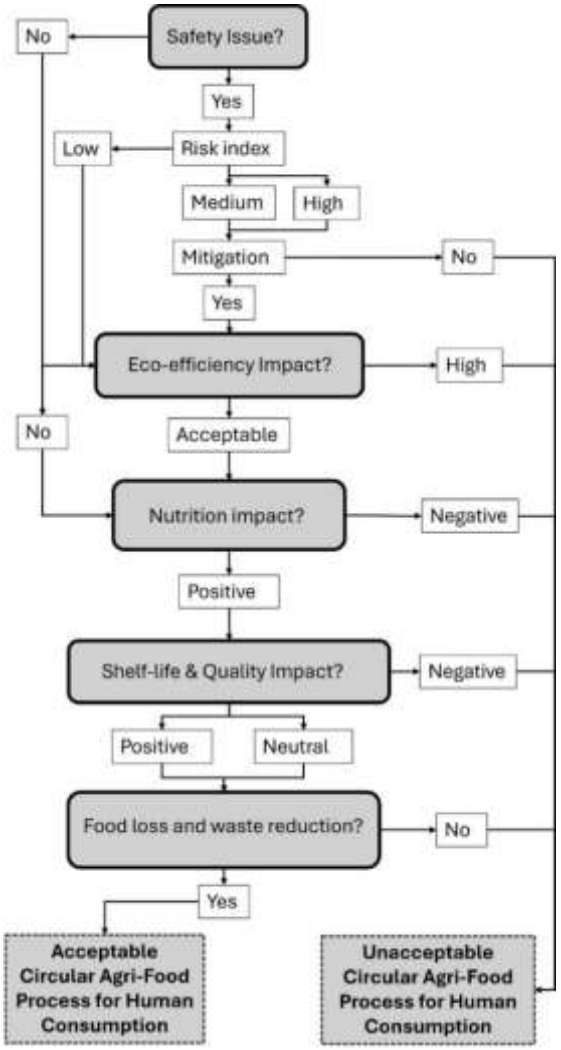

Figure 13 Hierarchical decision tree used for the assessment and calculation of performance indicators in the Circular Agri-Food Systems approach (source: Saint-Hyacinthe Research and Development Centre).

Many promising sectors for the integration of a Circular Agri-Food Systems approach are studied through an integrated pilot scale process (Figure 14): dairy industry, field crops (cereals, pulses, oilseeds) and fruit production. Preliminary results from the integrated pilot scale process already allow to target some Circular Agri-Food Systems approaches that will enable the sector to thrive economically while reducing greenhouse gas emissions by 2030 and to contribute to a clear and common vision across the Canadian value chain.

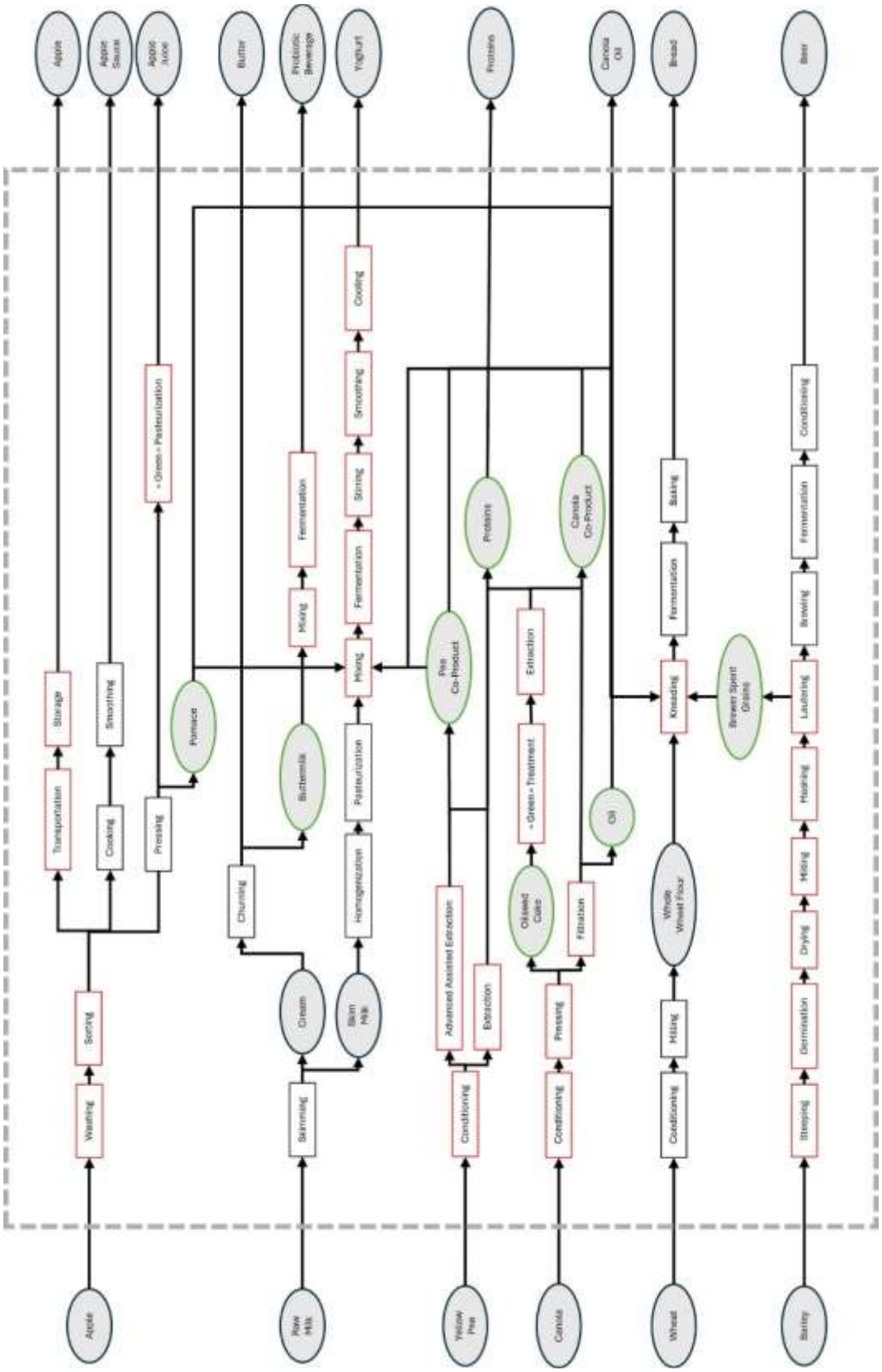

Figure 14 Circular Agri-Food Systems approach tested at the pilot scale level in an integrated process; Green: Co-Product development; Red: Performance indicators assessed and quantified for each unit operation (soucre: Saint-Hyacinthe Research and Development Centre.

3.1.6.2 Can waste streams be used to further reduce waste along the food value chain?[5]

It seems like our planet is reaching a tipping point in history where our response to climate change and global warming can no longer be deferred. Recent global climate events including higher temperatures, shifting rainfall patterns, extreme weather events and rising sea levels are testament to this rapidly changing climate. Evidently, there is no silver bullet in our effort to mitigate these challenges. Since the anthropogenic nature of these climatic occurrences are well-established, it seems plausible that adjusting our human activities could be one of the viable solutions.

Waste streams are inevitably produced along the food value chain. It has been reported that up to one-third of food produced and intended for human consumption ends up in the landfills, generating an estimated 8 to 10% of global greenhouse gas. In fact, when food is wasted/lost, all the resources used to produce, process and transport them are also wasted leaving behind significant carbon footprint at the expense of the planet. As such, reducing food loss/waste through circular economy approaches could play an important role in mitigating the associated economic, social and environmental implications of this human activity.

In the past year, the work in my program has been focusing on diverting these food secondary streams away from the landfills back into the food value chain. Most importantly, recycling these waste streams as a resource to further reduce waste along the food value chain. Our works have been focussing on utilizing some low value streams from the meat processing industry (in this case, collagen from beef hide and plasma from blood) in the fabrication of edible/biodegradable film/coating (Figure 15). Also, to add value to plant-based by-products, glucosinolates from hull and anthocyanins from select berry pomace are being used as bioactive ingredients in intelligent/active films and as ingredient in beef burger/sausage formulations.

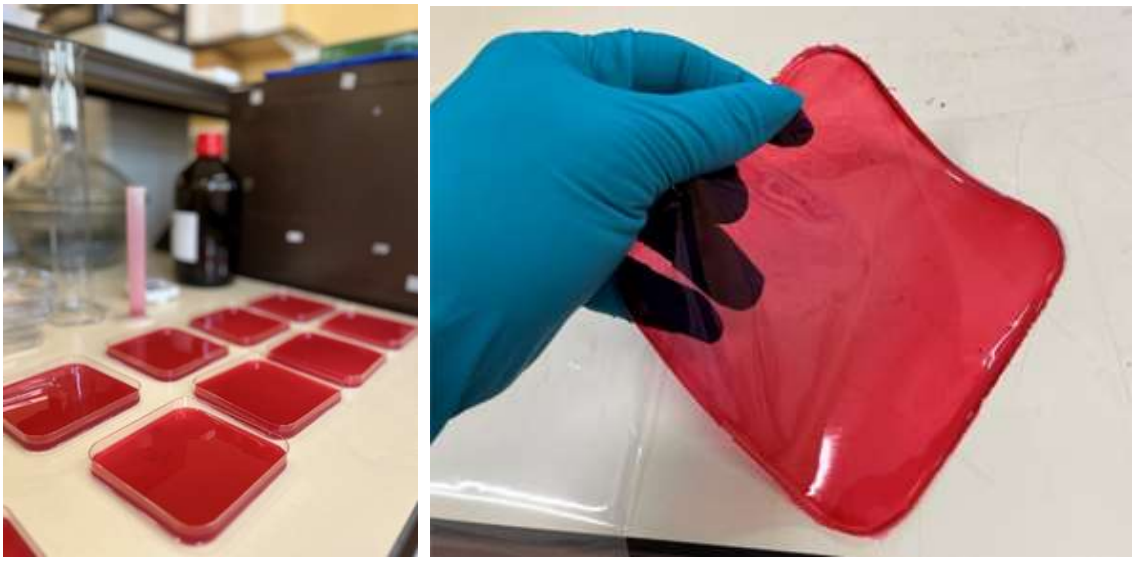

Figure 15 Edible biodegradable film produced from low-value meat processing streams (credit: Philip Soladoye).

Now back to the question: can waste streams be used to further reduce waste along the food value chain? The answer lies hiding in the ongoing research in my program and the outcome will be communicated in the next editions of this report. The possibility of using these waste streams to further reduce waste along the food value

[5] This section was provided by Dr Philip Soladoye from Lacombe Research and Development Centre at Agriculture and Agri-Food Canada.

chain aligns well with the concept of circular economy and could be one of the viable approaches to tackle the issue of climate change and achieve the Sustainable Development Goal 12, target 12.3.

3.1.7 Update on FLW activities in China[6]

Since 2020, the Sino-German Agricultural Centre (DCZ) has been promoting Sino-German collaboration on reducing food loss and waste as one of its focus areas. In addition to attending and organizing events on the issue with relevant partners from Germany and China, DCZ monitors regulatory advances in China that seek to reduce food loss and waste.

3.1.7.1 New regulations

In China, food loss and waste are most prevalent during post-harvest handling and storage, with fruits and vegetables contributing significantly. Since 2021, the **Anti-Food Waste Law** has served as key regulation targeting loss and waste along the food value chain.

In June 2024, the **Grain Security Law** introduced further measures. It focuses on post-harvest losses by supporting advanced harvesting technologies and on-site drying techniques to improve grain storage and quality. An updated version of the Action Plan on Food Loss and Waste Reduction, first released in 2021 and updated in November 2024, sets new targets to bring food loss and waste rates below the global average by the end of 2027.

Additionally, **GB 7718** (General Rules for the Labelling of Pre-Packaged Foods) , introduced in 2024 by the State Administration for Market Regulation (SAMR), mandates clear labelling of production dates and shelf life on pre-packaged foods, addressing consumer confusion over product freshness. In addition, the **GB 43284-2023** standard on Excessive Packaging for Fresh Agricultural Products came into force in 2024, aiming to reduce material usage while ensuring better protection of goods during storage and transport.

3.1.7.2 Dialogues and events

In 2024, DCZ has maintained active dialogue with international organizations like FAO and UNEP, which manage the SDG 12.3 food loss and waste index reports. Additionally, DCZ collaborates with civil society groups like Foodthink, RARE, and Good Food Fund. At the latter's **Good Food Summit** from 1 to 3 November, DCZ science coordinator Eva Sternfeld discussed with Chinese and international experts how shifting diets to regional, plant-based foods can reduce food waste and offer health and environmental benefits (Figure 16).

On November 18, DCZ experts Michaela Boehme and Ahmatjan Rouzi participated in panel discussions at the **Save Food China Forum**, exploring the role of packaging in reducing food loss and waste across the entire food value chain, from post-production to consumption (Figure 17). The forum was organized by FAO China and the multi-stakeholder Save Food Initiative.

In the catering sector, the EU SWITCH-Asia **Pride on Our Plates** project, led by Shenzhen One Planet Foundation (OPF), WWF Beijing Office, Rare Europe, and Rare China Center for Behaviour, aims to assist China's MSME restaurants in reducing food waste. As a stakeholder, DCZ will attend the project closing event taking place in Beijing in December 2024. The event will serve as a platform for sharing valuable insights and building networks.

