

LOWINFOOD

**Multi-actor design of low-waste food value chains
through the demonstration of innovative solutions
to reduce food loss and waste**

GA No. 101000439

D5.9 Report on the demonstration of the plate waste tracker at schools

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MATO, SLU, AIE, ISUN, UPP



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Summary

The deliverable 5.9 aims at reporting on the plate waste tracker which aims at reducing plate waste in school canteens in Sweden, Germany and Austria. The involved stakeholders apart from the canteens where the plate waste tracker was deployed is MATO, SLU, AIE, ISUN and UPP. The plate waste trackers succeeded to lower the amount of plate waste with 14%. 9 out of 13 canteens saw a reduction in plate waste where the plate waste tracker was introduced. In Germany one of three participating schools succeeded to lower the amount of plate waste significantly with a reduction of 49% and in Sweden one canteen managed to reduce food waste by 73%.



Introduction to the deliverable

LOWINFOOD is a project committed to co-design, together with actors of the food chain, low-waste value chains by supporting the demonstration of a portfolio of innovations in a set of value chains particularly concerned by food loss and waste (fruits & vegetables, bakery products and fish), as well as in at-home and out-of-home consumption. Each of these value chains corresponds to a single Work Package (WP) of the project.

The innovations are selected among promising solutions that have already been developed and tested by some partners of the consortium, with the aim to provide the necessary demonstration and upscale to allow market replication.

The LOWINFOOD consortium comprises 27 entities, located in 12 different countries, and ranging from universities and research institutes to start-ups, foundations, associations, and companies working in the food sector. During the 52 months of the project, the partners are committed to complete 30 tasks and to deliver 60 outputs (deliverables).

This deliverable (D5.9) is part of WP5, which is dedicated to reducing food waste within household and foodservice consumption settings. Specifically, D5.9 is related to the innovation of task 5.3 that targets a broad reduction of food waste in restaurants and school canteens, with an emphasis on plate waste.

1. Introduction to the Matomatic Plate waste tracker

Matomatic AB, a Swedish company, has introduced an innovative solution focused on reducing plate waste, primarily targeting school canteens. This inventive concept involves a software application designed for tablet computers. This software is seamlessly integrated with a scale positioned beneath the waste bin where patrons typically dispose of their uneaten food. Each time an item is discarded, the tablet records its weight, providing instant feedback to guests regarding the amount they have discarded. Depending on the quantity discarded, the guests receive tailored messages. In cases of substantial waste, encouraging messages prompt them to be more mindful in the future, while instances of minimal waste trigger positive reinforcement, acknowledging their efforts to minimize food disposal. To visualize waste trends over time, the software also presents a bar chart displaying the cumulative plate waste for the current day and offers insights into past days' data. To foster a relatable understanding of waste's impact, the software contextualizes discarded food's value, equating it to metrics familiar to guests, such as the number of cinema tickets it could have covered. The core objective of the "Plate Waste Tracker" initiative is twofold. Firstly, it serves as a tool for canteens to engage their guests, inspiring them to reduce plate waste by establishing a target for acceptable waste levels. When waste aligns with this goal, the bar chart adopts a green hue; however, if waste surpasses the target, it shifts to red. Additionally, the platform facilitates guests in providing feedback on the menu offerings, enabling canteen staff to gather insights into the reasons behind food waste and potentially modify menu items that contribute to higher waste levels.

2. Methodology

Overview of methodological approach

All plate waste data collected originated from the “plate waste trackers”. Plate waste is here defined as “All waste from the plates of guests. May contain inedible part such as bones and peels” (Malefors et al., 2019; Swedish National Food Agency, 2019). The trackers consist of a set of weighing scales (2g resolution) connected to a tablet computer running a dedicated software which interacts with the guests. The scales are positioned under a bin into which the guests throw the food remains from their plates. Each time a weight difference occurs, the mass of this weight change is recorded, along with a timestamp. The interface displays how much food each guest is throwing away and the impact of this waste in terms that the guests can relate to. The idea is that the guests are nudged to change their behaviour over time to waste less if they get feedback on how much they are wasting. Figure 1 provides an overview over the concept.

