

# Collaboration Initiative Food Loss and Waste launched at MACS-G20

2022 update on activities



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Contact Coordinator Initiative: Dr Felicitas Schneider

phone.: +49 531 596 5335

E-Mail: felicitas.schneider@thuenen.de

With kind support from Sabrina Bergeron Quirion (Agriculture and Agri-Food Canada/Canada), Clara Cicatiello (University of Tuscia/Italy), Héctor Barco Cobalea (Enraíza Derechos/Spain), Maria-Angeles Fernandez-Zamudio (Valencian Institute of Agricultural Research (IVIA)/Spain), Rupert Fritzenwallner (Austrian Armed Forces/Austria), Ronja Herzberg (Thünen Institute of Market Analysis/Germany), Stefan Lange (Thünen Institute/Germany), Sharon Yeukai Mada (Thünen Institute of Market Analysis/Germany), Carole McKinnon (Agriculture and Agri-Food Canada/Canada), Roberta Pietrangeli (University of Tuscia/Italy), Tatiana Pina (University of Valencia), Gustavo Porpino (Embrapa Foods and Territories/Brazil), Louis Sasseville (Agriculture and Agri-Food Canada/Canada), Thomas Schmidt (Thünen Institute of Market Analysis/Germany), Eva Sternfeld (Sino-German Agricultural Center (DCZ)/China), Sébastien Villeneuve (Agriculture and Agri-Food Canada/Canada). Many thanks to Ms Susanne Kendell (Thünen Institute of Market Analysis/Germany) for English proofreading.

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## 1 Preface

In 2022, the Collaboration Initiative Food Loss and Waste launched at MACS-G20<sup>1</sup> finished its seventh year. The global pandemic is still an issue in global food supply chains and the Ukrainian war has major effects on global food availability. Fighting against food loss and waste was addressed by G20 presidency Indonesia as well as discussed during COP27. Cooperation between research, policy and practice as well as a more inter-disciplinary approach was requested in many discussions throughout the year. Let's contribute to these issues together!

As in previous years, we - Stefan and Felicitas from the Thünen Institute (Federal Research Institute for Rural Areas, Forestry and Fisheries) - invited our Initiative partners to contribute with a brief summary to the present report not only on our joint but also on their own or ongoing national FLW activities. This approach supports our aim to share knowledge and experiences within our global network. Enjoy!

## 2 Introduction

The Collaboration Initiative on Food Losses and Waste launched at MACS-G20 was founded in 2015 at the MACS-G20 in Izmir, Turkey. 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 he supervises the coordinator and takes part in selected activities. Since then, Germany has been financing the position of a coordinator. The coordinator is located at the Thünen Institute 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 and further countries and stakeholders to participate in joint activities. The present report **provides a brief update and summarises the activities from 2022**. 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 [here](#) 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 20<sup>th</sup> to 22<sup>nd</sup> 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](mailto:felicitas.schneider@thuenen.de) and by visiting the website of [FLW Initiative](#). You are always welcome!

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.

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<sup>1</sup> 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](#).

### 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).

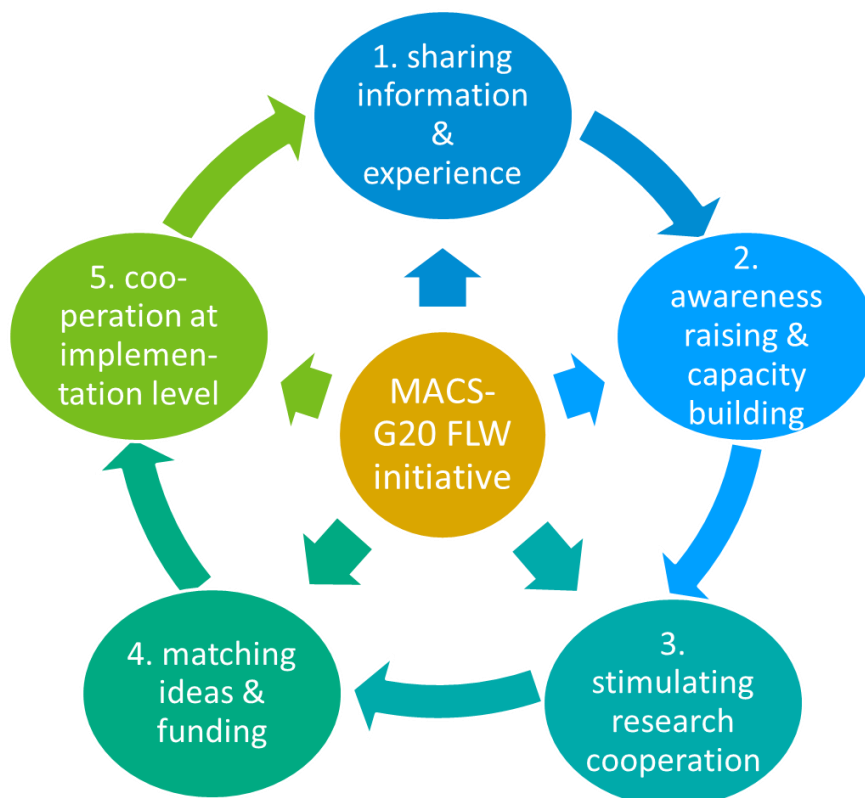


Figure 1 Scheme of the main topics of Collaboration Initiative FLW launched at MACS-G20

#### 3.1 Topic 1: Sharing information & experience

##### 3.1.1 Global Food Loss and Waste Research Platform

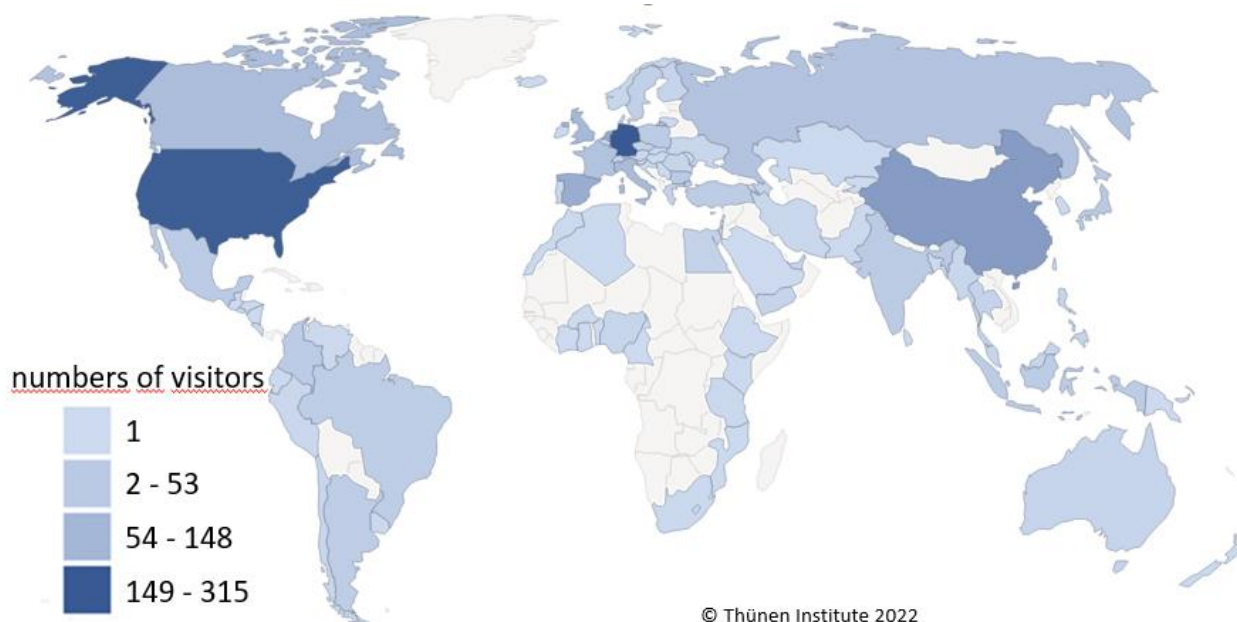
The Global Food Loss and Waste Research Platform is an [international database](#) where experts register in order to make their contact information and their FLW projects more visible on a global level. Aim of the Platform is to offer easy access to focused information for policy decision makers, companies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

Unfortunately, due to technical problems during the relaunch of the Thünen website, the Research Platform has **not been available since end of August 2022**. We hope that the issue can be solved soon and the database will be available again. In our next report, we will again include statistics related to the expert database. Then, all interested colleagues are welcome to contribute further knowledge to the database by inviting additional experts also from non-G20 countries to register and using the content for their own investigations and network establishment.

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 mid December 2021 to mid December 2022 (although not available since end of August 2022), 2,093 accesses from 97 different countries were counted for the website in total which represents a 14 % increase of access compared to recent years. Figure 2 shows the visitors' countries of origin wherever this could be tracked. The majority of the visitors came from Germany, USA, China, Netherlands, Spain,

UK, Italy, Canada, France and Russia with more than 50 different counts. Looking at the origin of users by continents, Europe ranks prior to the whole of America and followed by Asia. In total, all continents are represented by at least 15 unique accesses (which were counted from Oceania). For our activities we conclude that we should further strengthen our contacts to interested stakeholders in the global South although we already made progress in the last years.

A huge increase shows the number of visitors who directly contacted our website; it doubled in the last year (from 777 to 1,829 visitors or from 42 % to 87 %). 150 visitors (7 %) were directed to the website by using search engines and 114 visitors (5 %) were redirected from other websites. Those numbers show a surprising increase of direct visitors which may be explained by active postings of our website link during global online events.



**Figure 2 Numbers of visitors at the Global Food Loss and Waste Research Platform in 2022**

### 3.1.2 G20 under the presidency of Indonesia

For these challenging times the Indonesian G20 presidency chose the overall theme “recover together, recover stronger”. The MACS-G20 took place from 5<sup>th</sup> to 7<sup>th</sup> of July 2022 in Denpasar/Bali with the main topics of food security policy post COVID-19, climate resilient agriculture and Food Loss and Waste. In his presentation Stefan Lange highlighted how the reduction of food loss and waste can – and must – contribute to sustainable intensification. His request for more cooperation included two specific suggestions: First, to establish bilateral partnerships among those G20 members and non-members which are more advanced and less advanced in relation to FLW reduction activities in order to achieve a better progress on global and national policy level. Second, to expand the global town twinning approach to share food loss and waste reduction experiences on the level of municipalities in order to enhance the implementation of actions and local policy. The presentation of our Collaboration Initiative can be found on the MACS-G20 [website](#) together with the other presentations. Due to the political discrepancy related to the Ukrainian war, for the first time since MACS was established in 2012, there was no agreed MACS-G20 communiqué.