[6] This section was contributed by Michaela Boehme (DCZ) and LI Shiyang (Rare).

Figure 16 DCZ science coordinator Eva Sternfeld (left) at Good Food Summit (credit: DCZ)

Figure 17 Save Food China Summit with representatives from FAO, Save Food Initiative and other Chinese and international organizations (credit: SWOP)

3.1.8 Update on FLW activities in Ecuador[7]

The **Integrated Management of Food Systems, Transitions, and Sustainability Research Group (GISAT)**, part of the PhD Program in Technological Management, is actively engaged in research initiatives focusing on sustainable food system management to reduce food loss and waste (FLW).

Xavier Oña Serrano and Oswaldo Viteri Salazar, professors at Ecuador's Escuela Politécnica Nacional de Ecuador (EPN), presented the paper "Integrated Food Waste Management in Quito: A Multidimensional Approach" at the **Regional Workshop on Food Loss and Waste Prevention in Latin America and the Caribbean**, held in Brasília (see chapter 3.2.1, Figure 18). Their presentation emphasized the need for a holistic approach to addressing food waste in Quito.

[7] This section was provided by Oswaldo Viteri Salazar, Xavier Oña Serrano, Lucía Toledo, Amanda Cañar (Integrated Food Systems Management Initiative), and Alicia Guevara (Quito Food Bank) from Escuela Politécnica Nacional (EPN).

Figure 18 Participation of Professors Xavier Oña Serrano and Oswaldo Viteri and Alicia Guevara (Quito Food Bank) from Escuela Politécnica Nacional (EPN), in the Food Loss and Waste Prevention in Latin America and the Caribbean, Brasilia (credit: GISAT)

The **Quito Food Bank (BAQ)**, an initiative led by EPN professors, has been operating for over 21 years in Ecuador's capital. Its mission is to raise community awareness about the importance of preventing food loss and waste to improve food security for vulnerable populations. The BAQ manages food donations, collects, rescues, classifies, and selects food items to distribute them to those in need. It stands as a leading organization in Ecuador's fight against hunger, malnutrition, and food waste. By October 2024, the BAQ had recovered over 40 million food servings, distributed monthly to more than 85,000 people. Its efforts have prevented the unnecessary emission of at least 2,235 tons of CO_2 equivalent.

Students enrolled in the Ecology and Environment course participate in food rescue efforts at Quito's wholesale market to foster environmental awareness (Figure 19). They are also actively involved in implementing the "Multiplier Plan for the Responsible Consumption Campaign."

Figure 19 EPN students collaborate in food rescue for the BAQ. (credit: GISAT)

Below is a summary of **research projects** currently underway, addressing food sustainability, agricultural development, and resource management:

- Food System Management in Quito Metropolitan District: Investigates FLW, representing 30% of global production. It aims to characterize Quito's food system, identify vulnerabilities, and assess public policies' impacts on FLW management.
- Analysis of Urban and Peri-Urban Agriculture as a Sustainable Development Model: Evaluates urban and peri-urban agriculture in Quito as a sustainable model. It examines natural resource impacts, organic waste management, and informs public policies that promote food security.
- Innovation Management in Processes and Organization at the Quito Food Bank (BAQ): Explores BAQ's innovative management practices, identifying improvements in processes and organization. It evaluates BAQ's contributions to food sustainability.

On November 20, 2024, an **Awareness talk** was held in Quito for 90 sixth-grade students, addressing food loss and waste. The event aimed to raise awareness among young people about reducing waste and fostering sustainable practices (Figure 20).

This **doctoral thesis** examines food waste in households within the Metropolitan District of Quito, quantifying its magnitude and the factors influencing it. The research, using a mixed-methods approach, estimated food waste levels in households, evaluated influencing factors, determined associated environmental pressures, and analysed waste within the social metabolism framework of the city.

Figure 20 Awareness talk about food waste (credit: GISAT)

The scientific article "Gestión de residuos sólidos urbanos y factores de desperdicio de alimentos en Quito" explores the issue of food waste (FLW) and its impact on urban solid waste (USW) management in Quito, Ecuador. The study focuses on the organic composition of USW, with 65% derived from food scraps, leading to negative environmental effects. The research aims to evaluate the factors influencing FLW in Quito households and to characterize the management of USW in the city.

Conclusion: The Integrated Management of Food Systems, Transitions, and Sustainability Research Group is actively engaged in research and outreach initiatives aimed at reducing food loss and waste in Ecuador. Their work is crucial in addressing the challenges of food security, environmental sustainability, and climate change.

3.1.9 Update on FLW activities in Germany

3.1.9.1 German National Strategy for Food Waste Reduction

The **German National Strategy for Food Waste Reduction** has been in place since 2019. In 2024, there were some interesting updates achieved:

(1) The strategy is implemented by the **Too good for the bin campaign** (Zu gut für die Tonne) which was initially started in 2012. In the course of 2024, the campaign was reorganised resulting in new brochures, posters, educational materials etc. available for multipliers, teachers, companies and the general public. The campaign´s website is offered in German only.

(2) After the final approval of the **voluntary agreement in German wholesale and retail** (VA, called Pact) in June 2023, Thünen Institute started its monitoring activities related to the implementation of this agreement. The companies reported data on their sales losses (write-off rates), food donations and the distribution of food as animal feed as well as information related to implemented prevention measures. The Thünen Working Paper No 250 (English abstract) summarises the results of the first data collection round within the Pact for the year 2023. The total rate of unsold groceries weighted according to turnover was 1.71 % across all companies in 2023. Less than 25 % of this was passed on as food or feed, while the rest was disposed of as food waste. In 2023, the reduction weighted according to turnover was 24 % across all companies as a result of a set of mandatory and voluntary prevention measures. More information on that implementation of the Pact can be found on the project website.

(3) In 2022, a **Centre of Excellence for Food Service To Reduce Food Waste** (CoE) was established to accompany e.g. restaurants and canteens on their way to reduce food waste and to collect FW monitoring data. In this centre, Thünen Institute is engaged in cooperation with our partner United Against Waste e.V. Our publication shows that two canteens serving up to 1800 people per day could reduce their FW by 46 % over six months. The Benefit-to-Cost Ratio was calculated being 0.03 kg of FW saved for each invested Euro. The final report is available in German with an English abstract. Updated information is also available on the project website in English.

(4) The **private household´s platform 2.0** started in October 2023. Its aim is to further connect stakeholders along the supply chain influencing private household food waste behaviour, introduce a FW measurement feature into the existing app and use this tool for further evaluation of implemented measures on household level. An expert panel was also established to support the work of the consortium consisting of Technical University Berlin and Slow Food Germany. In 2024, focus was laid on the content design and technical implementation of the app. More information can be found on the website of the strategy (in German only).

(5) As a result of previous dialogues for specific sectors along the food supply chain, a new **intersectional approach "Together against food waste – dialogue for a new food appreciation chain**" was started in early December 2024 by the German Ministry of Food and Agriculture. Aim is to support knowledge exchange between actors, identify and prioritise prevention opportunities, develop effective and efficient solutions and facilitate cooperation. The website is in German only.

3.1.9.2 XXL-Refrigerator Roadshow with the Consumer Advice Centers[8]

The German Consumer Advice Centers ("Verbraucherzentralen") are consumer organizations and cooperate in a project funded by the Federal Ministry of Food and Agriculture on the topic of food waste and how to prevent it. Reducing Food waste begins with the correct storage of food. The initiative Zu gut für die Tonne! (Too Good for the Bin) continually tries to emphasize this message: On behalf of the Federal Ministry of Food and Agriculture (BMEL), the initiative sent a giant fridge on a nationwide tour this summer. From August 14 until October 17 2024, the XXL fridge went to Berlin, Halle, Saarbrücken, Mönchengladbach, Mainz, Lüneburg, Bonn, Nuremberg, and Erfurt (Figure 21).

The fridge was professionally managed by the local Consumer Advice Centers. Staff were available to provide helpful everyday tips and educate on food appreciation. Alongside information provided by the staff, the fridge could also be explored audio-visually: Through visually designed scenes and audio content, it provided information on the proper storage of food.

The Consumer Advice Centers had many conversations with people from all age groups. From young families to seniors, they were all curious about the fridge. The animated food scenes especially were an eye catcher for children.

Figure 21 German Consumer Advice Centers in action with the XXL refrigerator in Lüneburg (left, credit: VZ Niedersachsen) and in Erfurt (credit:VZ Thüringen)

Media coverage on the radio and local newspapers attracted many people and raised awareness about the fridge. School classes also came by and learned about the topic of food waste. During its nationwide tour, the XXL fridge brought the issue of food appreciation directly to consumers and lead to many "Aha" moments.

Further information and tips from the consumer protection organizations regarding food waste and food appreciation can be found here (in German). Information provided by the Initiative Zu gut für die Tonne! can be found here (in German).

[8] This section was provided by Dr Janina Willer, VZ Lower Saxony with translation by Bethel Yonas, VZ Bremen.

3.1.9.3 Food Council Braunschweig and Braunschweig region

As reported in our 2022 annual report (chapter 3.1.7), the Collaboration Initiative co-funded the **Food Council Braunschweig and Braunschweiger Land** (so-called **ERBSL**) in November 2022. The aim is to make food supply in the Braunschweig region more sustainable and socially just. The ERBSL is open for all citizens living in the Braunschweig region and financially supported by the City of Braunschweig. The different working groups of ERBSL were again very active in 2024 by supporting other local food related initiatives, participating in selected decision-making committees of the city and organising awareness raising events towards food and nutrition. End of 2024, ERBSL developed further and was to be registered as an independent non-profit organisation. This will enable ERBSL to apply for funding and increase visibility of the overall activities.

The success of the **Good Food Festival** organised under the umbrella of the ERBSL was continued. For a second time, various food related initiatives across Braunschweig region cooperated in 15 events in September 2024. The type of events varied from workshops how to build a raised bed for your garden, sharing cooking recipes for vegan spread, workshops addressing fermentation of beverages, enjoying a fair dinner cooked only from fair traded ingredients, a guided tour to an organic farm, fishing and cooking of underexploited local fish species or guided bicycle tours to unharvested public fruit trees. Of course, a snip party was also part of the Good Food Festival (see chapter 3.2.1). In addition, a classic concert addressing beauty of nature was connected to an exhibition and discussion related to food loss and waste prevention and food sharing activities.

The **ERBSL working group Food Waste** was renamed to **Food Rescue** and was very active with the implementation of a series of activities in 2024 as well. It is chaired by our coordinator Felicitas and increased number of activities due to the motivation and enthusiasm of its great members. We co-organised smaller snip parties in cooperation with selected grass root organisations and local church communities and supported other Good Food Festival events, continued valuable discussion with the City of Braunschweig and provided awareness raising at climate concerts.

3.1.9.4 Global Forum of Food and Agriculture 2024

The Global Forum for Food and Agriculture (GFFA) is an international conference related to global agricultural and food policies. Hosted by the Federal Ministry of Food and Agriculture (BMEL) in cooperation with the Berlin Senate and Messe Berlin GmbH it is held in Berlin on an annual basis. In previous years, high-level guests from international organisations and politicians contributed to the event as speakers. GFFA is also the event where the world's largest informal conference of Agriculture Ministers takes place.

Besides other parts, interested parties are invited to apply for organising Expert Panels as well as contribute to the Innovation Forum exhibition. Especially young scientists are called to introduce their field of research in the GFFA Science Slam.

"Reducing food loss and waste" was one of the central themes of the 16th Global Forum of Food and Agriculture (GFFA) which took place in Berlin from January 18th to 20th, 2024. Our Collaboration Initiative FLW was very active - together with cooperation partners we held an Expert Panel and organised an exhibition stand - and were invited as key note speaker to another Expert Panel organised by the European Food Banks Federation (FEBA).

The Parliamentary State Secretary at the German Ministry of Food and Agriculture, Ms Claudia Müller, visited our **exhibition stand** where we presented activities from A like Australia to Z like Zimbabwe (Figure 22, left). A huge number of our cooperation partners contributed to display the variety of food loss and waste challenges

and solutions: banana losses in Sri Lanka[9], urban circular food systems in Brazil[10], storage pests in Germany[11], street market FW in Zimbabwe[12], persimmon harvest losses in Spain[13], a set of social innovations to reduce FW in Europe[14], reduction of by-catch in the Baltic Sea[15], redistribution of surplus food in Europe, fruit and vegetable losses due to private marketing standards in Germany, Spain and Italy and voluntary agreements in wholesale, retail and food service sector[16] in Germany (Figure 22, right).

Figure 22 Ms Claudia Müller, Parliamentary State Secretary at the German Ministry of Food and Agriculture visiting our GFFA stall (left, credit: BMEL), group photo with in-person contributors to the GFFA stall (right, credit: Gustavo Porpino)

Our **Expert Panel** "From global strategies to local implementation in preventing FLW" took place on January 19th, 2024. It was organised in close cooperation with the Global Research Alliance on Agricultural Greenhouse gases (GRA), the Brazilian Agricultural Research Corporation (Embrapa) and thinkstep-anz. Aim of the panel was to show opportunities how to connect high-level policy and on the ground practice involving multiple actors. About 90 multinational participants followed the discussions on-site and online. A summary of this Expert Panel can be found here. The presentations of Dr Chanjief Chandrakumar (thinkstep-anz/GRA), Dr Felicitas Schneider (Thünen Institute), Dr Gustavo Porpino (Embrapa) and Sharon Mada (Thünen Institute) provided insights into climate impacts of FLW, an overview on the Collaboration Initiative FLW activities from global to local level, details on the Brazilian Cities and Food project and results from household food waste in Zimbabwe (Figure 23, left).