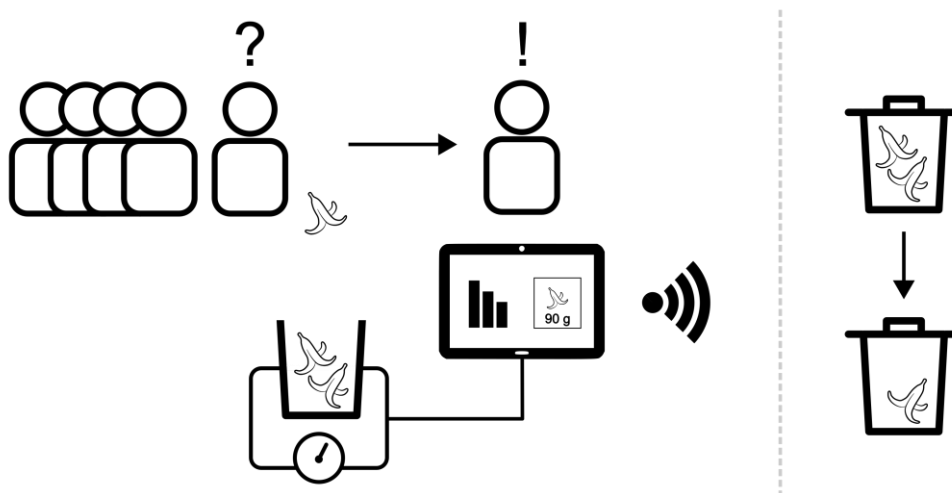


Figure 1 – Overview of how the guests interact with the plate waste tracker. The guests throw their plate waste into a bin which sits on weighing scales. The scales are connected to a tablet computer that displays the weight of the items thrown away. All information collected is sent to a central database.

To nudge guests to waste less, the interface displays different messages depending on how much each individual guest is wasting. If a guest throws away more than 70 g, the interface shows a message with a red background asking the guest to waste less next time and stating the amount of food discarded. If a guest throws away 20-70 g, the same message about throwing away less food is shown, but with an orange background. If the guest throws away less than 20 g, the feedback is that the guest created little food waste. The interface also allows the guest to provide feedback on why they wasted food, with some predefined

alternatives such as “I did not like it/It was not to my taste”, “I took too much food”, “I did not have time to finish my meal”, “I ate it all, thanks for the food”.

The guests are also shown the total amount of plate waste for the current meal and how this compares to the previous day in the same week and to the average for the previous week. Information for the previous day and the average for the previous week are based on manually recorded values entered by kitchen staff each time the plate waste bin is emptied. The reason for this procedure is that staff can record the actual amount of plate waste if the scales are tampered with by the guests. The staff can also record the number of guests served each day, to get the relative indicator ‘plate waste/guest’. **Errore. L'origine riferimento non è stata trovata.** shows the different parts of the interface and how it interacts with the guests.