In addition to the obligatory MACS there was also a G20 technical workshop on Climate Change organised by MACS-G20 secretariat. The agenda and the presentations can be found [here](#).

With relation to FLW, a virtual workshop on Gap Analysis on Food Loss and Waste Indices (June 21-22, 2022) was organised by the Indonesian Agriculture Working Group. The objective was to “*assess and understand food*

*practices and problems related to the fulfilment of the variables used to form the food loss index and food waste index” as well as “to address and disclose gaps between measurement methods and available data and input on specific efforts to minimize gaps in data”. For further information and the presentations, please see the [event’s website](#). One of the presenters was Gustavo Porpino – our Brazilian colleague from Embrapa who reports more about his presentation in section 3.1.5.*

### 3.1.3 6<sup>th</sup> Regional FLW Workshop in Yogyakarta/Indonesia

One aim of our activities is to organise an annual Regional FLW Workshop. In order to take the G20 responsibility into account more, 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. Our first complete [online workshop](#) during the Italian G20 presidency in 2021 targeted the Mediterranean countries.

In 2022 we were kindly supported by the Indonesian MACS-G20 secretariat assisted by our colleagues from the Indonesian Center for Agricultural Postharvest Research and Development (ICAPRD), Stockholm Environmental Institute (SEI), Center for Indonesian Policy Studies (CIPS), Simon Fraser University, FAO Indonesia and UN Environmental Programme in co-organising the 6<sup>th</sup> Regional FLW Workshop (Figure 3). The target region this year included the members of the Association of Southeast Asian Nations (ASEAN) which are Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam. The aim of the workshop was to support the exchange among regional stakeholders and enhance practical implementation within the topics: Recent Indonesian Initiatives to FLW, Food Waste in ASEAN and Lessons learned from ASEAN Postharvest Food Loss.

The programme followed our strategy to enhance knowledge exchange and structured discussion among our participants in order to support action. First, plenary sessions provided introductory presentations which were then followed by working in groups guided by certain key questions. After two years of pandemic-induced lack of an excursion, we were very happy that we could offer a one-day field trip to our participants.

The final rehearsal went well (Figure 4) and on October 5<sup>th</sup>, 2022 we welcomed 180 stakeholders in person and more than 320 online from policy makers, universities, private and public research institutions, social welfare organisations, food companies etc. from nine different countries! Indonesian media was present and reported about the workshop (Figure 5).

The first plenary session, chaired by Dr Fauzi from Center for Indonesian Policy Studies (CIPS), summarised recent G20 activities related to FLW driven by Indonesia. Prof. Handewi Saliem provided an insight on the findings of the data gap workshop mentioned in chapter 3.1.2. The Policy brief FLW which was developed by the Stockholm Environmental Institute (SEI) in the course of a T20 call was presented by Ms Melati. More information on the policy brief and further SEI activities can be found in chapter 3.2.4.

Food waste was the topic of the second session chaired by Felicitas. Ms Hur from the UN Environmental Programme (UNEP) presented the UNEP Regional Working Groups facilitating the implementation of the Food Waste Index as well as a social media kit developed for the [Every Plate Counts challenge](#). The presentation was completed by Ms Budiani from the Indonesian Business Council for Sustainable Development who introduced the activities of the voluntary agreement related to FLW, called [GRASP 2030](#). Further insights into food waste from households were summarised by Prof. Watanabe from Teikyo University by comparing data from Malaysia, Indonesia and Japan.



**Figure 3 Family photo with some of the onsite FLW workshop participants (credit: Stefan Lange).**



**Figure 4 Stefan Lange and Dr Prayudi Syamsuri, director of ICAPRD, testing the gong used for workshop opening ceremony at final rehearsal (credit: Felicitas Schneider)**

Dr Haryono from Binus University chaired the third plenary session which informed about the postharvest food loss (PHL) issue in ASEAN countries. Data on food losses in combination with specific case study information related to implementation of improvement measures were presented by Prof. Munsaro from the Indonesian Society of Postharvest Technology. Ms Carola Fabi from the FAO Statistical Office complemented the session with updated information on PHL data in ASEAN countries and findings from further Food Loss Index measurements on a global scale.



**Figure 5 Dr Prayudi Syamsuri, director of ICAPRD, Stefan Lange and Prof Fadry Djufry, director general of Indonesian Agency for Agricultural Research and Development (IAARD) surrounded by media representatives (credit: Felicitas Schneider)**

After the break, four working groups were established where the onsite participants discussed the following guiding questions:

- Which utilisation methods are common in your country to prevent food losses from wastage (e.g. use as feed, industrial use) and which methods are currently being implemented or planned?
- Are there specific burdens to implement those strategies on a large scale?
- How can we improve storage techniques (both modern and traditional) to contribute to the reduction of post-harvest loss in ASEAN countries?
- The opportunities and challenges of Food Banks in ASEAN regions.

The input from the onsite participants was complemented by written input from online participants. The findings were summarised by the facilitators and discussed in the last plenary session.

During the breaks, the participants could have a look at the different stalls presenting various activities connected to food surplus redistribution or food loss and waste prevention and utilisation (Figure 6). At the lunch and coffee break buffet, table displays raised awareness of conscious consumption of food (Figure 7). This approach was already implemented during some G20 events hosted during the presidency of the Kingdom of Saudi Arabia (see also our Annual Report [2020](#)). We suggest that upcoming G20 presidencies adopt such awareness raising issues for all their events.



**Figure 6 Workshop participants experiencing the exhibition stalls (credit: Felicitas Schneider)**



**Figure 7 Table displays raising awareness towards conscious food consumption (credit: Felicitas Schneider)**

The second day of the FLW workshop was dedicated to the experience of practical implementation of FLW related issues. A group of about 80 people joined the interesting field trip. The first place was Protema Natural Feed PT Maggoprotein Alam Indonesia where we could see the breeding of black soldier fly maggots (Figure 8, right) fed by shredded food waste from restaurants (Figure 8 left). The products can be used as feed for pets such as fish, birds or turtles.



**Figure 8 Restaurant food waste as feed input (left) for maggot production (right) (credit: Felicitas Schneider)**

Our next stop was the agricultural production of snake fruits (salacca) in Sleman where the salacca trees as well as the sorting and packaging facility could be inspected. The fruits have to be handled with special care as only high qualitative products can be exported and achieve high economic value (Figure 9). A tasting of fresh salacca and durian fruits complemented the morning.



**Figure 9 Selection of perfect snake fruit (salacca) from the conveyor belt for export (left, credit: Stefan Lange), final quality check and certification of the fruits (right) (credit: Felicitas Schneider)**

Even the lunch break was dedicated to our main topic and was a very good example for practicable measures to use food waste as valuable resource. The visited mushroom restaurant produces its various species of mushrooms themselves on-site. Wood chips as well as sanitised food waste are used as substrate (Figure 10). The result is not only very tasty but also contributes to a sustainable food system.

In the afternoon, the Food Bank of Indonesia presented their main location in Yogyakarta together with two social institutions supported nearby. The visited kindergarten offers donated food to the children to ensure a regular food intake. The women and children healthcare centre is supported with food to ensure that women and their children as well as elderly women do not experience malnutrition. A visit at Winotosastro Batik Craft, followed by a dinner at beautiful Candi Prambanan temple hosted by Bupati Sleman (Region) and finally the breathtaking Ramayana Ballet completed the day.

The agenda, a summary as well as some photos are provided at the Initiative's [website](#). The presentations will follow after presenters' legal approval of the content.

We would like to thank our cooperation partners, and all colleagues from the ICAPRD team, the presenters, chairs and moderators who contributed to the success of the workshop. We would like to highlight the professional performance of the whole Indonesian team, especially Dr Prayudi Syamsuri, Prima Luna, Lina Marlina, Dr Hadis Jayanti, as well as the moderators for the working groups which were Dr Kohei Watanabe from Teikyo University and Ms Dewi Farmaningrum from FAO Indonesia and Dr Tammara Soma for their generous support of the FLW workshop!



**Figure 10 Two types of mushrooms grown on wood chips as well as sanitised food waste at the lunch break restaurant (credit: Stefan Lange)**



**Figure 11 Food Bank staff members demonstrate how donations are sorted for further distribution (credit: Felicitas Schneider)**

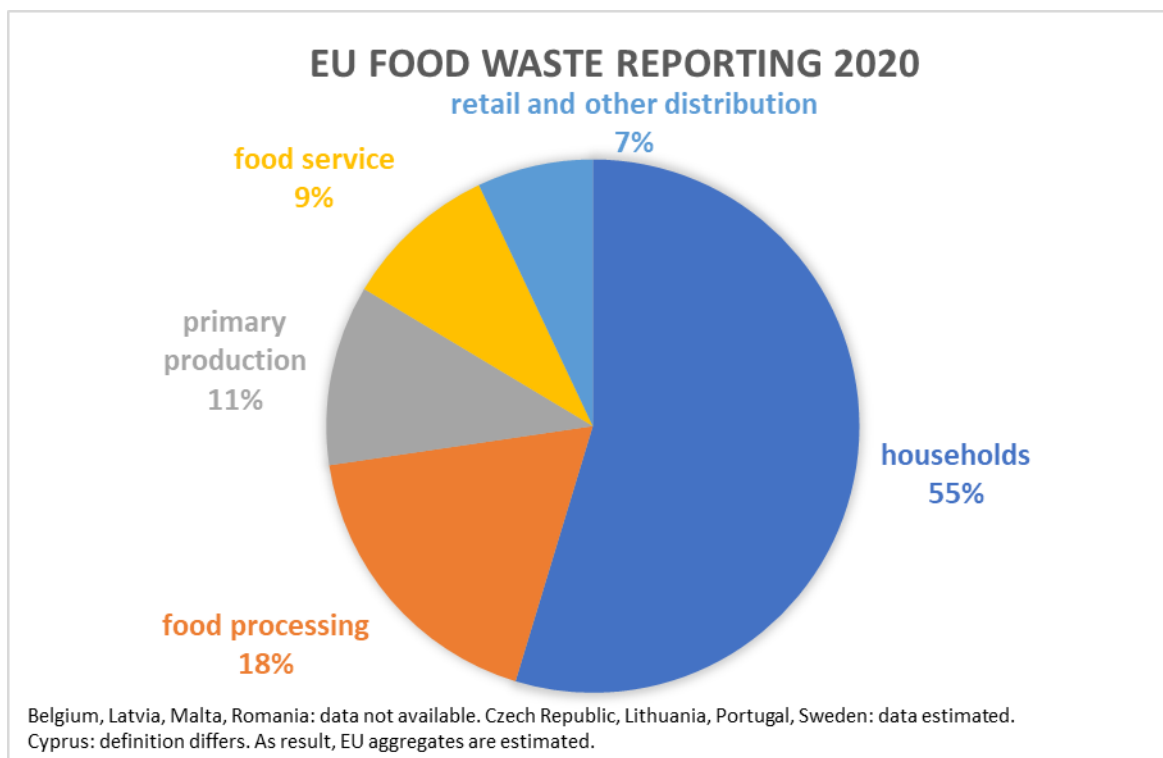
### 3.1.4 European Platform on Food Losses and Food Waste

The first EU platform FLW meeting of the new term 2022 to 2026 was organized virtually on February 17<sup>th</sup>, 2022. As already mentioned in our previous annual report, Thünen Institute was one of the selected members and will contribute its expertise to the general platform work and in addition specifically to the sub-groups “action and implementation”, “food loss and waste monitoring” as well as “consumer food waste prevention”.