[9] This cooperation was among others strengthened by our annual FLW Workshop in India in October 2023.

[10] See also further information on our cooperation with Embrapa in subsection 3.2.1 and 3.1.4.

[11] See also further information on our research results in the AVoiD project in subsection 3.3.5.

[12] See also more detailed information on our ongoing PhD project in subsection 3.3.8.

[13] See additional information on ongoing FLW work in Spain in subsection 3.1.9.5.

[14] See also further information on our connection to the LOWINFOOD project in subsection 3.3.7.

[15] See also the breath-taking work of our colleagues at Thünen Institute of Baltic Sea Fisheries.

[16] See also further information in subsection 3.1.9.1.


Figure 23 Panel discussion at the Initiative´s Expert Panel (left, credit: Manuela Kuntscher), Panel discussants at the FEBA expert panel (right) (credit: Felicitas Schneider)

Our **key note address** was part of the Expert Panel "From farm to food donation. How to maximise the potential of preventing harvest losses to ensure food security?" provided the framework for the lively discussion performed by Chris Hill from FoodCloud, Adolfo Villafiorita from Shair.Tech and Eva Sali from Copa*Cogeca. Rosa Rolle from FAO FLW team concluded the panel related to unexplored and unexploited potential to reduce food losses in primary production in context to food redistribution (Figure 23, right).

3.1.9.5 Research cooperation on consumer preferences for beef colour[17]

Reducing food waste is particularly relevant for the production of resource-intensive product groups such as beef. Consumers in Western industrialized countries often prefer a bright cherry red beef colour and reject discoloration. Beef that turns brownish red to brown is therefore offered at a reduced price at the retail level or even discarded. Ramanathan et al. (2022)[18] conducted a study on grocery stores in the United States and found that approximately 195,000 tons of edible ground beef and beef steaks are discarded annually due to discoloration and consumer rejection.

The objective of a research project at Colorado State University (CSU) was therefore to gain insights into the interactions between sensory properties, product attractiveness and consumer acceptance of beef. In the course of a one-year research stay at CSU and in collaboration with an interdisciplinary team of researchers, I analysed consumer preferences for beef colour in North America. This research was supported by the postdoc fellowship of the German Academic Exchange Service (DAAD) and the German Agricultural Society (DLG). The research questions we addressed are directly aligned with my work at the Thünen Institute of Market Analysis, as they cover both, the study of consumer demand behaviour for animal products and efforts to reduce food waste at the retail and household levels[19].

We used a mixed-methods approach to understand United States consumers' preferences and their willingness-to-pay (WTP) for retail beef colour. A consumer survey using a standardized questionnaire including a discrete choice experiment (DCE) initially served to investigate consumer preferences for different degrees of discoloration of beef steaks. Participants were surveyed outside supermarkets in Colorado. During the DCE, participants chose between different beef steaks, taking their actual purchasing budget into account in 12 choice

[17] This chapter was written by Dr Annika Johanna Thies from Thünen Institute of Market Analysis.

[18] Ramanathan, R.; Lambert, L. H.; Nair, M. N.; Morgan, B.; Feuz, R.; Mafi, G.; Pfeiffer, M. (2022): Economic Loss, Amount of Beef Discarded, Natural Resources Wastage, and Environmental Impact Due to Beef Discoloration. In: Meat and Muscle Biology 6 (1). DOI: 10.22175/mmb.13218.

[19] In 2021, Annika Thies and Felicitas Schneider worked together on meat waste in hospitality sector in Germany.

situations. The steaks varied in colour, price and the discount label as illustrated in the choice set shown in Figure 24.

Figure 24 Example of a choice set presented to participants (credit: Annika J. Thies)

In a second part of the study, qualitative focus group discussions were conducted to obtain a detailed understanding about consumers' associations with different beef colour levels and their acceptance of brownish coloured products. In four discussion rounds, a moderator and 33 participants discussed the topics of avoiding food waste, sustainable meat demand behaviour, beef quality and the perception of beef colour.

Results of the DCE demonstrated distinct consumer preferences for beef colour (4, 7, and 9 days of retail display) and price discounts (30% off price per pound (lb)). Results suggested that beef consumers prefer colour nearly linearly across days of retail display. A steak that discoloured over 0 days was most preferred, while 9 days of retail display was the least preferred by participants. On average, consumer WTP was decreased nearly proportionately with an increase in discoloration (Thies et al. 2024a). Focus group participants associated a bright cherry colour with beef quality and eating satisfaction. Discoloration however was rejected by most participants and linked to food safety and product quality concerns. Nevertheless, informative marketing strategies, alongside price discounts, could help influence consumer purchasing behaviour and reduce meat waste at the retail level (Thies et al. 2024b[20]).

You can learn more about the research results in Annika´s Podcast.

3.1.10 Update on FLW activities in Spain[21]

During 2024, efforts have continued to promote the prevention and reduction of food loss and waste in the Valencian Community, a region in the Spanish Mediterranean. These activities have been framed within the Action Plan launched by the regional government, supported by the SosteSabio project of the Valencian Institute for Agricultural Research (IVIA). The coordination and direction of these initiatives have been led by Dr Maria-Angeles Fernandez-Zamudio, currently a professor in the Department of Economics and Social Sciences at the Universitat Politècnica de València (UPV).

This year's initiatives have focused particularly on training and raising awareness among the general population and stakeholders within the agri-food chain, aiming to foster understanding and action on a challenge that can only be resolved through the collaboration of society as a whole. The ultimate goal is to achieve far more responsible production and consumption models.

[20] Thies A.J., Altmann B.A., Holloway M., Smith C., Nair M.N. (2024b) Reducing food waste. How beef color influences consumer buying decisions. Presented at the 64th annual conference of the Society for Economic and Social Sciences of Agriculture e.V. (GEWISOLA).

[21] The text and the figures were provided by Dr Maria-Angeles Fernandez-Zamudio from Universitat Politècnica de València (UPV).

3.1.10.1 Work with collective catering (HoReCa Channel)

The HoReCa channel is one of the sectors with the highest levels of food waste, requiring efficient measurement protocols and actionable recommendations to drive change. As mentioned in our 2023 report, various researchers from different institutions are working to improve aspects of sustainability in food management at the Convention Centre of Valencia, as part of a collaboration promoted by the World Sustainable Urban Food Centre of Valencia (CEMAS). The multidisciplinary team includes Dr Jose Miguel Soriano, Dr Nadia San-Onofre, and Dr Inma Zarzo (Lluís Alcanyís Foundation - University of Valencia, UV), Dr Tatiana Pina (Department of Experimental and Social Sciences Education, UV), and Dr Maria-Angeles Fernandez-Zamudio (Department of Economics and Social Sciences, UPV).

In addition to measuring food waste generated in MICE tourism (Meetings, Incentives, Conventions, and Exhibitions), the project proposes recommendations aimed at encouraging more responsible consumption behaviour among diners. Alternatives are also being explored for the use of unconsumed food, prioritizing donations to social organizations. For food waste that cannot be repurposed, the team is working on a composting project. The main findings of this work have been published in a scientific article.

3.1.10.2 Online Course on Food Loss and Waste Reduction Training

A self-paced online course (in Spanish) titled “Prevention of Food Loss and Waste” has been launched. It is free and open to the public (upon registration) and is part of the training portal of the Ministry of Agriculture of the regional government (Generalitat Valenciana, GVA). The course has a duration of 15 hours and is structured into 12 educational modules delivered through videos and other multimedia resources.

The course content delves into topics such as the definition of food loss and waste, reporting on the scale of the problem and its diverse impacts, outlining legal and regulatory frameworks, and exploring scientific approaches to addressing this issue. It also introduces research groups, international projects, and platforms focused on this topic, provides recommendations and best practices for reducing food loss and waste at both collective and individual levels, and covers other relevant topics.

While the course is designed for the general public, it specifically aims to provide basic training for stakeholders in the agri-food sector and the educational community, enabling them to gain foundational knowledge and engage with this critical issue.

3.1.10.3 Guide for Implementing a Food Waste Prevention Plan

This document provides detailed guidance on how to design a prevention plan for entities that manage food, with a central focus on school cafeterias. While the guide is specifically tailored to the school environment, its structure and information are adaptable to other types of businesses. This is particularly relevant in light of the upcoming Food Loss and Waste Law currently being processed by the Spanish government, which aims to require a wide range of agri-food companies to develop such prevention plans. However, there is a lack of practical information on how to implement these plans, making this guide an invaluable resource.

The guide emphasizes the critical role of private stakeholders in contributing to the collective effort to reduce and prevent food waste within their facilities. Such collaboration is essential to effectively address the problem in the medium and long term. The guide is available in Spanish (Figure 25).

Figure 25 Cover of the Guide for Implementing a Food Waste Prevention Plan in School Cafeterias of the Valencian Community (source: M.A. Fernández-Zamudio).

3.1.10.4 Specific Workshops on Food Loss and Waste

In February 2024, a meeting of persimmon producers was organized by the agrarian association L'Unió to discuss the various agronomic, sanitary, and economic challenges faced by this crop. Persimmon is a key agricultural product in this Spanish region, where 15,500 hectares account for 89 % of Spain's persimmon production, primarily destined for fresh consumption in European markets.

The opening presentation was delivered by Dr M.A. Fernandez-Zamudio, whose talk "Harvest Losses and Economic Sustainability of Persimmon Production", emphasized the need to analyse on-field losses and their impact on the profitability of agricultural operations (Figure 26). Her presentation generated significant interest among the large group of farmers in attendance. The video of this presentation is available here.

Figure 26 Workshop on Harvest Losses and Economic Sustainability of Persimmon, held in Carlet (Valencia, Spain) in February 2024 (source: M.A. Fernández-Zamudio).

In June 2024, a workshop was held in the auditorium of the Ministry of Agriculture of the regional government, titled "Advances in the Agri-Food Chain to Reduce Food Waste" (Figure 27). The event brought together a diverse group of professionals, providing an opportunity to understand how this issue is perceived from different sectors of society. Dr Héctor Barco (Fundació Espigoladors) began by contextualizing the problem of food loss and waste and discussing how initiatives can be generated across different regions to address its reduction. A representative from the Spanish Ministry of Agriculture followed, explaining the potential implications of the new law currently being developed. Next, representatives from key sectors of the agri-food chain (producers, agricultural

industries, and supermarkets) shared their insights, followed by an educator working on this issue within the school context and an internationally renowned chef. Each shared their direct experience in preventing food loss and waste, fostering a rich debate among the attendees.

Figure 27 Workshop on Advances in the Agri-Food Chain to Reduce Food Waste, held in Valencia, in June 2024. (source: M.A. Fernández-Zamudio).

In September 2024, the event titled "A Future Without Food Waste" was held at the Botanical Garden of Valencia, organized in the form of round tables by the Chair of Economics of the Common Good at the University of Valencia. The first round table featured Dr M.A. Fernández-Zamudio, who emphasized the crucial role of science in addressing food waste and the need for quantification studies. Dr Tatjana Pina discussed how the school community can help change public perceptions of this issue, while Dr J.M. Soriano highlighted the nutritional losses associated with food discards.

Along with the other round tables held, this session sparked an engaging debate among an audience composed mainly of university students and agri-food industry entrepreneurs, ultimately concluding that they must become more actively involved in tackling this issue.

3.1.11 Design & Development of a Decision Support System to Reconfigure Vegetable Supply Chains to Enhance Sustainability: Case study from Sri Lanka[22]

This project is focused on identifying main aspects related to present vegetable supply chain performance in Sri Lanka and to identify possible interventions to improve its performance, enhance the overall sustainability practices aiming towards reducing post-harvest emissions and losses. This research study is funded by National Science Foundation of Sri Lanka and will continue from 2022 to 2025.

From this project it is expected to identify:

1. What are the key SC characteristics, dimensions, and parameters that make an impact on overall vegetable supply chain performance?
2. How can distinct vegetable supply chain decisions be made to match supply and demand, enhancing supply chain performance?

[22] This chapter was provided by the project team consisting of Dr Asela Kulatunga of University of Exeter, UK, Dr Subodha Dharmapriya of University of Peradeniya as Co-investigators and Ms Chethana Chandrasiri as the main research assistant and there are several part-time team members acting as field assistants and data collectors.

At the end of this research project, it is expected to design and develop an analytical platform for making data-driven analytical decisions to support vegetable supply chain configuration towards sustainability.

This is achieved through:

- Visually representing the aggregated supply and demand density distribution across the country.
- Reconfiguring vegetable supply network managing supply and demand and planning logistics operations
- Achieving performance measures in terms of cost, transient time and quality
- Facilitating individual entities' decision making supported by computational intelligence technique.

The mapping of the vegetable supply chain of Sri Lanka has already been completed by conducting substantial visits to farms, regional collectors, economic zones operated in different areas of Sri Lanka. Data was collected by stakeholder interviews and also from data/statistics maintained by Department of Agriculture and Department of Census and Statistics of Sri Lanka. In addition, observations were also recorded along the chain from harvest, to storage, sorting and packing and most importantly handling and transportation. Apart from these, focused group discussions were conducted. In early 2025, stakeholder workshops will allow to update the Supply chain mapping validations and to disseminate some of the findings of different supply chain reconfigurations which were already carried out to achieve the final objectives using the integration of mathematical models and computer simulation techniques through CPLEX and SIMIO software. The identified supply chain structures are represented in Figure 28. More details related to the mapping and reconfiguration were published in a conference paper. Figure 29, Figure 30 and Figure 31 respectively display the different stages of the supply chain: cultivation, temporary storage, transportation and retail markets where data on practices and behaviour were collected. In this study, all the 15 Economic Centers in Sri Lanka were covered and their operational differences observed. Each economic centers' inflows and outflows were spatially mapped.