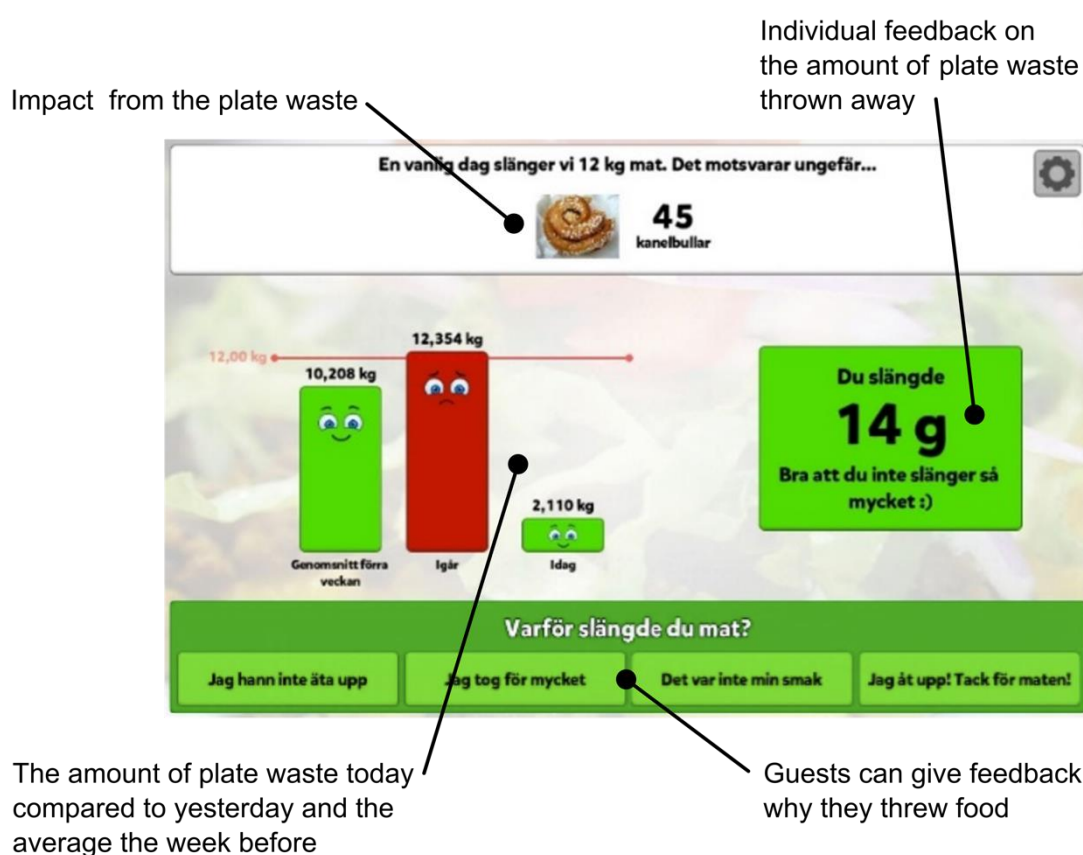


Figure 2 – Overview of the interface of the plate waste tracker software and the different elements. The top part of the interface gives information about the impact of the plate waste generated (approximately) in the canteen in terms that the guests can relate to, for instance the number of cinnamon buns that 12 kg of plate waste represents. The middle part of the interface displays how today's levels of plate waste relates to the previous day's and the previous week's average. This information is also relative to a goal that the canteen has set, in this case 12 kg. Individual feedback is displayed to the right of this information and changes depending on how much food

is wasted. The bottom part of the interface lets the guests give feedback on why they are wasting food.

To collect the information that the guests provide when using the plate waste tracker and transmit this to the canteen staff in a systematised way, the tracker is also connected to a web interface. Here, all gathered data is summarised in different categories from which the canteen staff can retrieve the information in a quick and simplified manner.

Figure 3 shows some locations where the plate waste tracker has been deployed in the LOWINFOOD project.

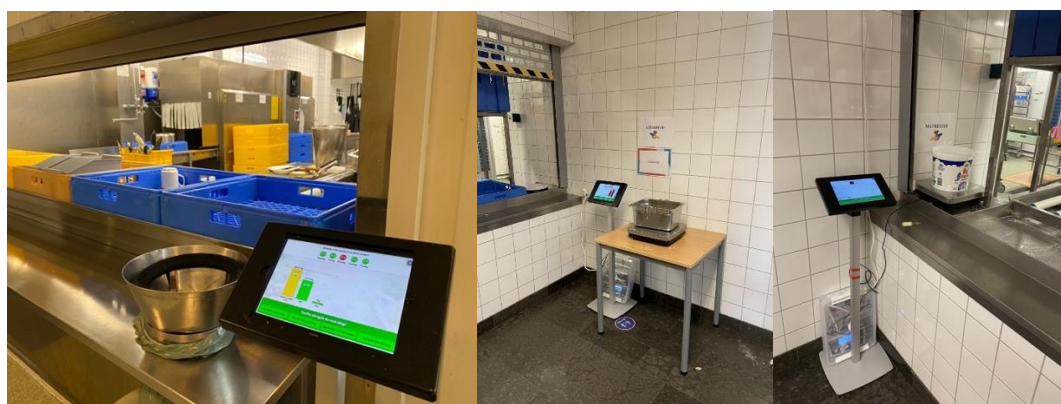


Figure 3 – Here are a few instances of where the Plate waste tracker has been implemented.

