COLLECTION AND RECORDING OF FOOD WASTE FROM OUT-OF-HOME CATERING

Overview of policy frameworks and existing recording tools

With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

In collaboration with:

UNITED AGAINST WASTE
GEMEINSAM GEGEN VERSCHWENDUNG

FH MÜNSTER
University of Applied Sciences

INL

WWF

GERMAN STRATEGY TOO GOOD FOR THE BIN!

The aim of the project **"Too good for the bin! – Dialogue on the avoidance of food waste in out-of-home catering"** is to reach a voluntary agreement together with the main stakeholders to avoid food waste for this sector. Parallel to the dialogue events, demonstration projects with selected pilot companies from the business and from industry, tourism and care sectors will be carried out.

For more information on the project see:

WWF
www.wwf.de/themen-projekte/landwirtschaft/ernaehrung-konsum/dialog-zur-vermeidung-von-lebensmittelabfaellen

BMEL
www.lebensmittelwertschaetzen.de/strategie/handlungsfelder/dialogforum-ausser-haus-verpflegung

About this report

Project funding	Federal Ministry of Food and Agriculture (BMEL)
Project-executing agency	Federal Office for Agriculture and Food (BLE)
Funding code	2817WWF016
Project partner	WWF Germany, talk & act Nachhaltigkeitsmanagement c/o United against Waste, Fachhochschule Münster, INL e. V.
Publisher	WWF Germany
Date	May 2020
Author	Kerstin Weber (WWF Germany)
Cooperation	Tanja Dräger de Teran (WWF Germany), Silke Friedrich (University of Applied Sciences Münster), Torsten von Borstel (talk & act Nachhaltigkeitsmanagement c/o United against Waste)
Coordination	Kerstin Weber (WWF Germany)
Contact	kerstin.weber@wwf.de
Editor	Kerstin Weber (WWF Germany)
Design	Anita Drbohlav (www.paneemadesign.com)
Production	Sven Ortmeier (WWF Germany)
Picture credits	iStock/Getty Images

Recording Tools – Summary

This report provides an overview of the instruments commonly used in Germany to collect and reduce food waste. The information provided is intended to give out-of-home catering companies low-threshold access to these instruments. This report is the result of the project "Too good for the bin! – Dialogue for the avoidance of food waste in out-of-home catering".

THE COLLECTION OF FOOD WASTE DATA HAS MANY ADVANTAGES FOR COMPANIES

The collection and reduction of food waste is profitable for companies in many ways. By measuring food waste, they can identify areas of improvement as well as savings potential and establish reduction measures in a targeted manner. This leads to raw material and cost savings. In addition, an active stand against food waste can be a response to the increasing pressure on the part of consumers for more sustainability and transparency. The collected key figures can be integrated directly into sustainability reporting.

> "For us, the prevention of food waste is a contribution to the conservation of resources, but in any case also an important tool for reducing the use of goods and lowering costs."
> Alexander Fitz, CEO of H-Hotels AG

ON THE POLITICAL SIDE, THERE IS A NEED FOR DATA ON ACTUAL WASTE VOLUME

The collection and measurement of food waste along the entire value chain and especially in out-of-home catering is also playing an increasingly important role in terms of political guidelines. To implement the UN goal of reducing food waste by half by 2030 (SDG 12.3), the German Federal Government published the "National Strategy to Reduce Food Waste" in February 2019. As part of the strategy, sectoral dialogue forums will be set up to jointly develop concrete measures against food waste and set sector-specific targets. The dialogue forum for the out-of-home sector started on 20.02.2019 and aims to develop targets and measures for the out-of-home sector and adopt them in a joint agreement. The entire sector is called on to collect and provide data in addition to national reporting in order to contribute to the UN goals for sustainable development. In Germany, various services have been developed in recent years which can support companies in collecting and providing the necessary data.