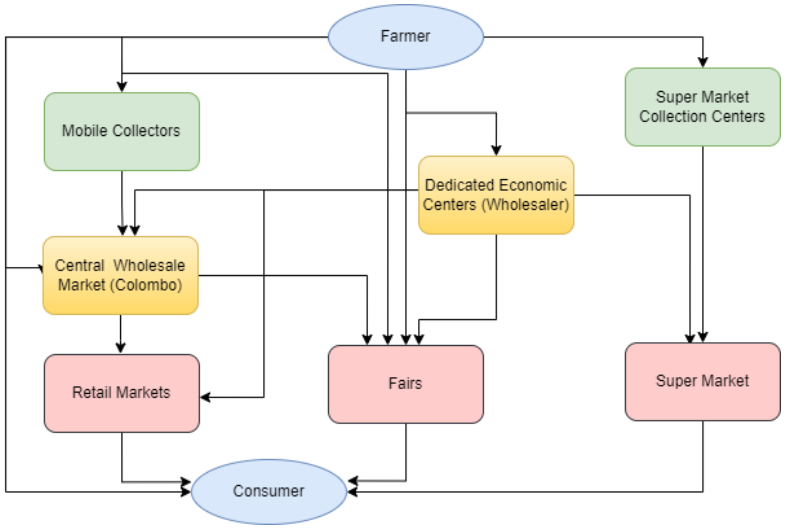

Figure 28 Network structures of existing vegetable supply chain (Chandrasiri et al., 2022[23]).

[23] Chandrasiri C., Dharmapriya S., Kulatunga A.K., Rathnayake R.M.R.N.K., Wasala W.M.C.B., Weerakkody W.A.P. (2023) Supply Chain Reconfiguration as an Option to Mitigate Post Harvest Losses and GHGs: Simulating a Case Study from Banana Supply Chain in Sri Lanka. In: H. Kohl et al. (Eds.) *Proceedings of the 18th Global Conference on Sustainable Manufacturing (GCSM 2022), LNME*, pp. 1044–1052, 2023, https://doi.org/10.1007/978-3-031-28839-5_116.

Figure 29 Cultivation Practices: (a) Nursery Preparation, (b) Soil Preparation, (c) Planting, (d) Water Supply, (e) Mix Crop Cultivation, (f) Single Crop Cultivation (Copyright to authors).

Figure 30 Supply Chain Practices: (a) Packing, (b) Loading, (c) Handling, (d) Temporary Storages, (e) Transport Modes, (f) While Transporting (Copyright to authors).

Figure 31 Vegetable Retailer Types: (a) Road Side Retailers, (b) Local Market Retailers, (c) Retailers at Economic Centers (Copyright to authors).

In the next step, the vegetable supply chain was modeled as a mathematical and a simulation model. Here, the two-echelon supply chains were mathematically modeled as a trans-shipment problem using a deterministic Mixed Integer Linear Programming (MILP) model for daily vegetable production and consumption to minimize only the transport cost. The decision variables considered - product flow, flow direction, inventory levels, and vehicle type selection - were optimized subject to supply, demand, economic center flow balancing, inventory, and vehicle capacity constraints. To incorporate uncertainty in product supply, the supply quantities were replaced by the expected values. Further to scaling up by incorporating the dynamic behaviour of the supply chain and related entities, a dynamic stochastic MILP model was formulated. The objective function has been further improved to minimize total supply chain cost, including production cost, transport cost, inventory holding cost and cost due to product wastage. Further, this MILP model has been solved for emission minimizing and waste minimizing objectives. The optimized configurations were then simulated as a discrete event simulation (DES) to assess the entity wise dynamic behaviour. Using the simulation model, lead time, input output buffers and waiting times at each economic center, vehicle travel distances and economic center utilization will be derived for an optimum configuration. More information on the model can be found in the peer-reviewed paper.

So far, the cost minimization model was found to be performing better in terms of cost, emission and waste as given in Figure 32.

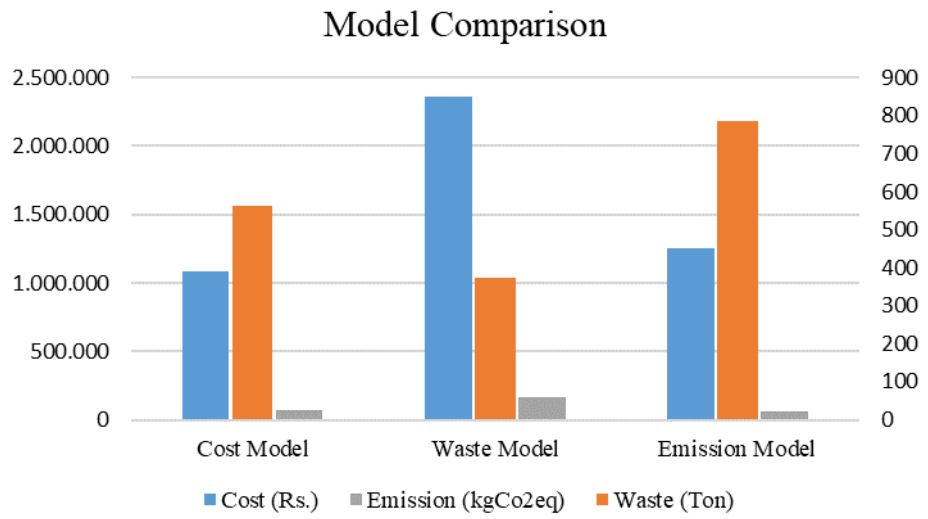

Figure 32 Cost, Waste and Emission Model Comparison (Copyright to authors).

Based on the mathematical models and simulation models the next steps of the project will include:

- An analytical framework is expected to be developed combining mathematical and simulation models.
- Based on the analytical framework, a decision support system will be created to aid in supply chain network level and configuration decisions.
- Furthermore, this decision support system is expected to be validated on real time data and scenario.

Further findings will be presented at the 12th Simulation Workshop 2025[24] in Exeter, UK. The research team is open for collaboration on comparative or benchmark studies of the same sector. If you are interested, please contact Dr Asela K. Kulatunga of the University of Exeter, UK.

3.1.12 Collaboration with an American Council on Germany Fellow[25]

In September 2024, Jaylin Stotler, a recipient of the American Council on Germany's McCloy Fellowship, reached Frankfurt from Denver, Colorado, USA with the mission to investigate methods to combat inequities in healthy food access. Her self-crafted two-month itinerary included visits with civil society, non-profit leaders, and researchers that shared perspectives about policy, systems, and approaches to improve healthy food access and reduce food waste. She describes her conversations with subject matter experts throughout the German food ecosystem as intriguing, eye-opening, and uplifting as they revealed the robust scope of work and collaboration from grass roots efforts through legislative change across Germany. With the goal of identifying transferable initiatives that could be implemented in her own community, she journeyed to Frankfurt, Wuppertal, Bonn, Cologne, Nuremberg, Berlin, and Braunschweig where she visited Johann Heinrich von Thünen Institute, the German Federal Research Institute for Rural Areas, Forestry, and Fisheries. There she met with representatives of the Sustainability and Food Loss and Waste Team within the Thünen Institute of Market Analysis to learn about their efforts to address food loss and waste (Figure 33).

[24] Chandrasiri C., Kulatunga A.K., Dharmapriya S. "Smoothing the transit centers operations of vegetable supply chain using mixed integer programming and simulation techniques: Sri lankan case study," in Simulation Workshop 25 in Exeter, 2025, vol. 2025.

[25] This subchapter was provided by Ms Jaylin Stotler from Thorton Parks, Recreation and Community Programs, USA.

Figure 33 Group photo with Sharon Mada, Jaylin Stotler, Thünen namesake Johann Heinrich von Thünen statue, Stefan Lange and Felicitas Schneider (from right to left, source: Felicitas Schneider).

The McCloy Fellow reports the following impressions from her time at Thünen Institute which will help to inform her strategy and work in the United States, making food more accessible and less wasted:

- Build Capacity: Through providing structured supervision to doctoral students that are completing research within the food space and collaborating with other investigative partners, organizational capacity in Thünen Institute's food-based research is bolstered. Efficiencies are created when trading knowledge of successes, challenges, and strategy.
- Engage Stakeholders: Thünen Institute involved stakeholders from across the food system in thoughtful deliberation of strategy to reduce food waste in a series of dialogue forums which convened wholesalers, retailers, scientists, and civil society. The resulting product was the Pact Against Food Waste which was signed by 14 of Germany's leading food wholesale and retail representatives in the summer of 2023, highlighting the impact of collaboration.
- Measure Success: In order to implement and monitor food loss and waste initiatives as part of the federal government's National Strategy for Food Waste Reduction, which came as a result of the European Union's Sustainable Development Goal 12.3 to halve per capita food waste at the retail and consumer level by 2030, a mechanism for measurement was necessary and with the appropriate feedback from across the food ecosystem, achieved.
- Share Results: The Thünen Institute team represents Germany at the annual Meeting of Agricultural Chief Scientists (MACS) at Group of 20 (G20), a united group of 20 governments with the largest global economies to discuss economic, political, and social agendas. Here, at other national and international convenings, and in an online platform hosted by Thünen, continuous engagement and learning are made possible.

Ms. Stotler expresses her gratitude to the American Council on Germany and all that made this fellowship and learning journey possible, including Stefan Lange, Dr Felicitas Schneider, and PhD Student Sharon Yeukai Mada of the Thünen Institute.

3.1.13 Cooperation with Tafel Österreich, Austria[26]

2024 – our 25th anniversary – has been an eventful year. We wanted to take advantage of this special year to reflect on our achievements, but also to lay the groundwork and continue building sustainable connections for the future. Our current conclusion: much has been accomplished – but there's still plenty to do...

Rebranding: Founded in 1999 as the "Wiener Tafel," we have long outgrown the association with only Austria's capital. For partnerships and donors alike, the name increasingly felt like a limitation for both of our missions – saving food to hand out for free to charities helping poor people and raising awareness for food insecurity and food waste – we have been active across Austria for a long time. Since 2024, we've been promoting our new brand "Die Tafel Österreich" – and it was very well perceived by our stakeholders.

New Records: Our annual report, presented in February 2024, revealed a milestone: We broke yet another record. Though with mixed feelings – for the first time, we rescued over 1,000 tons of food and provided free food to more than 35,000 people affected by poverty across about 100 social institutions. Meanwhile, our network in the Austrian states has massively expanded: around 20,000 people and 50 social institutions have joined since last autumn. Without increased sourcing from agriculture, meeting this rising demand would have been challenging – but last year alone (our start in the agricultural sector), we rescued around 120 tons of fresh produce, hence farmers become an increasingly important food donor group for us.

25th Anniversary: One of the major highlights was our 25th-anniversary celebration on September 9th, 2024 in the Vienna City Hall (Figure 34). The event brought together around 350 guests, including numerous prominent persons (Figure 35, Figure 36), politicians, and international FEBA guests. The day began with an international press conference and featured a 28-part exhibition on "25 Years of Die Tafel Österreich" at the town hall. A notable addition: our commemorative publication and the presentation of our "Proud Partners" in the "Hall of Fame" on our website.

The Collaboration Initiative FLW congratulates the Tafel Österreich for their valuable work through the last 25 years and submits the best wishes for future work. Our cooperation is based on sharing experiences and contacts as well as updates on recent developments. Thank you for inviting us to also join your anniversary event!

Figure 34 Dr Alexandra Gruber (left, source: Thomas Topf) welcomes the guests together with Elmar Furtenbach from Tafel Österreich and Lindsay Boswell as FEBA president at the 25th anniversary party at the Vienna town hall (right, source: Julia Dragosits).

[26] This section was provided by Dr Alexandra Gruber from Tafel Österreich, Austria and completed by Felicitas Schneider.

Figure 35 Event´s food buffet was distributed by colours in jars through celebrities such as singer Marika Lichter and celebrity chef Johann Lafer (left, source: Julia Dragosits), actress Ursula Strauss (right, source: Julia Dragosits)

Figure 36 Event´s food buffet could be combined according to individual preferences (left, source: Felicitas Schneider), actress Konstanze Breitebner supports Alexandra Gruber in cutting the cake (right, source: Thomas Topf)

Political Engagement: For many years, we've been active in public affairs to highlight areas for action at political level. In 2024, we celebrated a major success regarding one of the longstanding demands of Die Tafel Österreich: the elimination of VAT on food donations. We also made a statement with a petition against food waste and food insecurity, accompanied by a survey amongst the Austrian political parties. The next Austrian government is still to be determined but in the meantime we will continue fighting for a better political framework to more effectively prevent food poverty and food waste in Austria.

1st Martin Haiderer Award: Named after the founder of Die Tafel Österreich, this award was presented for the first time, honouring social institutions and their commitment to help people in need with food aid and poverty relief. The award ceremony took place at the anniversary celebration, followed by a special publication containing all projects (Figure 37).