To assess the plate waste tracker's impact on plate waste reduction, we use baseline data from locations before its deployment as a reference. We then compare this with data from its active phase. The decrease in plate waste is measured in terms of median "g plate waste/guest".

User of the demonstration

The innovation is utilized by school canteens across Sweden, Germany and Austria. In Sweden, 10 canteens were onboarded through the collaboration with Uppsala municipality, a partner in the LOWINFOOD project who operates public catering canteens serving meals to schools. Meanwhile, three German and five Austrian users were brought on board by ISUN and AIE, respectively.

Each school canteen in Sweden that deployed the plate waste tracker provided meals to students aged 6-15. In Sweden, legislation mandates free meals for primary school students on school days. These meals are funded and supplied by the municipality, or in the case of private schools, by the school's proprietor. All Swedish schools participating in the LOWINFOOD project are municipally operated, which lends them a uniform structure. In this setup, the municipality shoulders the cost and responsibility of meal provision. Lunches are served buffet-style in the school canteens, a format consistent across most of the schools. Typically, each meal includes two options: one vegetarian and the other featuring fish, meat,

or another non-vegetarian alternative. Since the municipality oversees meals for all municipal schools, the menus are generally standardized. While many canteens feature in-house production kitchens, some, especially those in smaller schools, operate as satellite kitchens. In such cases, a central kitchen prepares the majority of the food, which is then daily transported to the canteens.

Upon entering the canteen for their meal, students are greeted by a buffet showcasing the day's offerings. Alongside this, a complimentary salad buffet awaits, granting them the freedom to select their desired items and assemble their plates. Typically, a canteen staff member is stationed near the buffet table, ready to guide and inform the students about the dishes. This includes gentle reminders to incorporate vegetables from the salad buffet, manage portion sizes, and return for a second serving if needed. Once the meal is concluded, guests proceed to the dishwashing station. Here, any leftover food is discarded into designated bins before they leave their plates for the staff responsible for cleaning the dishes.

Each school canteen in Germany that deployed the plate waste tracker provided meals to students aged 10-18. At two schools, the municipalities are the school authorities, which are therefore also responsible for organizing school meals. The municipalities maintain the local school canteens where fresh food is cooked on site every day. The third school is run by a diocese of the Catholic Church. In this school a private catering company runs the school canteen. In this school, too, the meals are freshly prepared every day.

In all canteens students can usually choose among two or three menus (at least one vegetarian and the other featuring meat or fish) + salad bar + dessert, and the emphasis is on a varied and balanced meal. In addition, water is freely available for drinking in the canteens. At one school a buffet is set up one day a week. At the beginning of the lunch break, students can pick up their pre-ordered food at the counter served by the kitchen staff or in the case of the buffet decide which offering they would like to eat that day. After the meal, the students return the trays and either place them in a tray rack trolley or dispose of the leftovers of their meals in the waste and place the trays and plates on a plate storage trolley.

The partaking Austrian school canteens testing the plate waste tracker provided meals to students aged 10-18. All partaking schools were schools with cooking classes as part of their curricula and are intertwined with the organization of school meals. The Austrian schools organized the school meals themselves and provided a list of two to three options pupils could choose from. Most schools had at least one vegetarian or even vegan option each day. In one school the lunch menus were cooked by the pupils themselves during their cooking classes and served to the registered guests (also pupils). The other schools had ordering systems where a specific meal can be picked beforehand and picked up at the canteens. The plates and trays are as in Germany left on a tray rack trolley and the food left on the plates is normally either left on the plates or scraped into a trash bin.

Pre-demonstration phase

The pre-demonstration phase was carried out in 10 primary schools in Sweden during the period between January 2021 and September 2021, where the total number of days of observation for each school varied between 15 and 229. This was during the Covid-19 pandemic and therefore the pre-demonstration phase was interrupted or delayed on several occasions in some of the schools. A majority of the schools were located in Uppsala municipality.

During the pre-demonstration phase plate waste was recorded with the plate waste trackers.

Throughout the pre-demonstration phase, several inquiries and improvement suggestions were raised by the participating canteens. Primarily, the issues addressed were related to the dashboard features of the innovation, rather than its technological functionality within the operational environment. An important takeaway from this phase has been the critical role of having a dedicated individual in each kitchen who is actively engaged with the innovation. These key personnel have played a pivotal role not only in advocating for the innovation's adoption within the canteens but also as a primary contact with the innovator.