For further information e.g. on agendas and presentations of all platform meetings or the list of members for the different sub-groups, please see the official [website](#).

By end of June 2022, the first obligatory European food waste reporting for member states had to be submitted to the European Statistical Office (Eurostat). All data refer to the year 2020 and the summary shows an average

food waste generation of 127 kg per inhabitant or 57 mio tons fresh mass in the European Union. Figure 12 displays that European households contribute with 70 kg/inhabitant (55 %), food processing with 23 kg/inhabitant (18 %), primary production with 14 kg/inhabitant (11 %), food service with 12 kg/inhabitant (9 %) and finally retail and other distribution with 9 kg/inhabitant (7 %). The figures are rounded.



**Figure 12 Distribution of food waste in Europe for the first reporting year 2020 (source: Eurostat)**

It has to be mentioned that Belgium, Latvia, Malta and Romania did not submit data. Czech Republic, Lithuania, Portugal and Sweden submitted estimated data and Cyprus used a divergent food waste definition. Thus, the aggregated data on EU level are estimated. More information can be found at the [website](#) of Eurostat.

### 3.1.5 Update on FLW activities in Brazil<sup>2</sup>

The Brazilian Agriculture Research Corporation (Embrapa) has engaged in several activities related to food losses and waste mitigation in 2022. In addition to the development of technological solutions with partners, Embrapa strongly contributes to discussions on public policies and participates in international working groups about the Sustainable Development Goal 12.3.

Gustavo Porpino, a specialist in food waste from Embrapa Foods and Territories (located in Maceió – AL), represented Brazil at the G20 workshop “Gap Analysis on Food Loss and Waste Indices” (see also chapter G20 under the presidency of Indonesia), organized by the Indonesian Government in June 2022. Mr Porpino also gave a speech during the [International Day of Awareness of Food Losses and Waste event](#), organized by the Food and Agriculture Organization of the United Nations (FAO) and partners, and joined the Champions 12.3 annual meeting during the NYC Climate Week. Furthermore, Brazil hosted the Global Forum of the Milan Urban Food Policy Pact in October 2022, in which Embrapa Foods and Territories organized a session about school feeding in collaboration with the FAO, Sebrae ("Serviço Brasileiro de Apoio às Micro e Pequenas Empresas", a Brazilian Assistance Service for Small and Micro Enterprises), and Comida do Amanhã Institute.

<sup>2</sup> The following section was kindly provided by Gustavo Porpino from Embrapa Foods and Territories/Brazil.

Successful initiatives involving feeding in schools in the cities of Copenhagen, New York, Maceió and other municipalities in Alagoas state (Brazil) were presented during the panel “Food in schools: fostering local food systems and biodiversity use”. More information on this panel can be found [here](#). The dialogue highlighted that, via school meals, the insertion of local food products in the market is increased and it allows not only impacts on food education, health and nutrition, but also on the socio-productive inclusion of urban and peri-urban farmers. Feeding is also an educational tool, capable of changing children's food choices to be healthier and to make each student an agent of change, in the sense of promoting a fairer and more sustainable food system based on quality local food. Mr Porpino moderated the debate joined by Kate MacKenzie (NYC Food Policy Office), Rafael Zavala (FAO Brazil), Bent Mikkelsen (University of Copenhagen), Harrison Freitas (Sebrae Alagoas) and Francine Xavier (Comida do Amanhã Institute).

In 2022, Embrapa started a new cooperation with the European Union to encourage the exchange of experiences on urban food policies and programs between Brazilian and European cities, in addition to engaging more Brazilian cities in the implementation of circular food systems that address the reduction of food waste. The project “Cities and food: governance and good practices to leverage circular urban food systems”, as part of the European Union-Brazil Dialogues, will conduct a series of activities in 2023, including the quantification of food waste in street food markets, and a case study about circular urban food systems in five Brazilian cities. Embrapa has a history of partnership with the European Union and, among the initiatives already funded by the European Union - Brazil Dialogues, the quantitative research on food waste in Brazilian families stands out, which had results analysed in a recently [published paper](#).

Embrapa has also cooperated with the Brazilian Social Service of Commerce (SESC), an organization that operates a network of 91 food banks in Brazil, at national seminars about food waste mitigation held in Brasília (DF) and Rio de Janeiro (RJ) with the participation of retailers, legislators and educators.

In relation to technological solutions, a bio-nanocomposite edible coating to improve the shelf-life of strawberries was developed by São Paulo State University (Unesp) in partnership with Embrapa. This innovation increased the shelf-life of strawberries in experiments conducted in Brazil from 5 to 12 days. More information about this issue can be found [here](#).

In terms of training related to food losses and waste mitigation (it was initially launched in November 2021), the 7th edition of the Post-Harvest Technology Course in Fruits and Vegetables, organized by Embrapa Instrumentation (São Carlos - SP) was implemented. The free e-course which is available [here](#) (in Portuguese), has reached about 6,000 registrations in 2022. It offers the opportunity for students, technicians and producers to learn more about traceability, harvesting, processing, post-harvest nanotechnology, non-destructive quality analysis and minimally processed products.

In terms of contributions to public policy, Embrapa is collaborating with the development of the “Pact against hunger”, a coalition with civil society representatives, public and private members to be launched in April 2023 in Brazil. The mitigation of food waste is one of the priorities of the new coalition. Additionally, in 2022, the Ministry of Agriculture, Livestock and Food Supply led a working group to identify which actions could be prioritized by the Brazilian government in order to strengthen food waste reduction. Embrapa cooperated with the working group and is also engaged in the discussions related to the implementation of the “Food is never waste” global coalition.

### 3.1.6 Update on FLW activities in Canada<sup>3</sup> - Brewer's spent grain: a promising ingredient for the food sector

[Station Agro-Biotech](#) ([Bilboquet Microbrewery](#)) and St-Hyacinthe Research and Development Centre of Agriculture & Agri-Food Canada gathered their expertise and effort in an ongoing collaborative project (2021-2024) aiming to characterize the attributes of cereal matrices produced from brewer's spent grain at the pilot scale using a "Circular Agri-Food Systems" approach. The preliminary results are promising and show the technological feasibility of the approach (Figure 13). The critical operations have already been identified and represent an important technological lever for innovation in the near future.



**Figure 13 Brewer's spent grain used as ingredient for pasta processing (credit: AAFC).**

Information on the collaboration between St-Hyacinthe Research and Development Centre of Agriculture & Agri-Food Canada (AAFC) and Thünen Institute can be found in chapter 3.3.1.

### 3.1.7 Update on FLW activities in Germany<sup>4</sup>

Advances within the [German National Strategy for Food Waste Reduction](#) were achieved in all five different branches:

- (1) The private household's platform initiated a Citizen science approach where household's food waste data were collected, associated by a range of actions such as workshops and trainings, social media, educational materials, Apps and email-newsletter.

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<sup>3</sup> The following section was written by Dr Sébastien Villeneuve from Saint-Hyacinthe Research and Development Centre in Quebec, Canada.

<sup>4</sup> This section was provided by Dr Thomas Schmidt and Ronja Herzberg from Thünen Institute of Market Analysis and completed by Felicitas Schneider.

- (2) A [competence centre](#) was established in the hospitality sector 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.
- (3) The Retail and wholesale enterprises had most intensive discussions with the responsible ministry about voluntary agreements (VA). A decision on the final approval and further approach is expected soon. Within this VA each enterprise committed to the SDG 12.3 and to implement reduction measures and also a monitoring system based on depreciations. On this level, Thünen Institute conducted a monitoring and some other [detailed measurements](#).
- (4) [Manufacturers](#) and (5) [farmers](#) had a lot of discussions in branch-specific round table meetings to identify efficient reduction measures. The Thünen Institute supported these initiatives with sustainability assessments of the implemented measures. In addition, a survey was conducted with 320 participants to identify the food loss hot spots within the food chain.

Sustainability assessments of food waste reduction measures were conducted from our Thünen team in agricultural, manufacturing and retail companies in the course of the above-mentioned bullet points. Meetings with practitioner were used to discuss these results of pilot projects, their transferability and also their efficiency.

A new project on the issue of **Preventing stored product pests in Germany (AVoid)** was released in cooperation with the Federal Research Centre for Cultivated Plants, the Julius Kühn Institute (JKI), in September 2022. The project consortium is led by Dr Cornel Adler from JKI Institute for Ecological Chemistry, Plant Analysis and Stored Product Protection. The project is divided into two parts: First, various options of above and underground hermetic storage for staple products will be developed, built and the achieved results compared to conventional storage options. There will be a special focus on the consideration of passive cooling, stable temperatures, pest tightness, preservation of product quality and sustainable production and operation among others. The reduction of product losses as well as a minimised use of pesticides are expected results of those implementations. The cost-benefit analysis will be calculated by the JKI colleagues from the Institute for Strategies and Technology Assessment and complemented with a sustainability assessment conducted by the Thünen Institute of Market Analysis. Experienced business partners bring in their valuable knowledge and their facilities. In the second part of the project, the occurrence of stored product pests in Germany will be analysed. Here the aim is to develop an optimised monitoring system for stored product insects, occurring inside and outside storage facilities.