Figure 37 Martin Haiderer hands over the awards named after him (left, source: Julia Dragosits), all awarded projects on the stage in front of beautiful Vienna Town Hall architecture (right, source: Julia Dragosits).

Additionally, our winter donation campaign "**Soup with a Sense**," in collaboration with the restaurant industry, entered its 17th season. The **TafelBox 2.0** - after having been introduced 10 years ago in Austria (Figure 38) - celebrated its sustainable revival in the anniversary year with testimonials from top restaurants and performed well at the Vienna Business Run 2024. Our new **fruit and vegetable sheets** offer easy-to-understand information about food; we established **new collaborations** (such as with the Green Party of Styria at the clim@ Festival or the Ecosocial Forum of Austria and Europe with "Will anyone eat this?"). New, unexpected major donors like Metallica added even more brightness to our year in 2024 and helped us as donor-focused NGO to fulfill our mission despite challenging times.

Figure 38 Sponsors of TafelBox 2.0 (left, source: Die Tafel Österreich/APA-Fotoservice/Rastegar), sustainable TafelBox 2.0 (right, source: Die Tafel Österreich).

Last but not least, in 2024 we started putting the spotlight on the new **sustainability reporting directive** according to CSRD and our role in this setting in order to create even more sustainable partnerships with companies in the light of the SDGs in the near future.

More information to be found at our website.

3.2 Topic 2: Awareness Raising & Capacity Building

3.2.1 8th Regional FLW Workshop in Brasilia/Brazil

One aim of our activities is to organise an annual Regional FLW Workshop. In order to take the G20 responsibility more into account, the workshops are a cooperation of the Thünen Institute with partners from the corresponding G20 presidency country and they target the neighbouring region of that country. The workshop series started with the kick-off workshop in Berlin/Germany in 2017. It was followed by a Regional FLW workshop organised for Latin America and the Caribbean countries (LAC) in November 2018 in Buenos Aires/Argentina. In 2019, the target region included Southeast and East Asian countries while the workshop took place in Tokyo/Japan. The first hybrid workshop was conducted in collaboration with Saudi Arabia in 2020 targeting Gulf Cooperation Council Countries plus the Yemen. Due to the pandemic we conducted the first complete online workshop during the Italian G20 presidency in 2021 targeting the Mediterranean countries. In 2022, we reached a new record of more than 500 participants in our hybrid workshop held in Indonesia. All video recordings of the sessions including English subtitles together with a summary and a selection of photos can be found at our website. In 2023, our workshop took place in New Delhi, India, targeting the South Asian Region.

The present workshop was organised with some changes to previous years. First, we were able to increase our workshop budget. The new Alliance for the Climate – Dialogue on climate and agriculture between New Zealand and Germany (AgriDENZ) registered our activity as one part of its "Third party countries" focus activities. The aim of that AgriDENZ focus is to "further develop low-emission and climate-friendly approaches" and thus fits perfect into our Regional FLW workshop aims. This partnership leads to joint budget from Germany and New Zealand and also increases the organisation team by colleagues from New Zealand which was the second change. The third change was to welcome Prof Martin Banse in our workshop team who is director of the Thünen Institute of Market Analysis where our coordinator is also located. Our long-term partner UNEP also provided financial support for some participants which was a great benefit for the diversity of the audience. Thus, we started into the organisation of the annual workshop with both improved manpower and financial resources. One of the consequences was that our workshop was supported by a dedicated logo for the first time (Figure 39).

Figure 39 The logo for the 2024 Regional FLW Workshop in LAC countries (credit: GRA)

The organisation team was built up by colleagues from Brazilian Agricultural Research Corporation (Embrapa), the Brazilian Ministry of Social Development (MDS), UN Environmental Program (UNEP), Food and Agriculture Organisation (FAO), Global Research Alliance (GRA), National Agricultural Technology Institute Argentina (INTA) and experienced local consultants. We were very happy to reconnect to most of the colleagues who already supported our workshop in 2018 in Buenos Aires, Argentina, and who shared their valuable experience not only with their specialised FLW knowledge but also supported the organisation.

The target region was Latin America and The Caribbean. From October 22 to 24, 2024, a total of 180 participants from 17 countries discussed the focus on multistakeholder Initiatives for FLW mitigation, social and disruptive innovations, delivering SDG 12.3 in Cities, policy frameworks as well as how FLW mitigation can help tackling the climate crisis (Figure 40). The contributors represented ministries, universities and other private and public

research institutions, non-governmental organizations, social institutions, international organizations, consulting and waste management companies, regional authorities and food companies. Another German bilateral cooperation, the Agricultural policy dialogue Brazil – Germany, was represented as well.

All plenary sessions were chaired by acknowledged experts from different LAC countries and international organisations. The speakers represented different stakeholder groups and shared experiences across the region. There was a rich discussion not only in the question-and-answer part of each session but also during the breaks and after each day at the happy hour. The four working group sessions were dedicated to work on selected topics in more detail in smaller groups and identify key messages as workshop output. The elaborated key messages were then communicated in the last plenary session on the second workshop day. Our exhibition which was organised parallel to the sessions offered further best practice related to FLW prevention and circular economy. The stalls and posters offered insights into research findings and multistakeholder cooperation, provided opportunity to taste food products processed from coffee processing by-products or to see best practice on micro biogas facilities from the Amazonas region.

To address the multilingual background of our participants and to facilitate exchange, we used Portuguese, Spanish and English as official languages. Thus, you can also find the workshop outputs in three languages on the website. At our website you can find the agenda together with most of the presentations and posters, a comprehensive summary of the workshop and many photos.

We appreciate the valuable support from SESC Mesa Brasil who provided the entire catering during the workshop and the excursion as a zero-waste buffet. It was great taste and no food waste. In addition, Pacto contra a fome supported the delivery of the workshop. We thank all chairs, working group facilitators, note takers as well as the motivated participants for their valuable input and especially Embrapa vegetables and corresponding on-site colleagues for hosting the event. A big thank you to all colleagues who engaged in the administrative and technical matters which contributed towards the success of the workshop.

Figure 40 Around 180 participants joined our workshop (credit: GRA)

Due to logistical reasons, we had only 55 seats available for registered participants on the last day of our workshop. We were kindly invited to visit SESC Mesa Brasil (Figure 41, left) as well as Aprospera, the Associação dos Produtores Agroecológicos do Alto São Bartolomeu (Figure 41, right). We would like to thank both organisations for the warm welcome, the generous hospitality and great opportunity to learn from best practice!

Figure 41 Our visit at SESC Mesa Brasil (left) (credit: Felicitas Schneider) and at Aprospera (right) (credit: Rachel Collie)

The agenda, a comprehensive summary as well as some photos are provided at the Initiative´s website. Some of the presentations are already available, others will follow after the presenters´ legal approval of the content.

We look forward to our Regional FLW Workshop in cooperation with South Africa in 2025!

3.2.2 Preparatory Workshop on Food Loss and Waste Prevention in Sub-Saharan Africa

The funding for the new Alliance for the Climate – Dialogue on climate and agriculture between New Zealand and Germany (AgriDENZ) is provided by the German Ministry of Food and Agriculture (BMEL) and the New Zealand Ministry for Primary Industries (MPI) and allowed us to organise an additional workshop outside our annual workshop series. The workshop was jointly organized by the Thünen Institute, Global Research Alliance on Agricultural Greenhouse Gases (GRA), The Sustainable Development Solutions Network (SDSN) and the University of Nairobi. The aim of the meeting was to discuss the current situation regarding food loss and waste in Sub-Saharan Africa with its challenges and opportunities, to strengthen the regional network, exchange experiences and to prepare the FLW workshop in cooperation with the G20 presidency of South Africa in 2025. The participants covered representatives from research, policy, governmental agencies, consultants, business, Non-Governmental Organisations and United Nations organisations (Figure 42).

The workshop was organised in six weeks only and we were very happy to welcome around 40 participants at University of Nairobi in Kenya from 17 to 18 April 2024. The plenary sessions included scene-setting presentations from African Union, FAO and UNEP representatives, a panel discussion on regional trends, challenges and opportunities with representatives from Ghana, Mauritius, Tanzania, Zambia, and Zimbabwe, moderated by our Kenian hosts. To facilitate networking among participants and insights into best practise, we split the group into two subgroups which visited either Food Banking Kenya or Upper Kabete campus FLW aligned research facilities.

Figure 42 Familiy photo with the participants from the FLW Workshop in Nairobi (credit: Rachel Collie)

Full of inspiration from the first day, we started the second one with two working group sessions. The first one "Food loss and waste policy implementation" was moderated by Mr Guido Geissler from African Union[27]. The second one addressed "FLW prevention, circular economy and data tracking - existing and missing data and information in Sub-Saharan Africa" and was facilitated by our coordinator Felicitas supported by our PhD student Sharon Mada.

After reporting back to the plenary on the results of both working groups, we discussed key messages for the South African workshop in 2025 and how to continue within the new network of the participants. The latter was driven by the motivation for cooperation and to contribute to FLW prevention by joining forces which was noticeable during the whole workshop. It was agreed to have a joint activity by using social media on the upcoming International Day of Awareness of FLW in September (see also subchapter 3.2.3).

More information including the agenda, a summary and photos of the workshop can be found at our Collaboration Initiative´s website.

3.2.3 International Day of Awareness of Food Loss and Waste

We at the Collaboration Initiative are very proud that we were able to support this great idea from the very beginning in 2018 under the G20 presidency of Argentina (see our Annual Report 2020). Since 2020 when the day was introduced, the 29th of September is celebrated by several global organisations, research institutes and stakeholders dealing with FLW prevention. As in the previous years, in 2024 we also implemented one local Day of Action in cooperation with other organisations as well as an online presentation of research results related to our ongoing projects open for public.

Braunschweig is the headquarter of the Thünen Institute and represents a medium size German city of approximately 250,000 inhabitants in Lower Saxony. In 2024, we collaborated with the local Food Council (ERBSL)[28] for a snip party to raise awareness of the general public on September 21st. This year the event took

[27] See also more cooperation details with African Union in subchapter 3.5.3.

[28] Find more information in subsection 3.1.9.3.

place in cooperation with the Parking Day 2024 in the city centre organised by Verkehrsclub Deutschland e.V. As in the previous years, foodsharing Braunschweig provided the rescued fruits, vegetables and bread while Transition Town Braunschweig supported with the mobile kitchen. Due to scarce space being available, we prepared the soups and salad by ourselves on-site (Figure 43) and invited the passing people to sit down, eat together and talk about surplus food and food loss and waste. Representing Thünen Institute and the Collaboration Initiative Food Loss and Waste, we provided insights into our research results by discussing our project briefs and other publications with the interested public (Figure 44). In total, we handed out more than 100 portions of soup and 30 portions of salad.

Overall framework of the snip event was the second Good Food Festival organised by ERBSL with a total of 15 events addressing various topics related to nutrition, health, fair trade and food sourcing in September 2024. Parallel to this, the official Action Week "Germany saves Food" was coordinated by the German Ministry of Food and Agriculture from September 29th to October 6th, 2024.

Figure 43 Members of the ERBSL working group food rescue love cooking (left), colourful salad made from rescued fruits and vegetables (right) (credit: Felicitas Schneider)

Figure 44 Members of the ERBSL working group prepare soup portions (left), stall with information material as basis for further discussions (right) (credit: Felicitas Schneider)

In 2022, the Thünen Institute started a new online format, the Thünen-Kolloquium, to get into closer contact with the general public. Every first Thursday of each month, there is an online presentation related to selected topics of Thünen research results. Dates and topics are promoted in advance and beside Thünen staff members, interested public is also welcome to join the presentation and following discussion. On October 10th, our PhD student Sharon Mada provided insights into the first part of her thesis with the presentation **"Maize porridge for**

the bin – why low-income households waste food" (see also chapter 3.3.8). It was her first oral presentation in German and we congratulate Sharon to successfully implement this difficult task! Finally, we reached about 65 colleagues as well as interested persons from outside Thünen and had a fruitful discussion. The slides of the presentation are available here in German.

As mentioned in subchapter 3.2.2, there was the idea to have a **joint activity with the participants from the Nairobi Workshop** on September 29th, 2024. Our intention was to commit as individuals to FLW prevention, raise awareness on the topic and show how easy it is to contribute to FLW reduction. The idea was to produce short videos on a selected topic, post it on our preferred social media channel, connect our contributions and share them with our individual networks. The used hashtag was #FLWAfrica. This should increase visibility – and fun! Our PhD student Sharon and our coordinator Felicitas produced a short video with the topic "how we contribute to FLW reduction at our gardens" and posted it on Felicitas´ LinkedIn account. The video shows the plum surplus from our garden and that we share it with our colleagues in the office. The post was shown at LinkedIn around 2,900 times and reached out to 1,900 members. The 40 seconds video itself was watched 1,520 times with an overall playback time of 5 h 30 minutes (as of December 8th, 2024).

Sharon also provided her own video which was produced at the ReTaste conference in Crete where she presented her thesis[29]. Her video is dedicated to her contribution to reduce FW by her research and dissemination activities in the course of her PhD dealing with street markets and household FW in low-income district of Harare, Zimbabwe. The post was shown 1,379 times and reached 647 members. It had 1,105 views and the 41 seconds video was played for 5h 8m 37s, as of 12 Dec 2024. We thank our colleagues Manex Urruzola Arrate, Eidar Olazar Elduaien, Oihane Lakar Iraizoz and Hariz Mutilva Garmendia from Elhuyar, Spain for their valuable support in producing the video in a professional way!