ANALYSIS SHOWS THE SPECTRUM OF COMMON TOOLS

This report presents the waste analysis tool of United Against Waste e. V., the kitchen monitor of the Verbraucherzentrale NRW, Winnow Vision of Winnow Solutions, the standard instrument of Leanpath and the RESOURCEMANAGER FOOD of the University of Stuttgart. Furthermore, the demand forecast models Delicious Data and Mitakus will be presented, which also serve to counteract the waste of food by ensuring that food is cooked according to demand.

The analysis of the recording tools shows the wide range and varying level of detail of existing instruments. The functions of tools available to companies range from simple measurements to the use of cameras and artificial intelligence for recording. Some of them are free of charge, some associated with considerable monthly costs. On the one hand, food components are measured mixed (e.g. in the waste analysis tool) and on the other hand separately (e.g. in Winnow Vision, Leanpath and RESOURCEMANAGER FOOD and Kitchen Monitor). Apart from in the Kitchen Monitor, the waste produced is usually set in relation to the amount of food produced. A strategy for developing reduction measures is not always included. With the waste analysis tools, Winnow and Leanpath, reduction measures are developed together with the suppliers as part of the measurement. The Kitchen Monitor is available free of charge for independent use and therefore does not offer active help in developing actions. General steps and further information are provided on the website. A consulting concept for the RESOURCEMANAGER FOOD is currently being developed.

The data collection is partly continuous as with Winnow and Leanpath and partly only over certain periods of time as with the waste analysis tool. All instruments show the cost of the waste. The waste analysis tool and the kitchen monitor calculate with a mixed calculation of 2 Euro per kilogram. Winnow, Leanpath and the RESOURCEMANAGER FOOD map the actual costs based on the stored raw material costs. With the exception of the kitchen monitor, all tools also calculate the greenhouse gas emissions of the waste produced. In addition, the waste analysis tool maps the use of water and space.

> "Thanks to waste measurement, we have succeeded in reducing the daily waste per person to 220 grams. The national average is currently 350 grams."
> Kai Uwe Moriz, Chef, ABConcepts Verpflegungsmanagement mit System GmbH

Overall, it can be said that the tools are suitable for very different company sizes and target groups. The Kitchen Monitor is currently only available for daycare and school catering and is better suited for catering concepts with few dishes. The RESOURCEMANAGER FOOD is very flexible and offers the user a variety of options. Leanpath and Winnow provide state-of-the-art systems that deliver very detailed data. They can be used for all areas of out-of-home catering, but are currently more suitable for large companies due to the monthly costs. However, they are working on solutions that can also be implemented by small businesses. The waste analysis tool is aimed at the entire spectrum of out-of-home catering.

Depending on their requirements, companies in the out-of-home catering sector therefore have numerous well-suited solutions and support options at their disposal to start reducing food waste in their own business.

Introduction

The collection of food waste has numerous advantages for food companies. Regular measurement can identify where waste is generated and quantify the waste. On this basis, suitable measures can be taken to bring about long-term changes in kitchen processes. It also increases employees' awareness of the problem of food waste, saving both raw materials and considerable costs. Active commitment to minimising food waste can be used to respond to increasing consumer pressure on the one hand and regulatory requirements on the part of politicians on the other. The key figures collected can be integrated directly into sustainability reporting. In the meantime, there are numerous instruments that can assist with measuring and recording food waste.

This background paper is part of the project "Too good for the bin! – Dialogue on the avoidance of food waste in out-of-home catering" and is intended as a working aid for actors in out-of-home catering. The aim of this paper is to present various instruments for measuring food waste and to work out which tool is best suited for the respective type of company and what advantages the respective tools offer.

To begin with, the political framework conditions at European and national level will be defined and the requirements for the collection of food waste will be described. The tools are then presented on the basis of various criteria. The target groups, collected data, elaboration of measures, presentation of results, costs and effort as well as the continuity of collection are considered. In an excursus, models for a more precise demand forecast are presented, which also serve to counteract the waste of food. After a detailed description of the individual tools, the results are presented in a comparative summary in the form of fact sheets.