Based on the feedback provided during the pre-demonstration phase the following changes were made to the demonstration phase:

- The tablet can only run the dedicated plate waste tracker application.
- Software is automatically updated on all devices if they are connected to the internet.
- The application supports multiple languages.
- Changes of some cables for better connectivity between scales and tablet.
- The application has built-in support and troubleshooting for common issues.
- The tablet hibernates to conserve battery when not connected to an external power source.
- Incremental software updates with minor issues discovered along the way.

Demonstration phase

The demonstration phase in Sweden ran from September 2021 to April 2022 for most canteens. During this phase, canteens utilized the innovation for periods ranging from 15 to 179 days. Plate waste data continued to be tracked in a manner consistent with the pre-demonstration phase. Although most challenges were addressed during the pre-demonstration phase, minor adjustments were made during the demonstration.

In Germany the demonstration took place between March and June 2023. Before that time a baseline measurement of at least four school weeks was conducted in each of the three units. Depending on the staff capacities of the canteens, the measurement of plate waste as well as serving waste and waste from overproduction was carried out independently by the canteen staff or with the support of the researchers. For the baseline period, there were 20,



25, and 13 complete data sets for the three school canteens respectively, as the four measurement weeks included days without meals and holidays. The demonstration phase was started by workshops in the schools in order to introduce the plate waste tracker. The researchers accompanied the introduction of the plate waste tracker by being present in the canteens during meal times and supporting the children in using the tracker. The amount of support needed varied depending on the school and possible support from the canteen service staff. The measurement during the demonstration phase yielded 26, 17, and 11 complete datasets for the three schools respectively.

The demonstration phase in Austria started in September 2022 and will last until end of November 2023. Before this time some schools already conducted baseline measurements and all measurements were conducted independently by the schools after a comprehensive introduction by AIE staff. So far three school baseline datasets for Austria are available. The first school collected baseline-data from two teaching kitchens (30 + 26 recorded days), one professional kitchen (33 recorded days), and the associated kindergarten's kitchen (31 recorded days). The second school recorded 18 days as baseline and 10 days post-implementation. The third school recorded 15 days as a baseline and 11 days post-implementation. This reduced number of days resulted from the fact that not enough pupils registered for school lunches to offer them each day of the week. To show the kitchen staff and teachers how to properly use the plate waste tracker AIE staff gave a presentation on site and was available for questions arising during implementation.

Challenges /Germany:

One challenge observed during the German demonstration concerns the maintenance of the devices. If there was no responsible person to take care of the plate waste tracker, it could happen that it was not switched on and that it was not cleaned after use. A dirty scale looks unhygienic, which is particularly undesirable in a kitchen context. In one school, the fact that no responsible person neither from the kitchen staff nor from the school teachers could be identified meant that the researchers had to be on site there every day to ensure that values were actually recorded during the four-week measurement period. In the other two schools responsible staff from the kitchen could be named. Nevertheless, it was also necessary here that the first days of use were accompanied by the researchers. This concerned on the one hand the technical use of the scale itself, but also the concept behind it. For example, students in one school found the plate waste tracker controlling and felt compelled to finish their plates completely. Students need to understand the idea behind Matomatic, that it is not a controlling instance but rather meant to raise awareness. For this reason, the researchers accompanied the introduction of the scale in all schools at short notice.

Challenges/Austria:

Working with the current version of the plate waste tracker presented a challenge and showed a few ways the product could be updated. The plastic casing for the tablet was not properly fitting together with the digital parts. In the beginning it was impossible to charge the tablet in the plastic casing. Only after drilling an extra hole in the plastic where the

charging cable could go through was it possible to set it up. A better adjusted casing with a clear positioning for the charging cable would be suggested. The long metal bar of the plate waste tracker was hard to transport and could be made more user-friendly if it is replaced by a telescope-bar. Further challenges derived from the fact that, with limited budget also the time spent in schools to supervise data collection and implementation was limited. So the quality of the data very much depended on the motivation and experience teachers and school staff had. This also led to only very few data being reported back to Matomatic at the end of the day. In one case a plate-waste tracker seemed to have stopped working. After investigation by AIE, the plate waste tracker appeared to be working fine and it was suspected that the plate waste tracker was used without being plugged in.