Also other colleagues from our new #FLWAfrica network contributed with short video messages or statements such as Dr Daya Goburdhun from Mauritius, Dr Abiodun Aderibigbe from Nigeria, Dr Anthony Gikuri from Tanzania, Dr Cephas Taruvinga from Zimbabwe. Others of the network contributed with comments and reactions. We thank all our engaged African colleagues to post their ideas and support the important topic in a different way!

3.2.4 Cooperation with the University Centre of the Westfjords (Iceland)

The University Centre of the Westfjords located in Iceland offers a master's program in "Coastal Communities and Regional Development". By continuing her previous teaching activities, our coordinator Felicitas facilitates the course "Sustainable Waste Management in Coastal Communities" annually since the summer term 2021. Her waste management experiences from former job positions allow her to offer the basics of general waste management focused on coastal regions as background information for a more detailed look into FLW generation, prevention and potential waste management options, circular economy and sustainable systems embedded in a global framework. The two-week course is accompanied by excursions and guest speakers from local waste management, private coastal clean-up initiative as well as local harbour authority. In 2024, the students from Canada, Germany, Netherlands, and the United States enriched the provided mix of theory and implemented practice with their own waste management experiences as well as with self-developed short presentations on selected waste management topics. The visited excursion venues included the sorting facility of the local waste management company contracted by the region as well as the local waste collection centre where the household biowaste collection and treatment is conducted.

Due to the legal requirements, the Westfjords Regional Development Office (Vestfjarðastofa) develops a regional plan for the Westfjords of Iceland covering a time span from 2026 to 2050. In parallel, a new regional plan of

[29] See also subsection 3.3.8

action for the period 2025 to 2029 (Sóknaráætlun Vestfjarða) is under preparation and should be aligned with the other plan. Aim is to facilitate a sustainable development of the region and the Westfjords Regional Development Office acts on behalf of all municipalities of the Westfjords. The opportunity to be able to discuss the present status of both plans with teachers engaged at the University Centre of the Westfjords resulted in the participation of our coordinator Felicitas in a two-hour online discussion where the developed preliminary results were evaluated by the participating experts. It was a very interesting discussion and increased understanding for very specific harsh conditions and challenging frameworks in Arctic municipalities and regions.

After teaching the course in May 2024, Felicitas had the opportunity to travel to the only operating Islandic large scale composting plant located in Akureyri, the largest city in the northern part of Iceland. It was an amazing experience to learn from the operator´s experiences given the very hard climatic conditions, the corresponding fluctuating collected organic waste streams and the long transport distances. The plant processes input streams consisting of paper cuts, wood chips, slaughterhouse category 3 material as well as separate collected food waste from households from multiple municipalities in the north and northeast of Iceland within a closed in-house process. The resulting material is marketed to the municipalities which provided the household FW, the forestry society for reforestation action, farmers and other stakeholders (Figure 45).

Figure 45 Compost heaps during maturation in front of scenic Icelandic mountains (left), close-up of the produced compost (right) (credit: Felicitas Schneider)

Another appointment was arranged with the operator of the city-owned abandoned landfill where the landfill gas is collected and further processed to be used as gas for cars and busses located in Akureyri. The landfill origins from the 1960s and was closed around 2009. This means that the unsorted municipal and commercial as well as agricultural waste was assumed to produce landfill gas which is emitted into the atmosphere. Some years ago, 50 boreholes were drilled to introduce gas collection pipes and thus, to reduce the environmental impact of the landfill (Figure 46, left). The collected gas is further processed nearby to fulfil the requirements for utilisation as gas for vehicles (Figure 46, right). According to the measurements, the gas utilisation is expected to end in the coming years due to a significant decrease of the exploited gas amount.

Figure 46 The old landfill surface already looks like the surrounding landscape except the visible gas wells in black (left), the handy landfill gas processing station in Akureyri (right) (credit: Felicitas Schneider)

The last appointment in Akureyri was dedicated to future waste management approaches and plans to be implemented in the course of the coming years in order to comply with European Union legislation on treatment of organic and food waste.

A big thank you to my contact persons at Molta, Norðurorka, Liforkuver and Eimur taking their time to show Felicitas around and explaining the current organic and food waste management situation, the opportunities, and challenges as well as discussing strategies to tackle environmental, social and economic issues. It was a great experience!

One Canadian student from 2023 course class finalised her master thesis "Going forward: A look at small Icelandic municipalities and waste management strategies" under supervision of our coordinator Felicitas in September 2024. Congrats, Gaëlle, you did great work!

Another student from the master course Coastal Communities and Regional Development was also supervised by Felicitas related to her thesis named "Plastic vs. Policy: A Plastic Pollution Policy Analysis in the Arctic". Congrats, Louise, you made a deep dive into waste policy!

3.2.5 Cooperation with the Swedish University of Agricultural Sciences

In addition to joint publication activities (see subchapter 3.3.3), our coordinator Felicitas started a 1.5 hours online guest lecture for the SLU master course called "Food waste - current situation and future opportunities" already in September 2023. As the content of the course is more focused on the Swedish framework and situation, the aim was to also provide other European and international insights and broaden the students´ knowledge. Due to the positive feedback provided by the Swedish students in 2023, the cooperation turned into a permanent one and thus, the guest lecture was repeated in September 2024 and will be continued in the coming years. It is a pleasure for us to share global updates and best practices as well as challenges with young Swedish research generation and contribute to capacity building.

3.2.6 Moderation of side-event at ANUGA FoodTec in Cologne, Germany

The German Agricultural Society (DLG e.V.) organised a Deep Dive session in the course of the ANUGA FoodTec in March 2024 in Cologne, Germany, Our coordinator Felicitas was asked to moderate the session dedicated to "Reducing food losses through digitalisation" which consisted of two presentations: The first one given by Michael Schüpbach from FANUC Europe addressed "Added value through automation in the food industry" while the second presented by Prof Dr Stefan Braunreuther from Augsburg University introduced findings from "The

REIF project: Using AI against food waste". The interested audience started into the discussion immediately after both presentations which was very inspiring.

In the next session which was also organised by DLG e.V., the DLG postdoc fellowship award 2023 was officially presented to our colleague Annika Johanna Thies (see also subchapter 3.1.9.5).

3.3 Topic 3: Stimulating research cooperation

3.3.1 Embrapa and Thünen sign Memorandum of Understanding to strengthen cooperation[30]

Strengthening international cooperation is part of the solution to accelerate the reduction of food waste. Embrapa, an agricultural research thinktank with 43 research centers in Brazil, has formalized a cooperation agreement with the Thünen Institute. The opening ceremony of our Regional FLW Workshop Workshop[31] held in Brasília in October 2024, marked the announcement of the partnership. To strengthen the history of cooperation between Embrapa and the Thünen Institute, the two institutions are planning new joint initiatives to foster the cooperation between Latin America and Europe aligned to circular food systems.

Considering the existing synergies between Embrapa and Thünen, there is potential to expand cooperation to other areas of knowledge in agricultural research. In this respect, the German Ministry of Agriculture and Food of Germany (BMEL), the Brazilian Ministry of Agriculture and Livestock (MAPA) and the Brazilian Ministry of Agrarian Development (MDA) also signed a MoU focusing on the transformation of food systems through the bioeconomy. Germany, as the first country to join the Global Alliance Against Hunger and Poverty, launched by Brazil during the G20 in 2024, is committed to continue cooperating with the Brazilian government in 2025, when Brazil will host the COP 30 in Belém.

The formalization of the cooperation, already consolidated through several joint participations in international forums on food waste since 2018, expands opportunities to share good practices between Latin American countries and to generate new empirical data on food losses and waste.

3.3.2 Cooperation with the Chinese Academy of Agricultural Sciences (CAAS)

This cooperation was formally started with a Memorandum of Understanding in 2017 and continued further as reported in our previous Annual Reports. In 2024, the cooperation led to the publication of a peer-reviewed paper jointly prepared by Xiangping Jia, Minghao Ning and Jiping Ding from CAAS and the Initative´s coordinator Felicitas Schneider. The paper gains insights into the on-farm grading processes and different marketing channels for fresh apples in China, measures mass and monetary values and discusses the effects of aesthetic preferences and shape abnormality on the economic income for smallholders.

3.3.3 Joint publication with the Swedish University of Agricultural Sciences

In 2024, we renewed our cooperation with the research group around Dr Mattias Eriksson at the Swedish University of Agricultural Sciences (SLU). After a book chapter on FW in retail in 2020, the current topic was related to the composition of school meal waste and the associated carbon footprint and nutrient loss. The

[30] The following section was kindly provided by Gustavo Porpino (Embrapa Foods and Territories/Brazil), Carmem Priscila Bocchi (Brazilian Ministry of Development and Social Assistance, Family and Fight Against Hunger – MDS) and Edilson Fragalle (Embrapa).

[31] See also subsection 3.2.1.

research was part of the LOWINFOOD project[32] where plate waste from around 5,000 meals in two elementary schools was analysed in detail. The results include recommendations to tailor FW prevention measures for Swedish school canteens, mitigate the associated environmental impact as well as save valuable nutrients for the children. The publication was released in Resources, Conservation and Recycling in April 2024.

Capacity building cooperation with SLU is mentioned in subchapter 3.2.5.

3.3.4 Joint publication on Biodiversity impact of food waste[33]

During the study program "Geo-Ecology – Environmental Sciences" at the University of Bayreuth, Jakob Bogenreuther developed the idea of quantifying the impact of food consumption on biodiversity in his master's thesis. Together with Prof. Thomas Koellner, this idea was further refined with a focus on food waste in Germany, as its reduction holds the potential for ecosystem recovery. Since the biodiversity impact occurs in the countries where the food was initially grown, Dr Thomas Kastner from the Senckenberg Institute joined the thesis as a co-supervisor, contributing his expertise on telecoupling consumption effects with distant regions. The amount of food waste was quantified for over 200 food products across various supply chain stages and their sub-stages. To achieve this level of detail at the household stage, representative data on the mass and composition of food waste were provided by the German Federal Ministry of Food and Agriculture. Additionally, Dr Felicitas Schneider from the Thünen Institute provided active support during the thesis and in the development of the scientific paper that emerged from it. The paper was published in the Journal of Industrial Ecology in 2024, with a particular emphasis on quantifying the biodiversity impact of animal products and biodiversity loss across different taxa. 0.3 vertebrate and 1.5 plant species are potentially lost globally because of Germany's avoidable food waste (food that was edible before its disposal). 47 % of this species loss is caused by households, while food services have the largest impact per mass. The most influential products are pork, lard, dairy, and beef, while amphibians are the most affected vertebrate taxa, occurring in the most affected country, Brazil. In November 2024, these findings were also presented in a talk at the "Ecosystem Service Partnership Europe Conference" in the Netherlands (Figure 47).

Figure 47 Jakob Bogenreuther giving a talk on the biodiversity impact of food waste at the "Ecosystem Service Partnership Europe Conference" 2024 (Credit: Dr Sebastian Candiago).

[32] See more information on LOWINFOOD project activities in subchapter 3.1.9.4 and 3.3.7.

[33] This section was provided by Jakob Bogenreuther from University of Bayreuth.

3.3.5 Preventing stored product pests in Germany (AVoiD)[34]

The AVoiD project (Abwehr von Vorratsschädlingen in Deutschland), funded by the Federal Ministry of Food and Agriculture (BMEL) as part of the Immediate Climate Protection Programme 2022, investigates environmentally friendly strategies for the prevention and early detection of pest infestations on stored plant products. In addition to the study of climate-optimised (hermetic) storage techniques (work package 1), a Germany-wide monitoring of stored product pest insects inside storages, but especially in the field, was established, to collect data on the occurrence and spread of (new) pests and correlations with climatic and regional factors.

Hermetic storage is a method of safely storing grain under low-oxygen conditions. Insects, moulds and microorganisms that need oxygen to survive are suppressed and losses can be avoided. But how can low oxygen levels be achieved as quickly as possible and how can they be maintained? These questions are being investigated in a series of experiments at the Julius Kühn-Institute in Berlin (Figure 48). The results show that oxygen consumption depends, among other things, on the moisture content of the grain, on microorganisms on the grain surface and, above all, on the presence of insects. The addition of caged insects to hermetically stored grain (Figure 49) causes a much faster decrease in oxygen content. This reduction depends on the number of insects present. Next year, larger silo experiments will be carried out in which insects are introduced into two hermetically sealed silos while oxygen, carbon dioxide, temperature and humidity are closely monitored.

Figure 48 Different types of commercially available hermetic bags used for experiments. (Photos: V. Misgaiski and C. Müller-Blenkle, JKI)

[34] The following section was provided by Cornel Adler, Camilla Albrecht, Benjamin Fürstenau, Christina Müller-Blenkle from Julius Kühn-Institute, Berlin, Julia Büchner and Jovanka Saltzmann from Julius Kühn-Institute, Klein-Machnow as well as Jones Athai and Felicitas Schneider from Thünen Institute of Market Analysis.

Figure 49 Grain weevils in different developmental stages were placed in cages inside hermetic containers to investigate the oxygen consumption to improve hermetic grain storage. (Photos: V. Misgaiski and C. Müller-Blenkle, JKI)

The occurrence of stored product pest insects outside storage facilities poses an additional threat to stored plant products and possibly to crops, and therefore represents a (further) challenge for farmers. Successful early detection of them therefore starts in the field and represents a future and important way in stored product protection. During the first two years of the project (2023 and 2024), a large number of storage pests of different species were caught inside and outside the storage facilities with three trap types (Figure 50). In 2023, more than 3000 specimens were counted on the nine test farms, including 11 moth and 19 beetle species, all of which have already been described or established in Germany (Figure 51). In 2024, a similar range of species was trapped, but in some cases at much higher abundances (Table 1). Most pests occurred indoors, but interestingly a few species, in particular the lesser grain borer, *Rhyzopertha dominica*, originally native to the tropics and subtropics, were found in high abundance outdoors on almost all test sites.