A [PhD project](#) at Thünen Institute has been continued within the past year. The aim of the PhD project is to analyse how **interactions between supply chain actors lead to food losses** in the upstream supply chain between primary production and retail and how these losses can be reduced. The process of data collection, both qualitative expert interviews and quantitative online survey, has been completed. The first publication on the basis of the expert interview data was [published](#) at the beginning of 2022, addressing the relationship between power imbalances and food loss in fruit and vegetable supply chains in Germany. It could be shown that short-term ordering, the informality of contracts and agreements, the setting of product requirements and unreliable quantity calculations in the fruit and vegetable sector cause a risk shifting and promote the occurrence of food loss in primary production. Moreover, a [project](#) with a **retailing company on food loss in fruit and vegetables due to private sector quality standards**, that had been launched in 2021, was completed this year. This project was launched independently from the PhD project on the initiative of a large German retailing company. The project aim was to evaluate the effects of the retailing company's quality standards on fruit and vegetable losses in upstream supply chains in Germany, Italy and Spain. The resulting data set of a quantitative online survey conducted in the frame of the project serves as a basis for the second paper of the cumulative dissertation. The data set provides insights into the crops and product requirements that are particularly conducive to the occurrence of food losses. First results show that requirements on caliber and pesticide residue limits provoke food loss in certain crops. In the upcoming year, the third scientific paper on policy and private sector measures

to reduce food loss in the early supply chain will be written. Moreover, a dissertation synthesis will be developed to link the three scientific papers and finalize the PhD thesis.

Since October 2022, we are very proud to host our colleague Ms Sharon Mada as **PhD student** who introduces herself in chapter 3.3.5.

A second **representative survey of households' food waste** was conducted by GfK, a market research institute, on behalf of the German Federal Ministry of Food and Agriculture. The approach was the same as in the [previous study](#) conducted in 2016/2017. Each survey provides 14-day-diaries of 6.000 private households in Germany in 2016 and 2020. A [master thesis](#) evaluated these data and examined the COVID-effects as well as the general trend: There are no significant differences between these two campaigns in food waste volumes in this four-year cycle. But significant changes in food waste volumes can be observed for both the pandemic period and the lockdown months. During lockdown, the increase in unavoidable waste is significant and avoidable waste is less significantly reduced compared to the pandemic. A redistribution of food waste from non-household consumption to households thus seems to be confirmed. About 60 % of the variation in waste quantities is due to differences between households. The explanatory share varies for sub-quantities. The socio-demographic characteristics recorded (household size, age, schooling and size of locality) and the year account for only about 10 %. As the master thesis was elaborated in German, there is the plan to publish an English paper in near future as a cooperation of the University of Kiel and Thünen Institute.

As in the recent years, Thünen Institute cooperated with other initiatives and NGOs related to the topic of conscious handling of food and sustainable consumption. To continue this valuable joint local activities, we co-organised a **World Disco Soup Day** on May 21<sup>st</sup>, 2022 in the city centre of Braunschweig. Foodsharing Braunschweig contributed with wonky and surplus fruits, vegetables as well as bread from different local retailers and bakeries. Activists from Transition Town Braunschweig, Slow Food Braunschweiger Land, proveg Braunschweig, Greenpeace Braunschweig as well as from our Thünen FLW team supported interested citizens with the processing of a two-course menu and provided background information on the topic on the way (Figure 14 and Figure 15). Different types of vegetarian and vegan soups and a delicious fruit salad served as desert were offered free of charge.



**Figure 14 Rescued surplus ingredients used for cooking at our World Disco Soup Day in Braunschweig (credit: Felicitas Schneider)**



**Figure 15 Participating population (left) and our chefs from Slow Food (right) at the World Disco Soup Day in Braunschweig (credit: Felicitas Schneider)**

As one of the results of the fruitful collaboration with the regional initiatives Transition Town, Fridays for Future and the Regional Energy and Climate Protection Agency, Johanna Schott and Felicitas Schneider from the Thünen Institute of Market Analysis also played a role in the establishment of the **Food Council Braunschweig and Braunschweiger Land** (so-called ERBSL) in November 2022. Preparations for the founding of the food council already started at the end of 2021. On November 7<sup>th</sup>, 2022 the time had come: with 61 founders which represented a wide range of city inhabitants, the Food Council was launched, modelled on existing food councils in Germany and Lower Saxony (Figure 16). The steering committee consists of five motivated persons representing civil society, food businesses and environmental initiatives. The ERBSL is financially supported by the city of Braunschweig. The aim is to make food supply more sustainable and socially just. In order to connect our Thünen research activities with practice and to further support the evolution of Braunschweig municipality towards a sustainable food supply system, Johanna Schott will offer her expertise in global food supply to the ERBSL advisory board. Felicitas is the spokesperson of the ERBSL working group Food Waste which already had its first meeting in December 2022. More information on the ERBSL can be found [here](#) (in German only).



**Figure 16 The founding of the Food Council was unanimously approved by the 61 voters present (left), the steering committee of the ERBSL (right, credit: Felicitas Schneider).**

Not only at Thünen Institute but in the whole of Germany a lot of FLW related activities are taking place. In 2012, the awareness-raising campaign “[Too good for the bin](#)” has been implemented in Germany. Each year innovative projects and activities focusing on FLW prevention are awarded with the Federal prize. Since 2020, the prominent jury members are supported by an expert advisory board to which Thünen Institute also contributes. The winners and nominees of 2022 are introduced on the [campaign’s website](#) (in German only).

The **first obligatory EU reporting of Food waste amounts** was conducted by German Federal Statistic Office based on waste statistics and expert estimates as well as literature values. This first German reporting to Eurostat comprises the maximum values of five sectors (agriculture, manufacturing, retail and other distribution, hospitality, households) and a broadly defined quality report. More information on the first reporting from all EU member states to Eurostat is provided in chapter 3.1.4.

### 3.1.8 Update on selected activities in Italy<sup>5</sup>

While the joint activities between the University of Tuscia and Thünen Institute are mentioned in chapter 3.3.3, here is some information on another innovative topic which is being addressed in the FLW-related research at University of Tuscia. It concerns the analysis of overnutrition as part of the food waste problem. A multidisciplinary group of researchers is working on this, covering dietary issues, environmental and socio-economic assessments. One [first publication](#) appeared on Scientific Reports in 2022.

### 3.1.9 Update on selected FLW activities in Spain<sup>6</sup>

Parallel to their collaboration with our Initiative which can be found in chapter 3.3.2, there is also a very fruitful collaboration between Dr Maria-Angeles Fernandez-Zamudio and Dr Héctor Barco Cobalea on national level. One joint project includes the **analysis of availability and level of awareness for measuring food loss and waste** in the region of Valencia (Figure 17). In a [previous work](#) (in Spanish only), all the entities and economic activities generating potential food waste were identified along the entire agri-food chain in this region. Currently, the focus is put on the analysis of the magnitude of the food loss and waste problem in this territory. For this, entities were selected according to eight NACE Classes:

- Production: (01.13) Growing of vegetables and melons, roots and tubers; and (01.23) Growing of citrus fruits.
- Manufacturing: (10.39) Other processing and preserving of fruit and vegetables; and (10.71) Manufacture of bread; manufacture of fresh pastry goods and cakes.
- Distribution: (46.31) Wholesale of fruit and vegetables; and (47.11) Retail sale in non-specialised stores with food, beverages or tobacco predominating
- Out of home consumption: (55.10) Hotels and similar accommodation; and 56.21 Event catering activities

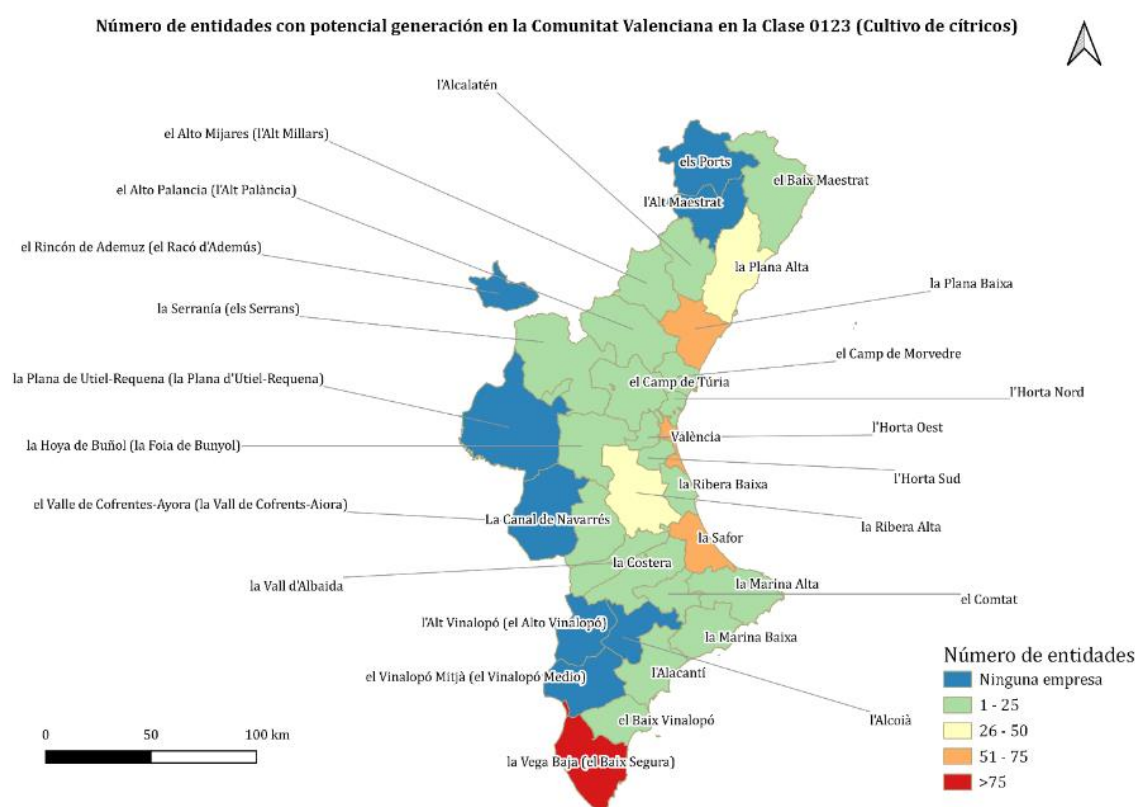
In a next step, 1,487 companies were contacted by phone aiming to have a dialogue on the following issues: obtaining their point of view about the food loss and waste problem, internal solutions to be carried out by their own company, external solution which could be implemented by the public administration and their availability of measuring food loss and waste during a period of 1 week. If the latter was refused, the reasons why these measurements are not possible were requested. In this regard, the analysis has also covered the reasons given by these sectors to refuse their participation in this dialogue.