3. Outcomes of demonstration phase

Figure 4 displays the reduction of plate waste in the different countries. In the Swedish canteens using the plate waste tracker, there was an overall waste reduction of 15%. The baseline period showed plate waste at 19.7 g/guest, but this figure declined to 16.7 g/guest during the intervention implementation. Notably, seven of the ten canteens employing the tracker in Sweden achieved plate waste reductions ranging from 8% to 73% which is also displayed in Table 1. The three canteens using the plate waste tracker in Germany managed to reduce plate waste by 24%. Data from Austria did not contain any number of guests at the time of writing the report, due to the separate collection through ordering-systems. Therefore the indicator waste/guests could not yet be calculated for Austria.

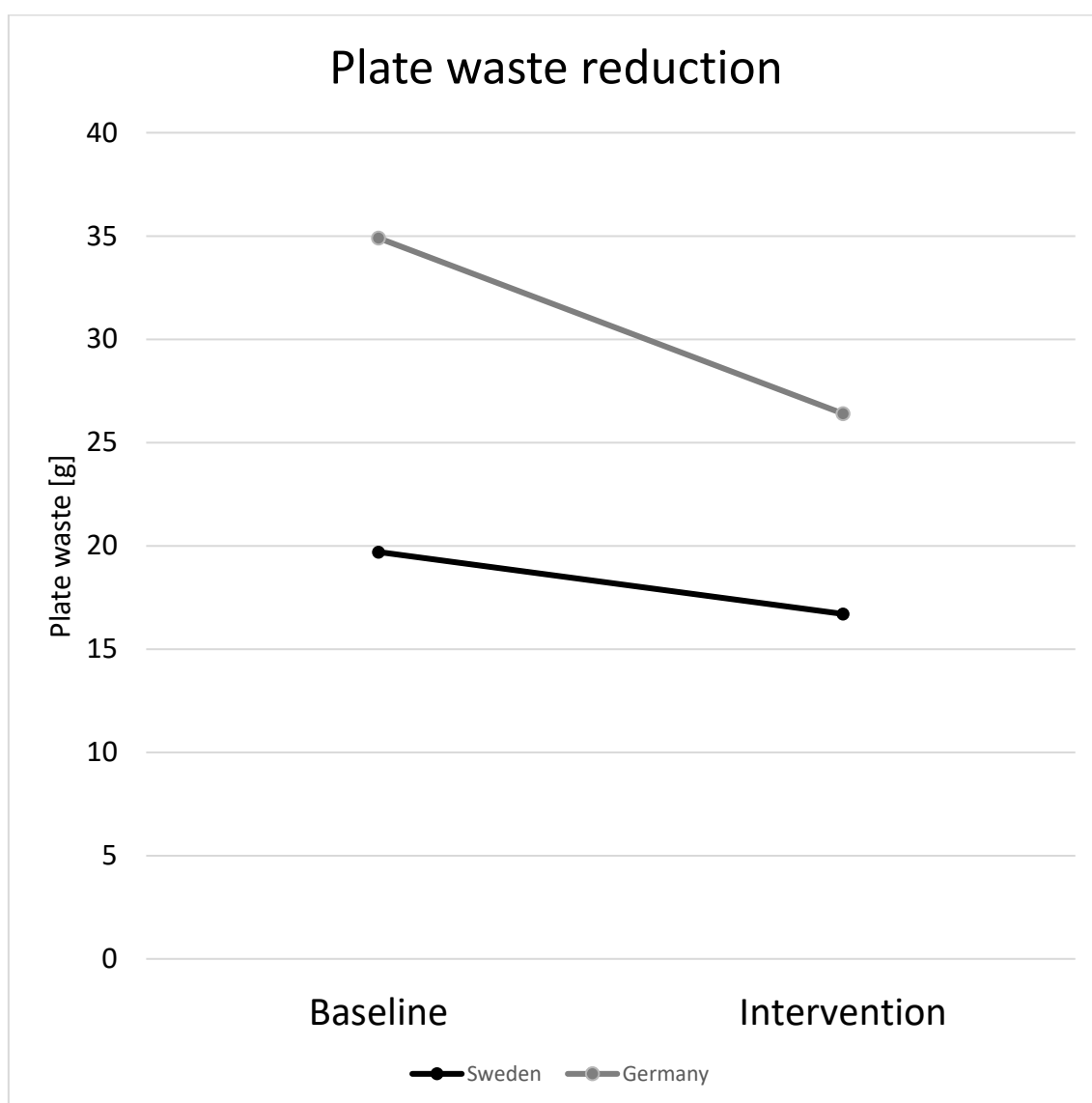


Figure 4 – Levels of median plate waste compared with and without the plate waste tracker.

Table 1 – Levels of median plate waste compared with and without the plate waste tracker per canteen and country.

Code	Baseline (g)	Intervention (g)	% change	Country
Canteen 1	19,1	13,9	-27%	Sweden
Canteen 2	16,8	11,3	-33%	Sweden
Canteen 3	23,8	26,7	12%	Sweden
Canteen 4	21,8	5,8	-73%	Sweden
Canteen 5	20,8	19,2	-8%	Sweden
Canteen 6	14,6	10,9	-25%	Sweden
Canteen 7	22,6	22,7	0%	Sweden
Canteen 8	18,9	16,6	-12%	Sweden
Canteen 9	21,5	22,3	4%	Sweden
Canteen 10	11,8	9,5	-19%	Sweden
Sweden	19,7	16,7	-15%	
Canteen 11	26,7	24,5	-8%	Germany
Canteen 12	42,1	47,5	13%	Germany
Canteen 13	36,2	18,3	-49%	Germany
Germany	34,9	26,4	-24%	
Canteen 14*				Austria
Canteen 15*				Austria
Canteen 16*				Austria
All canteens	20	17,2	-14%	

* plate waste in g/guest could not be calculated due to the lack of information regarding how many guests that attended the meals at the time of writing this report.

4. Learnings and recommendations for future applications

Experiences gained in Sweden:

A key lesson for the plate waste tracker to be successful is that there is someone dedicated or responsible in the canteen that maintains the device and cares for the data that is being captured by for instance guest's feedback. Engaged staff is the key to get over any hurdles with this innovation. Today, the interface displays daily feedback based on the total weight of captured waste in kilograms. This could inadvertently place undue pressure on individuals, especially if their waste causes the tally to exceed the set goal. We're considering an experiment to present this data as daily averages rather than total cumulative plate