Figure 50 Traps for flying and crawling insects in the field in Schleswig-Holstein (photo: C. Albrecht, JKI)

Total number	2023	2024
Rhyzopertha dominica	1182	1128
Oryzaephilus surinamensis	280	1534
Ephestia spp.	576	1901
Plodia interpunctella	248	1937
Nemapogon spp.	327	364
Psocoptera spp.	1057	2441

Table 1 Comparison of total catches of the most abundant pest species in storage and in the field.

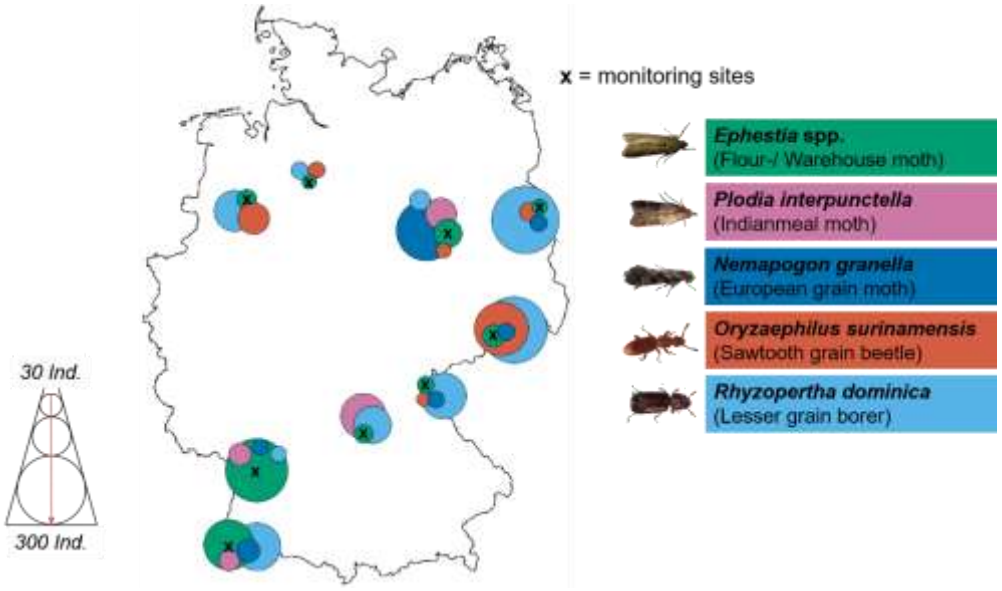

Figure 51 Schematic representation of the total number of catches of the most abundant stored product pests at the different monitoring sites in Germany (April-November 2023) (credit: JKI).

The extensive data set compiled by Julius Kuehn Institute (JKI) on the properties and costs of around 600 grain storage facilities in Germany was evaluated in terms of investment and operating costs. Different storage capacities, properties and equipment of hermetic and non-hermetic storage facilities were taken into account. Scenarios and damage assumptions for evaluating the economic viability of storage facilities under future climate conditions were created and will be analysed economically in the next step.

Another part of the AVoiD project includes to efficiently assess the environmental and social impacts of the different storage systems. In 2024, life cycle inventories and background information on social indicators (such as working hours) were drawn up for some storage systems from literature and survey results. These inventories serve as the basis for the forthcoming life cycle assessment and comparison of social indicators.

3.3.6 Cooperation within European project FOLOU[35]

The FOLOU project (Figure 52) addresses the issue of food loss (FL) at the primary production level, a critical challenge that impacts food security, environmental sustainability, and economic efficiency. FL prevention faces barriers such as insufficient measurement methods, limited understanding of drivers, and gaps in stakeholder skills. FOLOU's main objective is to reduce FL at the primary stage and support the transition to a sustainable EU food system by providing tools, frameworks, and training for effective prevention strategies.

Figure 52 FOLOU logo (credit: FOLOU)

In 2024, FOLOU advanced efforts to understand, measure, and reduce FL while promoting stakeholder engagement. A thorough review of FL data, drivers, and regulations resulted in a consolidated repository and a

[35] The chapter was provided by Valerie Verniers and Hans Ryckebusch from Impact.

new, consistent definition of FL, distinguishing it from food waste. The project also developed a behavioural framework to analyse drivers of FL, combining environmental, societal, and operational factors.

To improve measurement, FOLOU created a Quantification Manual outlining standardized methods for assessing FL across commodity groups (e.g., fruits, vegetables, meat). A national FL registry was established for company-level reporting, forming the foundation for a European-wide system. Six innovative technologies, including Unmanned Aerial Vehicles (UAVs) and blockchain, were tested to enhance FL measurement accuracy and cost-effectiveness. A tailored sustainability assessment framework, based on Life Cycle Assessment (LCA), Sustainable Product Life Cycle Assessment (SLCA), and Life-Cycle Costing (LCC) methodologies, was also developed to evaluate FL's environmental, social, and economic impacts.

Figure 53 Family photo of the participants of FOLOU general project meeting in Ghent, Belgium (credit: Wouter Maes).

FOLOU initiated the development of an eLearning Centre, which will train stakeholders on FL measurement, sustainability, and policymaking, with the first course launching in early 2025. Collaboration with initiatives like WASTELESS and the EU Food Loss and Waste Prevention Hub and several EU funded research projects has further expanded FOLOU's outreach. Initiated in October 2024, the FOLOU's Twinning Regions Program is engaging agricultural regions to replicate its solutions, with ongoing efforts to foster adoption.

The FOLOU project has also conducted a comprehensive review of FL-related regulations, providing evidence and recommendations to policymakers to support sustainable practices. By developing tools, methodologies, and training programs, FOLOU is contributing to a more resilient and efficient EU food system.

Dr Felicitas Schneider supports the FOLOU project as member of the External Expert Advisory Board. The 2024 general project meeting took place in July at the University of Ghent (Figure 53). The public deliverables from the FOLOU project can now also be accessed on the FOLOU publication website. For more information about the project, its activities, and outputs, visit the website as well.

3.3.7 Research cooperation with University of Tuscia, Italy[36]

The University of Tuscia is actively engaged in various projects and initiatives aimed at reducing food loss and waste.

A methodology for assessing food loss in the post-harvest phase of the supply chain is developed after a visiting period which involved the **mobility of PhD students** between University of Tuscia and Thünen Institute[37]. This methodology focuses on quantifying food downgraded due to private quality standards and downgraded to "suboptimal products"; a case study on carrots is considered in this study, with the field data collection performed at the warehouse of a Producer Organisation. The findings are published in a scientific article and form a key component of a PhD dissertation, the defense of which is scheduled for Spring 2025.

Part of this work is also presented in the ELLS Scientific Student Conference 2024, taking place in November 2024 in Wageningen, as part of a Master thesis in Food science and technology. The title of the contribution presented at the conference is "Market acceptance and trade channels of suboptimal fruits and vegetables: a case study on carrots".

The same methodology is used in another study developed by a Master student in Food and nutrition of University of Tuscia. The master thesis is entitled "Brutti ma buoni: canali commerciali e valore degli ortaggi con difetti estetici" ("Ugly but good: commercial channels and value of vegetables with cosmetic defects") and it was defended in October 2024. This study conducts a direct assessment on cauliflower and zucchini at an organic farm, with a focus on the commercial channels of standard and downgraded products, and their market value.

In the same stream of research, another Master thesis in Food and nutrition was developed focusing on redistribution of surplus food to charities. This work is conducted in collaboration with the Municipality of Viterbo and it allowed to establish a procedure to allow any supermarket or food company of the area to donate surplus on a daily basis, at the same time keeping the traceability of the product from the donor up to the charities and the final users. The title of the study is "Organizzazione di una Filiera Solidale per il recupero delle eccedenze alimentari nel Comune di Viterbo" ("Organization of a solidarity-based supply chain for the redistribution of surplus food in the Municipality of Viterbo") and the thesis was defended in October 2024.

The Thünen Institute is also involved in the **LOWINFOOD project** by means of the availability of Felicitas Schneider to be a member of the External Advisory Board of the project. In this role, she revised three crucial deliverables of the LOWINFOOD project in October 2024, focusing on the evaluation of the innovations against food loss and waste that have been demonstrated during the project. In January 2024, LOWINFOOD was invited by the Collaboration Initiative FLW to join the Global Forum of Food and Agriculture in Berlin and present results by video and poster contribution as well as on-site discussions[38]. There was also a cooperation to derive the policy and market recommendations for the diffusion of innovations which will be submitted as deliverable D6.10 in February 2025.

[36] This section was kindly prepared by Dr Clara Cicatiello and Roberta Pietrangeli from University Tuscia.

[37] See also 2022 annual report, chapter 3.3.3 and 2023 annual report, chapter 3.3.5.

[38] See also subchapter 3.1.9.4

3.3.8 PhD on food waste in households and street markets in Zimbabwe -2024 Update [39]

The main focus of the project in 2024 was data analysis. Key findings show that the average food waste in the surveyed households is 3.19 kg per household per week, equivalent to 46 kg per capita per year. The household food waste consisted mainly of cooked food, primarily vegetables and starchy foods such as sadza (thick maize meal porridge), the staple of the Zimbabwean diet. Socio-cultural practices around food preparation, eating, and storage of leftovers significantly influenced food disposal in these households.

At the street market level, 1,427 kg of food waste was sorted and weighed. The most wasted items were vegetables such as tomatoes, cucumbers, bell peppers, and fruits like bananas. Contributing factors to market-level food waste included overstocking, inadequate infrastructure, and the lack of refrigeration facilities.

The findings were shared at multiple events. First, at the Global Forum for Food and Agriculture in Berlin, where the findings of the households were presented in a panel discussion (Figure 54, left; also see chapter 3.1.9.4), while the results of the street markets were exhibited as a poster. Secondly, at the Retaste Conference 2024 in Crete (Figure 54, right) and lastly at the Thünen Colloquium to commemorate the International Day of Awareness of Food Loss and Waste (also see chapter 3.2.3).

Figure 54 Sharon presenting her findings on household food waste at the Global Forum of Food and Agriculture 2024 in Berlin (left, Credit: Lia Orr) and at the ReTaste Conference 2024 in Greece (credit: Max Urruzola Arrate, Eidar Olazar Elduaien, Oihane Lakar Iraizoz, Hariz Mutilva Garmendia).

The project's next phase is to write and publish scientific articles based on these findings. The project received additional funding from the Herman Weber Scholarship.

3.3.9 Collaboration on the role of food banks for Zero Hunger Challenge [40]

In 2024, a new research collaboration was established between the Collaboration Initiative FLW and Dr Ryan Atkins, Associate Professor of Supply Chain Management from Duquesne University/USA, Dr Guénola Abord-Hugon Nonet, Assistant Professor in Sustainability Strategy & Leadership from Jönköping International Business School/Sweden as well as Dr Kimberly Deranek, Professor of Decision Sciences from Nova Southeastern University/USA. Driven by the joint interest to contribute to international knowledge, the planned output is a research paper. As part of a previous study which investigated the barriers and incentives associated with food loss and food waste (FLW), our team identified food banks as a crucial stakeholder. To build on the findings of

[39] This chapter was written by Sharon Yeukai Mada who is currently PhD student at Thünen Institute of Market Analysis.

[40] This chapter was written by Dr Ryan Atkins from Duquesne University/USA, Dr Kimberly Deranek from Nova Southeastern University/USA and completed by Felicitas Schneider.

the previous study, we launched the current investigation of food banks Within the framework of Agenda 2030, the Zero Hunger Challenge has since gained widespread support from numerous member states and other entities. It calls for:

- Zero stunted children under the age of two
- 100 % access to adequate food all year round
- All food systems are sustainable
- 100 % increase in smallholder productivity and income
- Zero loss or waste of food

The purpose of the project is to gain a better understanding of the role of food banks in engaging with stakeholders to help achieve Zero Hunger Challenge defined by SDG 2 Agenda 2030. By using a broad multinational approach, this study seeks to understand how national-level food bank organizations engage with stakeholders throughout food supply chains including sources of supplies and donations, food recipients, government agencies, transportation and logistics agencies, volunteers, and local distributors (i.e. food pantries). In doing so, we seek to understand the value propositions for each stakeholder, considering all three dimensions of the triple bottom line. Critical elements of stakeholder engagement that we seek to understand include the alignment of incentives and motivations and the processes and mechanisms that are used to achieve alignment. The intended outcomes of the study include a theoretical contribution related to food banks and the identification of best practices at national levels.

The intended outcomes of the study include a theoretical contribution related to food banks and the identification of best practices at national levels. The study is currently in progress, with interviews expected to be completed by the end of 2024.

3.3.10 Collaboration with the European project WASTEWISE

The WASTEWISE project was selected for funding by the European Commission within the call HORIZON-CL6-2024-FARMTOFORK-01. The consortium is led by EU Core consulting while the scientific coordination will be done by LUKE, Finland. In total, nine partners from six European countries form the consortium. The project will implement a holistic, multi-actor approach across the food supply chain, to measure environmental impact of food waste prevention and reduction. Further expected outputs are to propose evidence-based measures and drive systemic shifts for sustainable food consumption, poverty alleviation, and environmental sustainability in prioritized supply chains.