> "As one of the leading caterers in Germany, Klüh provides meals for tens of thousands of people in numerous clinics, large companies and in public administration every day. We have set the goal of raising awareness with all employees in the companies for the topic of food waste, to identify the causes, reduce them to a minimum and thereby optimise the companies sustainably."
> Klüh Catering

Future requirements for the collection of food waste

Political framework

The implementation of the UN objective for sustainable development regarding the reduction of food waste (12.3) is pursued in the European context through the amendment of the Waste Framework Directive. The aim is to reduce food waste by 50 percent by 2030. The EU member states should define specific measures and monitor progress in reducing food waste. The reporting obligation of the EU member states and thus also of Germany will begin in 2020. The framework for the methodology and the minimum requirements for recording food waste have been laid down.

The proportion of food waste within a stage of the value chain must be determined by a representative sample of food companies or households. The recording should be carried out in accordance with the methods listed below, a combination of these methods or in accordance with methods that are of equal value in terms of relevance, representativeness and trustworthiness. The following methods are possible for restaurants and out-of-home catering:

- **Direct recording:** by weight or estimation of volume
- **Waste analysis:** physical separation of food waste from other waste to capture the weight of separated food waste
- **Counting and scanning:** estimating the number of items that make up food waste to determine weight
- **Diaries:** regular records kept by individuals or groups of individuals on the occurrence of food waste.

National strategy to reduce food waste

With the coalition agreement of 2018, the Federal Government has set itself the task of reducing food waste and has commissioned a strategy to achieve a reduction. Building on this, the Federal Ministry of Food and Agriculture (BMEL) published the "National Strategy for Reducing Food Waste" in 2019. As part of the strategy, an overarching national dialogue platform will be created. In addition, there will be sectoral dialogue forums at which concrete measures to reduce food waste will be jointly developed and sector-specific targets defined.

For the out-of-home sector, the dialogue forum "Too good for the bin! – Dialogue on the avoidance of food waste in out-of-home catering" was set up on 20.02.2019. The aim of the dialogue forum is to highlight positive examples from Germany and abroad, to develop binding targets and adopt them in a joint agreement. The results of this dialogue forum will flow into the strategy for the reduction of food waste in Germany. The participating companies are required to collect and report food waste data on a regular basis.

A future reporting or collection system, which should enable Germany to demonstrate the reduction of food waste in the sectors over specific periods of time, in a comprehensible way is currently being developed on the basis of the specifications from the EU. Existing recording tools can help companies to record and provide the necessary data for national reporting.

Overview Recording Tools

In the following, the tools commonly used on the German market for the collection of food waste data are presented. At this point, it should also be mentioned that, in addition to these recording tools, there are other German-language platforms supporting companies with a reduction of food waste, for example:

Publisher: Federal Ministry of Food and Agriculture
www.lebensmittelwertschaetzen.de

Publisher: Münster University of Applied Sciences
www.lebensmittel-abfall-vermeiden.de

Waste-Analysis-Tool

United Against Waste e. V.

In order to be able to prove what percentage of the actual food waste would be avoidable, United Against Waste e. V. (UAW) developed the waste analysis tool in mid-2014.[1] From May 2014 to May 2019, UAW carried out over 650 waste measurements and analyses in cooperation with various out-of-home catering (AHV) companies.

Description of the tool

The waste is sorted, weighed and documented using four transparent collection containers that represent the entire kitchen process. The waste analysis tool aims to provide an overview of the actual amount of food waste generated in the individual measurement areas. It maps the entire kitchen process.[2] On the basis of the results, causes are identified and measures for waste avoidance are developed for the respective company. In the process, cost/environmental saving potentials (euro, CO_2, water, area under cultivation) can also be identified using representative averages.

Figure 1: ***Environmental impact saved***

1 United Against Waste (o. J.): Abfall-Analyse-Tool, URL: https://www.united-against-waste.de/14-abfall-analyse-tool-teaser (Date: 27.09.2019)
2 United Against Waste (o. J.): Zwischenbilanz, URL: http://www.united-against-waste.de/der-verein/zwischenbilanz (Date: 24.07.2019)

Target audience

The waste analysis tool is suitable for all settings and all catering concepts for out-of-home catering. In addition, the tool can be used for all operations of a company.