Despite the fact that there is a general lack of awareness and interest to have a dialogue and address this problem, there are three economic sectors which are the most promising to continue this dialogue and address the problem in more detail: 47.11 Retail sale in non-specialised stores with food, beverages or tobacco predominating; 56.21 Event catering activities; 55.10 Hotels and similar accommodation. The other economic activities need additional effort in order to increase their participation rate and level of awareness about the importance of minimizing food loss and waste.

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<sup>5</sup> This section was kindly prepared by Dr Clara Cicatiello and Roberta Pietrangeli from University Tuscia.

<sup>6</sup> The text and the figures were provided by Dr Héctor Barco Cobalea from Enraíza Derechos, Dr Maria-Angeles Fernandez-Zamudio from Valencian Institute of Agricultural Research (IVIA) and Dr Tatiana Pina from University of Valencia.



**Figure 17 Number of companies with potential food loss and waste generation in the Region of Valencia for the NACE Class 01.23 (Growing of citrus fruits), by counties. (credit: Héctor Barco Cobalea)**

To increase the implication of all studied sectors, at present 15 companies have been identified as “flag companies” to be a driving force to promote the reduction of food loss and waste for the studied economic activities .

Another cooperation between Maria-Angeles and Héctor focuses on the analysis of the main **reasons for the food waste problem in the catering sector**. A pilot study is conducted in the [Convention Centre of Valencia](#) which is a collaboration promoted by the World Sustainable Urban Food Centre of Valencia, where a working group was created, including experts from the University of Valencia (Dr Jose Miguel Soriano, the PhD candidate Inma Zarzo from Food & Health Lab, Institute of Materials Science as well as Dr Tatiana Pina from Department of Experimental and Social Sciences Education), the NGO “Enraíza Derechos” (Dr Hector Barco) and the Valencian Institute for Agricultural Research (IVIA) (“BonProfit” Plan, Dr Maria-Angeles Fernandez-Zamudio).

The work started in 2022 aiming to promote a more sustainable management of food products in the case of event catering, fully specialized in congress and convention tourism. On one side, the nutritional, health and gastronomic aspects of the menus were revised in order to determine which aspects could be improved. On the other hand, different food waste (Figure 18) quantification protocols were designed for the leftovers on buffet and plate waste. These protocols are personalized according to the number of diners, or the type of food service carried out (coffee break, brunch, standard lunch, special dinner, etc.). Moreover, questionnaires were being carried out to analyse the attendee’s attitude in relation to the food waste perception and the food provided. This attitude could be very different to their own home’s food management or in a restaurant of their own individual choice. That work will continue in 2023 and the main conclusions will be extrapolated to the entire event catering sector and other similar catering and HORECA sectors.



**Figure 18** Photos taken from a catering event at the Convention Centre of Valencia and parts of the food waste generated (credit: Maria-Angeles Fernandez-Zamudio)

In last years, Maria-Angeles established another cooperation with Dr Tatiana Pina from the Department of Experimental and Social Sciences Education at the University of Valencia. The **Regional Plan of Valencia against food loss and waste (Plan BonProfit)** is also working on the educational sector. Particularly, the two researchers have created a dossier on educational tools, resources and online publications as a guideline about the food loss and waste problem to facilitate, promote and stimulate the class work about this problem for teachers of primary and secondary level. The Spanish project report can be found [here](#) (Figure 19).



**Figure 19** Cover page of the guideline addressing the food waste problem for teachers of primary and secondary level (source: [Agroambient Website](#))

After completing his doctoral thesis (see our Annual Report [2021](#)) Héctor continued his work on food loss and waste in manifold projects such as the **creation of a quantification manual**. It aims to support the measurement of food loss and waste in different territorial scales (local, regional and national level). This manual aims to standardize the 3 main questions:

- What do we have to measure? Linked to concepts and definitions
- Where do we have to measure? Within each of the agri-food phases, which economic activities should be measured in line with the European Delegated Decision.
- How do we have to measure? Pros and cons about the different methods of measuring food loss and waste.

These questions have been answered using the most pioneering projects in Spain which can be found [here](#) (in Spanish).

Stages-of-the-agrifood-chain	Quantification-methods				
Primary-production	Questionnaires-and-interviews	Direct-measurements	Mass-balances	Waste-composition-analysis	Coefficients-and-production-statistics
Processing-and-manufacturing					
Retail-and-other-distribution-of-foods			Counting/scanning		
Restaurants-and-food-services					Diaries
Households					
Qualitative-methods					
Quantitative-method.-High-level-of-reliability					
Quantitative-method.-Medium-level-of-reliability					
Quantitative-method.-Low-level-of-reliability					

**Figure 20 Proposal for the improvement of the FLW quantification method in the region of Valencia, by stages of the agrifood chain and according to the European Delegated Decision (credit: Héctor Barco Cobalea)**

## 3.2 Topic 2: Awareness Raising & Capacity Building

### 3.2.1 International Day of Awareness of Food Loss and Waste

We at the Thünen Institute are very proud that we were able to support this great idea from the very beginning in 2018 (see our [Annual Report 2020](#)). Since 2020 when the day was introduced, 29<sup>th</sup> of September is celebrated by several global organisations, research institutes and stakeholders dealing with FLW prevention. In 2022, we implemented one local Day of Action in cooperation with other organisations as well as a Thünen-wide online presentation of research results related to one of our ongoing projects.

Braunschweig is the headquarter of the Thünen Institute and represents a medium size German city of approximately 250,000 inhabitants in Lower Saxony. In 2022, we collaborated with civil society organisations for raising awareness of the general public on September 25<sup>th</sup>. This year we organised the event in cooperation with the so-called **Apple Day** at a central place near the city centre. The Apple Day calls the citizens to join one of the offered collection tours through the city and harvest unused apples from apple trees owned by the city. The apples are collected and transported by (cargo) bicycles and finally pressed into apple juice at a central place. All people supporting the collection receive a bottle of fresh apple juice. Thus, our topic of food loss and waste awareness raising fitted perfectly. As in the previous years, other local food-related initiatives also contributed to the event.

As the Thünen Institute, we provided insights into our research results by offering posters and an interactive online memory, practical tests and quizzes suitable for different age groups (Figure 21). Although it was a windy and rainy day we had good discussions with interested stakeholders.



**Figure 21** Visitors of the Apple Day at the Thünen stall (left, credit: Michael Welling), our table for some interactive quiz challenges and tests (right, credit: Felicitas Schneider).

As a part of pandemic measures in recent years, most of the Thünen Institute staff members received access to an online video conference tool which made it possible to offer a FLW discussion for all of our 15 specialist institutes and back-office units located at nine different Thünen locations in Northern Germany. This was a very good precondition to organise a Thünen-wide presentation in order to raise awareness on food loss and waste as well as to facilitate interdisciplinary discussion. On September 28<sup>th</sup>, in the **presentation “Food loss due to product requirements and business practices in retail - results of an online survey”** Dr Anika Trebbin and Ronja Herzberg offered results from an ongoing [project](#) (see also chapter 3.1.7). Finally, we reached 60 colleagues from eight different disciplines of Thünen Institute and had a fruitful discussion which was moderated by our colleague Dr Yanne Goossens.

Another awareness campaign was co-organised in May 2022 which is summarised in the German country update in chapter 3.1.6.

### 3.2.2 Cooperation with Sino-German Agricultural Centre (DCZ)<sup>7</sup>

Since 2020, the DCZ has established a regular exchange on FLW with the Thünen Institute of Market Analysis and relevant Chinese Academy of Agricultural Sciences (CAAS) institutes. Early in 2022, we invited Dr Huang Jiaqi, researcher at the Agricultural Information Institute of the CAAS to write a **policy brief** on Food Loss and Waste in China: Status Quo, Policies and Actions. The policy brief is available from [DCZ website](#).

In spring 2022, Dr Felicitas Schneider informed DCZ about the **German chancellor fellowship** by Humboldt Foundation and offered her support for Chinese FLW researchers as potential host organisation. In cooperation with the International Department of CAAS we could support the application of two researchers from the Graduate School of CAAS and the Institute for Agriculture Economics and Development of CAAS. The researchers focus on research FLW along the food supply chain and would like to conduct comparative studies of Germany and China.

In July 2022, Dr Eva Sternfeld, DCZ science coordinator, and Felicitas Schneider met at German Ministry of Agriculture (BMEL) in Berlin with Nathalie Banz, division 211, project manager for EU-affairs and international food waste reduction, and Friederike Dörfler who works as **Agricultural Counsellor of German Embassy** in Beijing since September 2022. We informed Ms Banz and Ms Dörfler about current policies and developments related to FLW in China.

<sup>7</sup> The text and the pictures were kindly provided by Dr Eva Sternfeld science coordinator from Sino-German Agricultural Center (DCZ) in Beijing/China.

On September 9, the DCZ held a kick-off meeting to launch the **center's third phase (2022-2025)**. The steering committee of representatives of the ministries of both countries agreed on the topic “food security” with the sub-topics digital farming, seed development and FLW, on which the center’s activities will focus in the coming three years.

The sub-topics were already addressed in three thematic forums during the **8<sup>th</sup> Sino-German Agricultural Week** (Nov. 21-25, 2022, Figure 22). The forum on 24<sup>th</sup> November discussed the FLW strategies in both countries at various stages of the agricultural value chain. In his welcome address Mr Liu Xiaowei from the Chinese Ministry for Agriculture and Rural Affairs (MARA) stressed the need to reduce losses during harvest. Ms Banz from BMEL presented Germany’s national strategy for food loss and waste reduction including measures to create public awareness through initiatives such as the “Too Good for the Bin” campaign.



**Figure 22 Impressions from the online Sino-German Agricultural week with Thünen colleague Dr Yanne Goossens presenting her results on the right (credit: Eva Sternfeld)**

Wang Fengzhong from the Institute of Food Science and Technology of CAAS highlighted the significance of governance, with China’s 2021 Anti-Food Waste Law a milestone in combating food loss and waste, as well as the need for technological collaboration between China and Germany, while Huang Jiaqi from the Agricultural Information Institute focused on the opportunities in reducing food waste in Chinese restaurants and the online food delivery sector.