It is a pleasure for our coordinator Felicitas to contribute to WASTEWISE as member of the External Advisory Board. The project started on November 1st and the kick-off meeting took place in December 2024 in Turin. Congratulations to the project team - we are looking forward to fruitful cooperation!

3.3.11 Collaboration with New Zealand – the AgriDENZ project

The Alliance for the Climate – Dialogue on climate and agriculture between New Zealand and Germany, short AgriDENZ (Figure 55), started in April 2024. The aim is to facilitate mutual understanding, cooperation related to politics, science and technology while transforming agriculture and food systems under climate change conditions. The project team is built from Thünen Institute and New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC). The funding is provided by the German Ministry of Food and Agriculture (BMEL) and the New Zealand Ministry for Primary Industries (MPI).

Figure 55 AgriDENZ logo (credit: AgriDENZ).

The project consists of three pillars:

a. Scientific exchange
b. Policy Dialogue
c. Third Party Countries

You are welcome to have a closer look on the AgriDENZ activities on its website. Our Collaboration Initiative FLW contributes to pillar a) and c). Our coordinator will participate in a scientific research stay planned for early 2025. Our FLW workshops support the knowledge exchange with the Third-Party Countries and facilitate network building and cooperation as part of pillar c (see also chapters 3.2.1 and 3.2.2). The project will be completed by end of 2026.

3.3.12 Collaboration with University of Tehran, Iran

Some years ago, we were kindly invited to cooperate with Dr Mostafa Moradi, Prof Hossein Shabanali Fami and Dr Ali Akbar Barati from the Department of Agricultural Management and Development as well as Reza Salehi Mohammadi from the Department of Horticultural Sciences from University of Tehran, Karaj, Iran. The international team was completed by Dr Lusine Aramyan from Wageningen University & Research, Wageningen Economic Research, the Netherlands.

The topic of the collaboration was the losses and waste of leafy vegetables that occur along the entire food supply chain in a selected province of Iran. The methodology used was a systems dynamics approach and the results provide valuable insights into the situation on the ground as well as the potential impact of different prevention measures, which were assessed by experts and other stakeholders. The contract farming intervention was analysed in more detail to see if and how it could improve the overall situation in terms of food loss and waste.

More information on the potential impact of food waste reduction interventions in the leafy vegetable supply chain can be found here, while the impact of contract farming is analysed in more detail in this second paper.

3.4 Topic 4: Matching ideas & funding

The Humboldt Foundation offers a fellowship related to combating climate change, adaptation strategies, preserving ecosystems and biodiversity, on the sustainable use of the seas and oceans as well as sustainability topics relating to natural resources, resource-efficient consumption or urban development. Target groups are prospective leaders working practically (one year research project in Germany) and postdocs (long-term academic research 12 to 24 months) from non-European developing or transition countries. Up to 15 International Climate Protection Fellowships to prospective leaders working practically and up to five to postdocs are selected each year. The submission deadline is February 1st, 2025. If you have an idea and think that the Collaboration Initiative FLW could be a good collaborating host in Germany, please do not hesitate to contact Felicitas.

3.5 Topic 5: Fostering cooperation at implementation level

3.5.1 Cooperation with national and international standardisation organisations

3.5.1.1 DIN Specification on Digital reporting of food surpluses in the supply chain

Since mid of 2023, the German Standard Organisation (DIN) hosted a consortium working on a so-called DIN Specification related to the topic "Digital reporting of food surpluses in the supply chain". Specifications are developed under different established processes rather than a standard but could serve as a basis for later upgrading into a standard.

The requirements for protocols for the standardised digital reporting of food surpluses along the entire value chain as a prerequisite for an AI-driven distribution platform are specified in that specific DIN Spec. The document is aimed at all parties involved in the food supply chain in the B2B segment. Stakeholders from food, technology and logistics businesses, research and NGOs contributed to the elaboration of the document which was published as DIN SPEC 91550-1:2024-08 in August 2024 with the subtitle "Part 1: Definition of semantics and a data protocol for digital transmission". Our coordinator Felicitas supported the discussions in the online and in-person meetings with her expertise. The publication can be downloaded free of charge here.

3.5.1.2 ISO/TC 34/SC 20 Food Loss and Waste

The work of the International Organisation for Standardisation subcommittee ISO/TC 34/SC 20 Food Loss and Waste was further developed during 2024. After preparatory work in 2023, the draft of the ISO/CD 20001 "Food loss and waste management system — Requirements for the minimization of food loss and waste across the food value chain" was reviewed by national mirror committees. A comprehensive list of comments was collected and discussed during the in person meeting of the subcommittee working group 1 members in April 2024 in the UK (Figure 56). Our generous host was the Harper Adams University who provided perfect framework conditions for a constructive discussion during the revision of the Committee Draft (CD). Besides the meetings the participants also had the opportunity to visit the Harper Adams University´s agricultural research facilities and to learn its history, meet the university board members and regional policy makers and get insights into further food waste reduction activities on-site. Thank you so much for the hospitality!

In the months after the in-person meeting, the management standard draft was further revised and in August the second internal review started. In the beginning of December 2024, all received comments from the national mirror committees were resubmitted. They will be addressed in the next in-person meeting planned for March 2025 in Sydney, Australia. In addition, two further working groups were finally approved by the national mirror committees. Working group 2 will elaborate the new working item called "Quantification, measurement, monitoring and reporting methods for food loss and waste". This guide (ISO/AWI TS 20008) will support organizations to analyse FLW occurrences, quantities and hotspots in line with the organization's policies and objectives, the root causes of FLW hotspots, monitor and report quantities and assess progress over time, and to verify the efficiency of FLW reduction actions. Working group 3 will cooperate on "Requirements for bodies providing audit and certification of food loss/waste management systems" (ISO/AWI 20020). This document will specify the requirements for the audit and certification complying with the requirements given in ISO 20001.

Figure 56 Group photo of subcomittee working group 1 members attending the meeting in Edgmond/UK in person (credit: Harper Adams University)

In Germany, the official DIN working group serving as a national mirror group is "NA 057-02-02 AA food safety – management systems". Here all information from the ISO group is discussed and feedback on behalf of Germany will be transmitted through the German delegation back to ISO. The Collaboration Initiative coordinator, Felicitas, is a member of the DIN mirror group as well as the head of the German delegation related to the ISO subcommittee, including working group 1.

3.5.2 Cooperation with United Nations Environment Program (UNEP)

Our fruitful cooperation with UNEP was continued in relation to our annual FLW workshop, this time in Brazil. We appreciate the workshop participation of Ms Clementine O´Connor very much as she also provided her valuable network contacts and budget to support the participation of selected participants (also see chapter 3.2.1).

In addition, our coordinator supported the 2024 Food Waste Index Report as reviewer.

3.5.3 Cooperation with the African Union

As Food Loss and Waste prevention can contribute to foster resilient and sustainable food systems, reduce hunger, tackle decreasing soil carbon content and facilitate smallholder farmers income, the cooperation between the Collaboration Initiative Food Loss and Waste and the African Union will be increased in the coming years. The framework is provided by the "Agricultural policy dialogue between the African Union and Germany to strengthen the resilience of food systems in Africa" which was started end of 2023. The first cooperation was related to the Preparatory Workshop on FLW in Nairobi (see also chapter 3.2.2).

3.6 Recent literature from Initiative partners and other sources

In this section, we introduce selected new literature related to FLW which was published by members of our network in alphabetical order. If you would like to see your publication listed here, too, please give us a hint!

Publications:

- Abulude I., Wahlen S. (2024) Food loss analysis in Nigeria: A systematic literature review. Environmental Challenges 17 (2024) 101027, https://doi.org/10.1016/j.envc.2024.101027
- Antonelli M., Giordano C., Chiriacò M.V., Casari S., Cadel E., Chen P.J., Magnani A., Pizzileo G., Falasconi L., Alboni F., Cicatiello C. (2024) Assessing the Monetary Value and Environmental Impact of Household Food Waste in Italy. Sustainability 2024, 16, 10614. https://doi.org/10.3390/su162310614.
- Argentina National Plan for the Reduction of Food Losses and Waste - National Law 27.454 - Progress Report 2022 – 2023. In Spanish, 21 pages.
- Bogenreuther J., Kastner T., Schneider F., Koellner T. (2024) Biodiversity impact of food waste - Quantification for supply chain stages and products in Germany. Journal of Industrial Ecology 2024;1–13, http://doi.org/10.1111/jiec.13471.
- Büttemeier M., Orr L., Schmidt T., Schlindwein M., Dierkes H. (2024) Evaluationsbericht Kompetenzstelle Außer-Haus-Verpflegung (Evaluation report Competence Centre Out-of-Home). Thünen Working Paper 252, Johann Heinrich von Thünen-Institut, Braunschweig, December 2024, 89 pages, DOI:10.3220/WP1732093170000 (German with English abstract).
- Chandrasiri C., Kiridena S., Dharmapriya S., Kulatunga A.K. (2024) Adoption of Multi-Modal Transportation for Configuring Sustainable Agri-Food Supply Chains in Constrained Environments. Sustainability 2024, 16, 7601, https://doi.org/10.3390/su16177601.
- Fernandez-Zamudio M.A., Zarzo I., Pina T., Soriano J. M., San Onofre N. (2024) Assessment and Solutions to Food Waste at Congress Events: A Perspective of the MagNuS Project. Foods, 13(2), 181, https://doi.org/10.3390/foods13020181.
- Generalitat Valenciana, IVIA (2024) Guía para la implementación de un plan de prevención del desperdicio alimentario en los comedores escolares de la Comunitat Valenciana (Guide for Implementing a Food Waste Prevention Plan in School Cafeterias of the Valencian Community). Valencia, March 2024, 129 pages, in Spanish.
- Jia X., Schneider F., Ning M., Ding J. (2024) Aesthetic grading causes food losses without financially benefiting farmers: Micro-level evidence from China's fresh apple supply chain. Waste Management & Research, 1–12, https://doi.org/10.1177/0734242X241280097.
- Kumari S., Dhingra D. (2024) Post-Harvest Management of Fruits in India: A Review. Journal of Agricultural Engineering (India), 61(2), 181-201, https://doi.org/10.52151/jae2024612.1845.
- Kuntscher M., Schmidt T. (2024) Pakt gegen Lebensmittelverschwendung im Groß- und Einzelhandel - Ergebnisbericht zum Monitoring 2023 (Pact against food waste in wholesale and retail – Monitoring 2023). Thünen Working Paper Nr. 250, 47 pages, Braunschweig, December 2024, DOI:10.3220/WP1730818070000 (in German with English abstract).
- Laila A., Gallant M., Bain M., Alexander C., Reis L., Welboren A., von Massow M., Parizeau K., Walton K., Ma D.W.L., Haines J. (2024) Household Food Waste Intervention Is Feasible, Acceptable, and Effective. Journal of Nutrition Education and Behavior, Volume 56, Number 2, 2024, https://doi.org/10.1016/j.jneb.2023.11.004.
- Moradi M., Shabanali Fami H., Barati A.A., Schneider F., Aramyan L.H., Mohammadi R.S. (2024) Investigating the Potential Effects of Food Waste Reduction Interventions Within the Leafy Vegetable Supply Chain in Kermanshah Province, Iran. Agriculture 2024, 14, 2344, https://doi.org/10.3390/agriculture14122344.

- Moradi M., Shabanali Fami H., Barati A.A., Schneider F., Mohammadi R.S., Aramyan L. (2025) Leveraging Contract Farming to Reduce Leafy Vegetable Waste: A System Dynamics Approach from Kermanshah Province of Iran. Cogent Food & Agriculture, 2025, Vol. 11, No. 1, 2443270, https://doi.org/10.1080/23311932.2024.2443270.
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Selected webinars, podcasts and other recordings from cooperation partners:

- MeatsPad Podcast "Consumer Preferences for Meat Color at the Retail Level" organised by Dr Francisco Najar on September 3rd, 2024 with guest Dr Annika Thies from Thünen Institute of Market Analysis (see chapter 3.1.9.5).
- Embrapa's distant learning free course related to techniques to improve post-harvest practices aimed at reducing food losses and improving quality (in Portuguese, see chapter 3.1.5.2).
- FAO webinar "Bringing in a Behavioural Perspective to Food Loss and Waste Value Chain Analysis" held on March 20th, 2024.

- FOLOU Webinar part 1 “Defining Food Loss in the European Union Framework – Challenges and Significance”, held on March 14th, 2024.
- FOLOU Webinar part 2 „Navigating Reliable Diagnoses for Measuring Food Losses in the Primary Sector of the Supply Chain", held on April 11th, 2024.
- FOLOU Webinar part 3 “Tackling the Challenge of Quantifying Food Losses Across All Fronts – Local, Regional and National Perspectives”, held on May 23rd, 2024.
- Self-paced online course (in Spanish) titled “Prevention of Food Loss and Waste” is free and open to the public (upon registration) and part of the training portal of the Ministry of Agriculture of the regional government (Generalitat Valenciana, GVA). The course has a duration of 15 hours and is structured into 12 educational modules delivered through videos and other multimedia resources (see chapter 3.1.10.2).
- The European Consumer Food Waste Forum closed its work in June 2024 with a public event Let’s reduce consumer food waste! and the launch of Toolkit website in Brussels.

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