waste. This approach would ensure that each person's contribution influences the overall average, preventing the blame from unfairly falling on the last few guests of the day should the waste exceed the canteen's target.

Experiences gained in Germany:

As in Sweden, an important key lesson for the plate waste tracker is that someone needs to be on site to look after the equipment and take care of the data. Secondly, the use of the plate waste tracker must go hand in hand with measures in the kitchen. Serving options must be adapted – if children want smaller portions, they must have the option to choose so or to get a refill/second portion. If serving is not changed (e.g. portion size / option two get second serving/improved quality of food), plate waste cannot change even if the students' awareness is raised. Experience has also shown, that the introduction of Matomatic must be accompanied by a holistic food waste prevention concept addressing the students and the staff of the school canteens. In addition to the technical use of the scales, the students should also learn why it makes sense to reduce food waste from a sustainability perspective. At the same time, they should perceive the use of the scales as a positive experience and not as a control instrument.

Experiences gained in Austria:

In Austria very similar issues as in Sweden and Germany were observed. The data collection needs supervision by scientific staff. The use of the plate waste tracker is also only attractive to the schools if there are more activities planned around it to the topic of food waste. As a general good practice, it is important that the recorded data of the plate waste tracker or generally the measured food waste is discussed in school lessons to connect the numbers to the underlying issues.

5. Conclusion

- The plate waste trackers used in the LOWINFOOD project reduce plate waste by 14% on average in the canteens where the innovation was deployed.
- There is potential to also reduce serving waste, however this is dependent upon if the feedback provided by guests is collected and examined by the canteen staff and if they have the possibility to make the amendments necessary to the menu.
- The interface is subject to change in the future to improve how messages are perceived and to how information is provided as feedback both to guests but also for canteen staff.

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