Cao Guangqiao from the Nanjing Institute of Agricultural Mechanization, Liao Xiaojun from China Agricultural University, and Cao Baoming from Nanjing University of Finance and Economics provided insights into the technical solutions such as improved machinery with which China is trying to reduce food loss and waste during harvesting, storage, transport, and processing.

Dr Yanne Goossens from the Thünen Institute of Market Analysis presented a sustainability assessment model that had helped dozens of German food processing companies to reduce food waste, thereby not only saving emissions but also generating economic gains (Figure 22, right). While Manuela Zude-Sasse from the Leibniz Institute for Agricultural Engineering and Bioeconomy shed light on how new models based on sensor data could help fruit farmers use resources more efficiently, her colleague Giacomo Rossi introduced circular economy concepts that use insects to valorise food waste. Finally, Judith Stiegelmayr from Community Kitchen München – winner of the German government’s initiative “Too Good for the Bin” in 2022 (see also chapter 3.1.7) – showed forum participants how her project was helping to reduce food waste through practical actions on the ground.

The forum program and the presentations of the event are available for download from our [website](#).

### 3.2.3 Cooperation with the Chinese Academy of Agricultural Sciences

This cooperation was formally started with a Memorandum of Understanding in 2017 and continued further as reported in our previous Annual Reports. At present, joint publications and potential hosting of young Chinese researchers (see also chapter 3.2.2) at Thünen Institute are under discussion. We will keep you updated!

### 3.2.4 Cooperation with the Stockholm Environment Institute (SEI)<sup>8</sup>

In early 2022, there was a calling on think tanks and policy researchers around the world to submit their policy abstracts to the [Think20 \(T20\) Task Force 4 on Food Security and Sustainable Agriculture \(TF 4\)](#). T20 is an official engagement group of the G20, which invites think tanks and research centres worldwide to provide research-based policy recommendations to G20 leaders. The Center for Indonesian Policy Studies (CIPS) was the host institution for TF 4 the T20, together with TF 4 Lead Co-Chair, Prof Damayanti Buchori from Bogor Agricultural Institute/IPB University. The Stockholm Environment Institute (SEI) was selected with its proposal together with partner organisations Commission for Sustainable Agriculture Intensification (CoSAI), CGIAR, Royal Holloway, University of London and International Water Management Institute (IWMI).

As urbanization increases, meeting the challenges of urban food supply and food security requires coherent and holistic strategies. Albeit important, the attention for urban food supply and security is often focused on best practices without addressing the required behavioural change. This [policy brief](#) highlights the importance of minimizing food loss and waste, which accounts for some 30 % of current global food production, in order to achieve SDGs 2, 11 and 12 and facilitate synergies across these SDGs. The proposals laid out in the policy brief cover four interrelated elements, namely adopting holistic and circular planning perspectives; facilitating urban and peri-urban farming; integrating innovative behavioural interventions; and providing enabling environments. The G20 has the capacity to act rapidly, without the need for major capital investment, thereby also providing leadership to the entire international community.

With respect to policy impact pathways, we have actively engaged to provide technical inputs to Task Force 4 through regular meetings and the drafting of the T20 Communique that will inform the G20 governments on food security and sustainable agricultural policy recommendations.

While the ‘backstage’ engagement and work through the T20 are critical, we have also been disseminating the outcome of the policy brief and the G20 Summit discussions. Before the Summit, we organised a webinar: “Transforming Food Systems through Circular Practices” inviting organization that work on waste management: Waste 4 Change-Indonesia, Thünen Institute-Germany, Eurocities-Belgium, Department of International Cooperation of the Ministry of Ecology and Environment – People’s Republic of China, and Center for Indonesian Policy Studies (CIPS). The aim was to amplify the policy recommendations laid out in the policy brief and set the tone for the G20 Summit. The webinar can be accessed at [CIPS’ Youtube channel](#). After the Summit, we presented the synthesis of our policy brief “Food waste minimization and circularity for optimizing urban food system resilience” at the MACS-20 Food Loss and Waste workshop in Indonesia (see also chapter 3.1.3). In addition, we also published three podcasts to highlight key points discussed at the G20 Summit & MACS-20 FLW Workshop to navigate the ways forward for achieving food security and sustainable agriculture.

The podcast can be found here:

- Asia podcast miniseries: Optimizing Urban Food Systems Resilience | [Ep01: Food Waste Minimization](#)
- Asia podcast miniseries: Optimizing Urban Food Systems Resilience | [Ep02: Building resilience in food systems by preserving local knowledge](#)

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<sup>8</sup> This section was kindly written by Kuntum Melati from Stockholm Environment Institute (SEI), Thailand.

- Asia podcast miniseries: Optimizing Urban Food Systems Resilience | [Ep03: Reinforcing sustainable food consumption through outdoor environmental education](#)

More specifically, the proposed initiative is expected to lead to the following immediate outcomes:

- i. The uptake of our evidence-informed policy recommendations by the G20 countries that could lead to the promotion of food security and sustainable agriculture.
- ii. Emphasising the importance of promoting policies that could contribute to reducing food loss and waste to achieve food security.

### **3.2.5 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 facilitated the course “Sustainable Waste Management in Coastal Communities” in June 2022. Her waste management experiences from former job position allow her to offer the basics of general waste management focused on coastal regions as background information for a more detailed look into FW generation, prevention and potential waste management options, circular economy and sustainable systems embedded in a global framework. The two-week course was accompanied by excursions and guest speakers from local waste management, private coastal clean-up initiatives as well as harbour authority. The students from Belgium, Chile, Canada, Czech Republic and The Netherlands benefited a lot from the mix of theory and implemented practice. One of the visited excursion venues transforms fish skin which is usually wasted by industry into high-performance medical tissues which reduces the impact of skin injuries (such as burns, snake bites, diabetic and other chronic wounds) on agility and aesthetics. The fish skin is hand-selected by experienced staff directly at the fish processor and further treated in the same village by the innovative company named Kerecis. The final products are exported to international destinations. This was a very good example for successful valorisation of food waste streams which are often disregarded. Another field trip to the local waste collection centre included the household biowaste collection and treatment. As shown in Figure 23 on the left-hand side, the biowaste is collected in biodegradable bags provided by the municipality. Unfortunately, the existing container composting facility is not operating as expected and thus, neither the decomposition of the bags nor of the organic material is working well. Therefore, an optimisation process is ongoing.

This year, Felicitas was invited to facilitate the graduation ceremony with a motivating speech which was a great honour. One of the graduated students successfully passed her waste management course in 2021. The waste management course will also be repeated in the new term in May 2023.



**Figure 23 Impressions from Isaffjörður municipal waste collection center: collected household biowaste (left), output of on-site composting facility (right) (credit: Felicitas Schneider)**

### **3.3 Topic 3: Stimulating research cooperation**

#### **3.3.1 Project cooperation with Canada<sup>9</sup> - Broken cold chain simulation at the scale-down level including vibration and altitude**

In 2022, Dr Sébastien Villeneuve and Dr Louis Sasseville, both scientists at the St-Hyacinthe Research and Development Centre of Agriculture and Agri-Food Canada, have focussed their research activities on adding the vibration caused by the road pavement during road transportation and the depressurization environment due to altitude (take-off, in-flight and landing) during air transportation to their scale-down transportation simulation platform. This technological platform can be used to assess attributes that can change the appearance, chemical components and microbial growth in food products and quantify related Food Loss and Waste along the food cold chain (see also our previous reports).

##### **3.3.1.1 Road transportation**

Briefly, a methodology has been developed to mimic vibration due to road transportation by using an accelerated approach inside an environmental chamber with a vibration table. In this approach, real-time data are recorded inside a loading of food products and frequency spectrum of Power Spectral Density (PSD) graphs of the random vibration encountered during road transportation are drawn. PSD graphs show an average of the acceleration in the frequency domain; spectral shape, intensity and duration characterizing the vibration profile. Once the PSD graph of the real-time profile is known, it is possible to perform an accelerated test that mimics road transportation at the scale-down where the amount of acceleration increase corresponds to a test time decrease. Basically, during accelerated vibration simulation, the spectral shape of the real-time profile remains unchanged but the intensity increases which moves the curve up (Figure 24).

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<sup>9</sup> The following section was written by Dr Sébastien Villeneuve, Dr Louis Sasseville, Sabrina Bergeron Quirion and Carole McKinnon from Saint-Hyacinthe Research and Development Centre in Quebec, Canada.

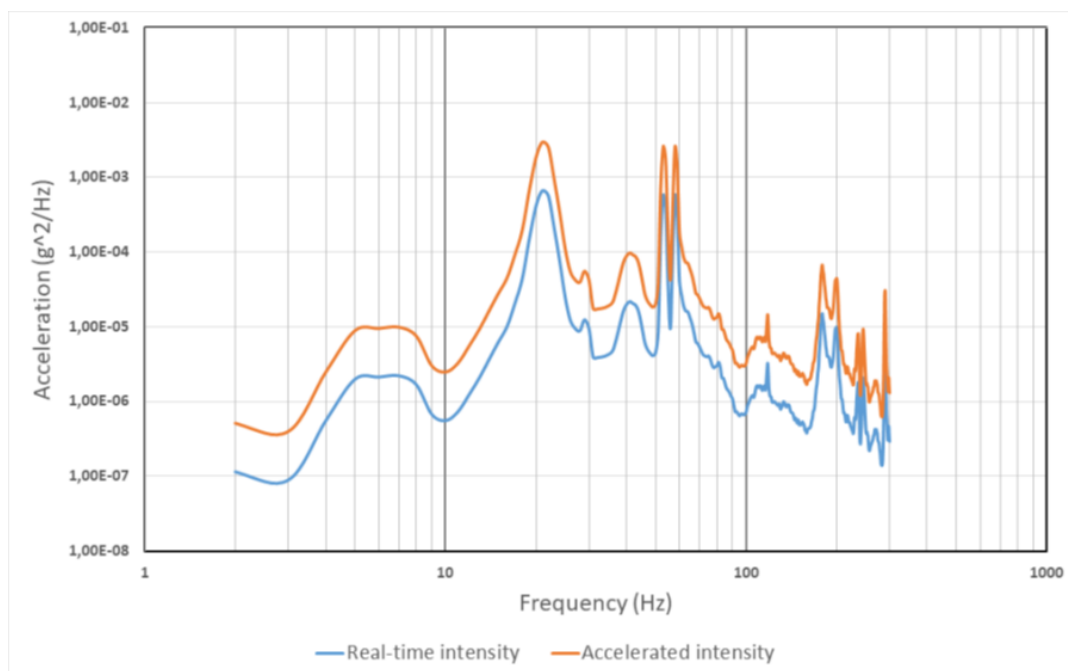


Figure 24 PSD graphs from real-time data compared with the one from accelerated testing (credit: AAFC).

### 3.3.1.2 Air transportation

Using data recorded at airports during ground operations and prior to air shipment of perishables<sup>10</sup> and by following the standards provided in the Perishable Cargo Regulations of the International Air Transportation Association (Montreal-Geneva), a temperature distribution pattern for food products is generated by simulation inside an AKE unit load device. For a scale-down purpose, a custom-made AKE with a scale size factor of 1:8 (Figure 25) is loaded inside an altitude test chamber which mimics environmental conditions encountered at the airport and inside a cargo hold of an aircraft at any moment during flight. The altitude test chamber can generate temperature ranging from -70°C to 177°C, relative humidity from 20 % to 95 % and altitude up to 30,000 metres.

<sup>10</sup> see also: Villeneuve S., Mercier F., Pelletier W., Ngadi, M.O., Emond J.-P. (2000) Effect of Environmental Conditions on Air Shipment of Perishables During Ground Operations. Presented at 2000 ASAE Annual International Meeting, July 9-12, Midwest Express Center, Milwaukee, Wisconsin. Paper No. 006058. ASAE, 2950 Niles Road, St. Joseph, MI 49085-9659 USA. <https://www.cabdirect.org/cabdirect/abstract/20003026324>.

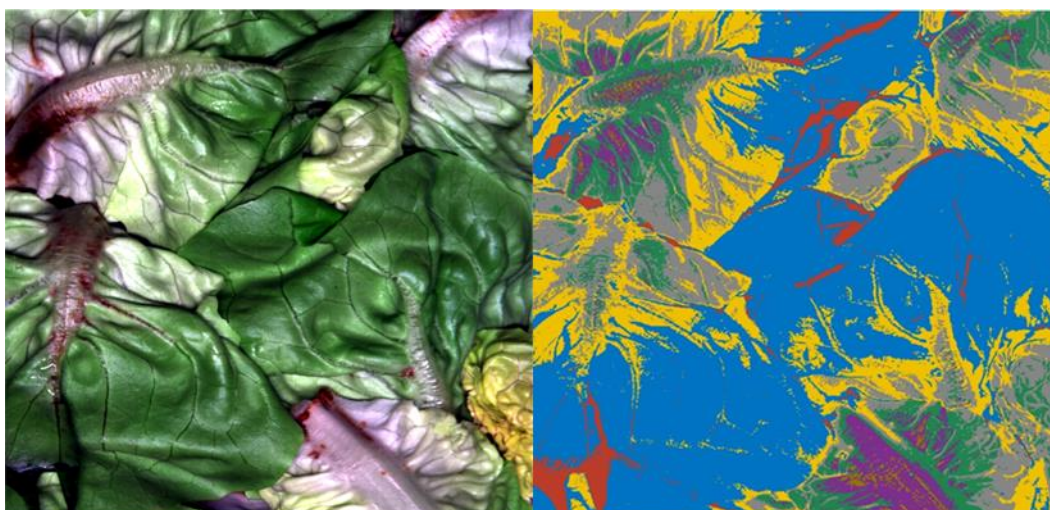
Villeneuve S., Ngadi M.O., Emond J.-P. (2001) Heat transfer in air cargo unit load devices. ISHS Acta Horticulturae 566: II International Symposium on Application of Modelling as an Innovative Technology in the Agri-Food Chain. 10.17660/ActaHortic.2001.566.30.



**Figure 25 AKE with a scale size factor of 1:8 being loaded inside an altitude test chamber for the simulation of an air shipment (credit: AAFC).**

### **3.3.1.3 Impact of transportation conditions on Food Loss and Waste**

Using the technological platform simulating the conditions encountered during food transportation, food products can be analysed with hyperspectral imaging at any step along the supply chain in order to quantify the quality degradation. The monitoring of food products by hyperspectral imaging coupled with statistical algorithms are interesting tools to understand and to prevent the occurrence of Food Loss and Waste. This methodology allows, by a non-destructive approach, to assess the senescence and the organoleptic properties of biological products in real-time. The preliminary results are promising. Next phase of this project will focus on the development of a powerful analytical methodology that allows to separate the degradation due to the intrinsic variability of food products (biological, variety, cultivar, etc.) from extrinsic factors such as conditions encountered during road and air transportation.



**Figure 26 Hyperspectral imaging analysis of leafy greens after a scale-down road transportation simulation (credit: AAFC).**

The Thünen Institute acts as a facilitator for the project results in order to share the findings that could also be useful for other countries within the Initiative's network.

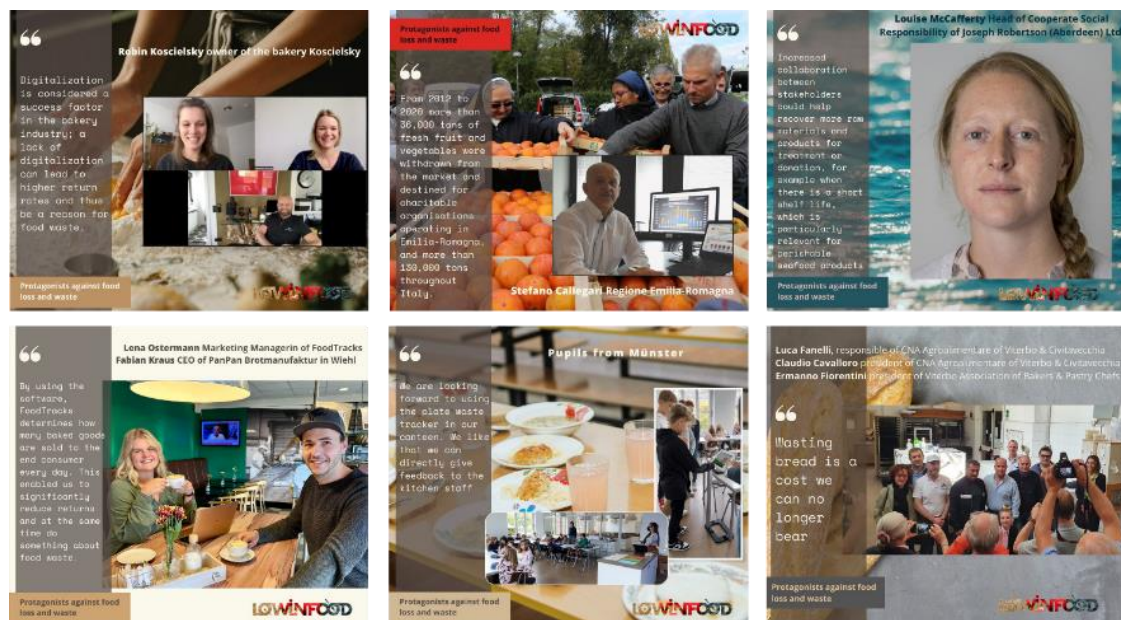
### 3.3.2 Research cooperation with Spain<sup>11</sup>

In order to continue the successful cooperation among the Collaboration Initiative and Maria-Angeles Fernandez-Zamudio as well as Dr Héctor Barco Cobalea, first discussions took place on how the pioneering experiences about direct measurement of mass and economic harvest and post-harvest losses in Spanish persimmon primary production (see also the Annual report [2020](#) and [2021](#)) can be applied for the food loss quantification of potatoes and other similar produce.

For further activities related to FLW in Spain see also chapter 3.1.9 in the present report.

### 3.3.3 Research cooperation with University of Tuscia, Italy<sup>12</sup>

The University of Tuscia is working on several activities related to food loss and waste reduction. It is coordinating the [LOWINFOOD H2020](#) project, an innovation action focusing on the evaluation of a portfolio of innovations against food loss and waste, in real food supply chains which are particularly affected by the problem. The project is now two years old, and the demonstration of the 14 concerned innovations is ongoing (Figure 27). Data on the quantity of food loss and waste avoided, on the socio-economic effects of the innovations, and on their environmental impact are being collected for all the innovations, in different European countries, and they are being treated along a common methodological framework which was co-designed with the food chain actors. LOWINFOOD involves actors from 12 European countries, and three external advisors (among which, Dr Felicitas Schneider from Thünen Institute) who are supporting the implementation of the project.



**Figure 27 Statements of food chain actors involved in the demonstrations of the innovations against food loss and waste of the LOWINFOOD project (credit: LOWINFOOD)**

<sup>11</sup> The chapter was provided by Dr Héctor Barco Cobalea from Enraíza Derechos and Dr Maria-Angeles Fernandez-Zamudio from Valencian Institute of Agricultural Research (IVIA).

<sup>12</sup> This section was kindly prepared by Dr Clara Cicatiello and Roberta Pietrangeli from University Tuscia.

University of Tuscia is also widening the scope of its FLW-related research by means of a **PhD project**, which focuses on the assessment of food losses in the fruits and vegetables sector. This project, which got started in 2022, foresees the assessment of the quantity and value of food loss streams in the post-harvest phase of the fruits and vegetables supply chain. A partnership with Thünen Institute has been established to co-design an assessment methodology to be conducted at a sample of Italian producer organisations in 2023. Mobility of PhD students between University of Tuscia and Thünen Institute has been agreed for this purpose.

### **3.3.4 Cooperation with Austrian Armed Forces – implementation project Smart Waste**

The conference proceedings of the conference on the topic of "Smart Waste" organised in September 2021 in Salzburg was published by Dr Rupert Fritzenwallner from the ICT & Cyber Directorate in the Austrian Federal Armed Forces together with the Thünen Institute (see also our Annual Report [2021](#)). The conference proceedings are also available [online](#).

Another conference which complemented the above mentioned with new aspects was organised in September 2022. It focused on use cases related to cyber security, inter-operability and Austrian framework conditions as well as digitalisation as collaboration scenarios between waste generator and waste management company. The corresponding conference proceeding will be published in the first quarter of 2023.

The approach of the pilot studies Smart Waste which targets food waste reduction and Smart Waste+ which is dedicated to general waste prevention will be supported by a newly implemented electronical waste management concept. In this way, the waste generation and the disposal paths can be monitored and controlled easily. Data transmission is implemented by using Long Range Wide Area Network (LoRaWAN) on the properties of the Austrian Federal Armed Forces. Aim of the projects is to reduce food waste as well as other waste generation and to optimise the waste management logistics in parallel. Latter includes a demand-driven collection of waste and an increase of the share of waste directed for recycling. The structure and first findings of the pilots were presented at a well-known waste management conference in Austria in November 2022 by Dr Rupert Fritzenwallner on behalf of the co-authors from Austrian Federal Armed Forces. The conference paper is included in the [conference proceedings](#).

### **3.3.5 PhD on food waste in households and street markets in Zimbabwe<sup>13</sup>**

My name is Sharon Yeukai Mada from Zimbabwe. I hold a Bachelor of Arts Honours in Geography and a Master of Science in Ecology and Nature Management. I developed research interests in household solid waste management at the undergraduate level and I am also interested in using Geospatial techniques in solid waste management.

Food waste is a growing problem in Zimbabwe and a global crisis. The city I live in, Harare, is a low to middle-income city with some households facing food insecurity and receiving food aid, yet fruits and vegetables are thrown away unconsumed in the same city. This anomaly prompted me to research more on why food-insecure communities evidently waste food. I combined my passion for solid waste management, Geospatial Science, and personal, academic and professional experience to pursue PhD studies in Food Loss and Waste.

My preliminary research led me to discover that Thünen Institute is one of the leading global research institutes in Food Loss and Waste. Ultimately, I approached Dr Schneider and Prof Dr Banse with my research intentions and they agreed to offer their supervisory support and expertise towards my PhD studies. With this support from the Thünen Institute, I successfully applied for the Catholic Academic Exchange Service (KAAD) PhD scholarship. The KAAD scholarship supports young people from developing countries to pursue their PhD studies in Germany.

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<sup>13</sup> This chapter was written by Sharon Yeukai Mada who is currently PhD student at Thünen Institute of Market Analysis.

The KAAD Scholarship grants me the opportunity to conduct PhD studies with the Göttingen University and the Thünen Institute while focusing on my country Zimbabwe. Working with the Thünen Institute provides a global platform for me to gain research and innovative experience and establish networks within FLW studies.

My PhD research focuses on analysing the characteristics and determinants of food waste in households and street markets in Hatcliffe, Harare. Recent research shows evidence of food waste in Zimbabwe but the types of food wasted, amounts, seasonality and spatiality are largely unknown. The study uses a mixed methods approach and combines a diary survey, a questionnaire survey and a sample waste composition analysis. In this study, various household characteristics such as food consumption behaviour, attitudes, perceptions and the spatial location of the household, are analysed to establish whether they may be used to explain food waste occurring at the street market (Figure 28).



**Figure 28 Food wasted after the market day in the surrounding areas (left), onions offered to costumers on the street market (credit: Sharon Yeukai Mada)**

### **3.4 Topic 4: Matching ideas & funding**

#### **3.4.1 German Chancellor Fellowship for Prospective Leaders**

In 2022, the Alexander von Humboldt Foundation again launched the “German Chancellor Fellowship for Prospective Leaders” for applicants from Brazil, China, India, the US and South Africa! Participation from Russia was not possible this year. Up to ten winners from each country are selected to carry out their individual projects in Germany for one year. The subjects of the projects are not restricted to a special topic but they should have societal relevance with respect to politics, economy, media, society, culture or administration. The fellows act as a link between Germany and their home country. The Alexander von Humboldt Foundation pays a monthly grant, helps with administrative issues during their stay and offers additional excursions and courses for the selected “prospective leaders” of the program. The German host organisation receives a monthly financial support for its expenses. More information on the program is provided [online](#).

In cooperation with DCZ and CAAS, Thünen Institute supported two applications from China. We keep our fingers crossed that there will be a positive review which is expected for end of March 2023.

## 3.5 Topic 5: Fostering cooperation at implementation level

### 3.5.1 Cooperation with national and international standardisation organisations

The work of the International Organisation for Standardisation subcommittee [ISO/TC 34/SC 20](#) Food Loss and Waste was further developed during 2022. As agreed during the kick-off meeting in December 2021 an ad hoc working group (AHG1) was established

- to develop a gap analysis of existing documents for the measurement and reporting of FLW,
- to look into existing terms and definitions and
- to make suggestions about the most beneficial type of ISO deliverables for the topic.

Thirteen nominated international experts representing seven countries and two companies were selected for the AHG1 and presented their results at the meeting in April 2022. Our Collaboration Initiative was represented by the coordinator Felicitas. As a result of the output from AHG1, it was agreed to continue by elaborating a preliminary work item (PWI) for the development and utilization of management system standards for the minimization of food loss and waste across the food value chain, either as a new management system standard or a supplement to existing management system standards.

In addition, AHG1 was closed and a call for another working group called 'Management systems for minimization of food loss and waste' (WG1) was elaborated. Our coordinator Felicitas is one of the nominated and finally selected experts for the WG1. First aim of WG1 was to contribute to the so-called justification study which is a mandatory step to develop management system standards (MSS) according to ISO Directives. During a meeting in August, the experts contributed their knowledge by balancing pros and cons for having their own MSS for food loss and waste or incorporate the issue into already existing standards. This is especially relevant for the acceptance and implementation costs for specific stakeholders, such as small and medium enterprises. As a conclusion, the new standalone MSS has to be compatible with existing MSS implemented already within the food sector such as ISO 9001, ISO 14001 or ISO 22000.

In December 2022, the justification study was approved by ISO Technical Management Board (TMB). In December 2022, the ISO/TC 34/SC20 had 21 participating and 34 observing members representing 55 countries and 3 liaison organisations. It is expected that as soon as the drafting of the standard will start, more members will join. The third meeting of ISO/TC 34/SC20 will take place as a face-to-face meeting in Copenhagen in April 2023 back-to-back with another WG1 meeting.

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 a feedback on behalf of Germany will be transmitted through the German delegation back to ISO.

### 3.5.2 Cooperation with United Nations Environment Program (UNEP)

In order to facilitate the implementation of the Food Waste Index reporting, the UNEP established four regional working groups: Asia Pacific, West Asia, Africa and Latin America & the Caribbean. Felicitas was invited to support the UNEP Africa Food Waste Working Group and took part in the eight online meetings jointly organised by UNEP's Initiative Global Opportunities for SDGs (GO4SDGs), Waste and Resource Action Programme (WRAP) and One Planet Network-Programme on Sustainable food Systems between end of 2021 until June 2022. The discussions were very fruitful and the workshop series will be continued in early 2023.

### 3.6 Recent literature from Initiative participants

In this section, we introduce 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!

- Brancoli P., Makishi F., Lima P.G., Rousta K. (2022) Compositional Analysis of Street Market Food Waste in Brazil. *Sustainability* 2022, 14, <https://doi.org/10.3390/su14127014>.
- Franco S., Barbanera M., Moschetti R., Cicatiello C., Secondi L., Massantini, R. (2022) Overnutrition is a significant component of food waste and has a large environmental impact. *Scientific reports*, 12(1), 1-11, <http://doi.org/10.1038/s41598-022-11813-5>.
- Fritzenwallner R., Schneider F. [Ed.] (2021) Tagungsband "Smart Waste" Reduktion des Lebensmittelabfalls, Nachhaltigkeit und Wirtschaftlichkeit durch die Digitalisierung und das Internet der Dinge (Conference proceedings "Smart Waste" Reduction of food waste, sustainability and economic efficiency through digitalisation and the Internet of Things). Wien, November 2021, 149 pages, ISBN 978-3-9504258-4-0, online version available [here](#) (in German only).
- Fritzenwallner R., Siller G., Monod-Roider O. (2022) Pilotprojekte Smart Waste, Smart Waste+ und elektronisches Abfallwirtschaftskonzept – Bundesministerium für Landesverteidigung als Vorreiter bei der Reduktion von Lebensmittel- und Systemabfall. In: Pomberger et al. [Ed.] Vorträge-Konferenzband zur 16. Recy & DepoTech-Konferenz, 9. - 11. November 2022, Montanuniversität Leoben, Österreich, ISBN: 978-3-200-08675-3.
- Herzberg R., Schmidt T.G., Keck M. (2022) Market power and food loss at the producer-retailer interface of fruit and vegetable supply chains in Germany. *Sustain Sci*:in Press, <https://doi.org/10.1007/s11625-021-01083-x>.
- Lana M.M., Gomes E.M.C. (2022) Visual quality and waste of leafy vegetables in the retail market. *Horticultura Brasileira* 40: 151-161. DOI: <http://dx.doi.org/10.1590/s0102-0536-20220204>.
- Lehn F., Schmidt T. (2023) Sustainability Assessment of Food-Waste-Reduction Measures by Converting Surplus Food into Processed Food Products for Human Consumption. *Sustainability* 2023, 15, 635. <https://doi.org/10.3390/su15010635>.
- Lourenco C.E., Porpino G., Lobo Araujo C.M., Marques Vieira L., Eckert Matzembacher D. (2022) We need to talk about infrequent high volume household food waste: A theory of planned behaviour perspective. *Sustainable Production and Consumption* 33 (2022) 38–48, <https://doi.org/10.1016/j.spc.2022.06.014>.
- Vieira L.M., Domingues I., Eckert Matzembacher D. (2022) Food Waste Redistribution and Implications for Achieving the Sustainable Development Goals: The Case of a Food Bank in the Municipality of São Paulo, Brazil. *Water-Energy-Food Nexus and Climate Change in Cities* pp 309–321, [https://doi.org/10.1007/978-3-031-05472-3\\_17](https://doi.org/10.1007/978-3-031-05472-3_17).
- Witte L. (2022): Lebensmittelabfallaufkommen in deutschen Haushalten: Eine empirische Untersuchung (Food Waste Generation in German Households: an empirical study). Kiel: Institut für Ernährungswirtschaft und Verbrauchslehre, Agrar- und Ernährungswissenschaftliche Fakultät der Christian-Albrechts-Universität zu Kiel, Doi: 10.3220/DATA20221116085631. online version available [here](#) (in German only)



Johann Heinrich von Thünen-Institut  
Bundesallee 50  
38116 Braunschweig  
Germany  
[www.thuenen.de](http://www.thuenen.de)