Data collection and analysis

The waste analysis tool collects waste data in four areas of the kitchen process. These four areas are: storage (e.g. too large quantities, spoiled goods), production waste in the kitchen (e.g. surpluses from mise en place), over production (e.g. at the buffet) and plate returns (leftovers on plates from guests).

The waste is collected in four containers in the kitchen and weighed separately every day. The results can either be recorded on a waste card (if there is no internet in the kitchen) or if using a tablet or laptop, entered directly when weighing into the online waste analysis tool.

Figure 2:
Waste per meal
in grams

Food waste is referred to as wet waste because all waste is collected in one bin and all food components are mixed. There is no separation according to components. However, the main components per area can be added using a note function in the online tool.

The waste quantities are measured in grams, the total result is given in kilograms. The waste per meal is calculated in grams as a key figure.

When using the waste analysis tool, there are usually two measurement periods. A measurement period lasts four to six weeks, regardless of the catering facility. The food waste is recorded daily according to the opening hours from Monday to Sunday (e.g. hospital, hotel) or from Monday to Friday (e.g. company canteen). The first measurement period is used to record the status quo.

After actions have been carried out to reduce food waste, a second measurement is taken. This shows how much waste could be saved in which areas by implementing these measures. Further selective measuring periods (e.g. of two weeks) are carried out to stabilize the reduction. In the waste analysis tool, a distinction can be made according to the type of waste measurement (breakfast, lunch, evening, banquet).

Evaluation and presentation of the results

The results are presented in a waste analysis report in the form of charts and calculation tables. This way, evaluations can be carried out at any interval (e.g. hourly/daily/weekly). The resulting waste is displayed in the four measuring ranges. The potential reduction can thus be quickly derived.

After action and a second waste measurement has been taken, the changes in waste generation between the two measurement periods are shown (reduction or increase). In addition to the general consumption data, the costs of the total waste per day or year are depicted, as is the environmental impact of the waste produced. Land and water consumption as well as greenhouse gas emissions are also shown.

In addition, the daily menu selection is compared with waste from plate returns and overproduction and sorted according to a traffic light system (green, yellow, red) into to “winners” and “losers”.

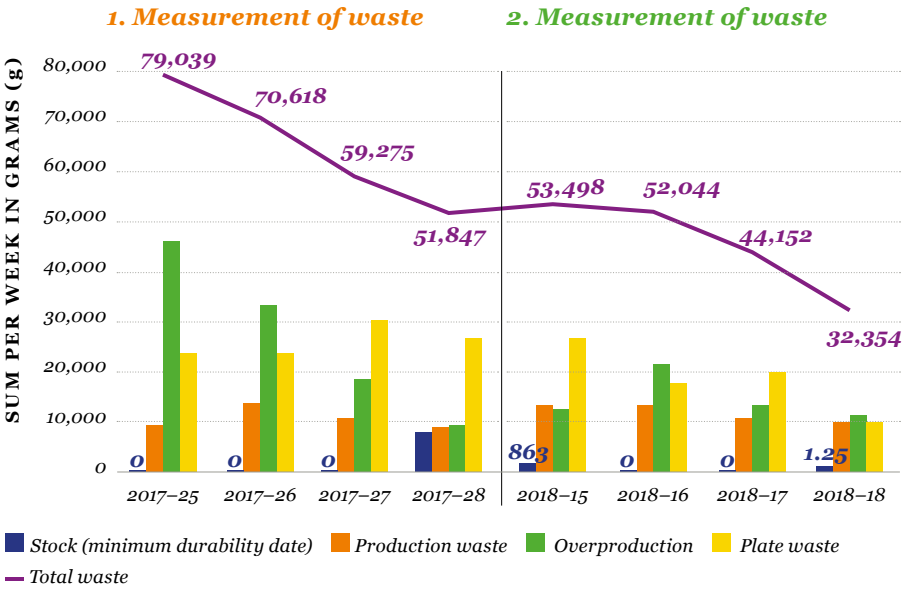

Figure 3: ***Comparison of the 1st and 2nd waste management – total***

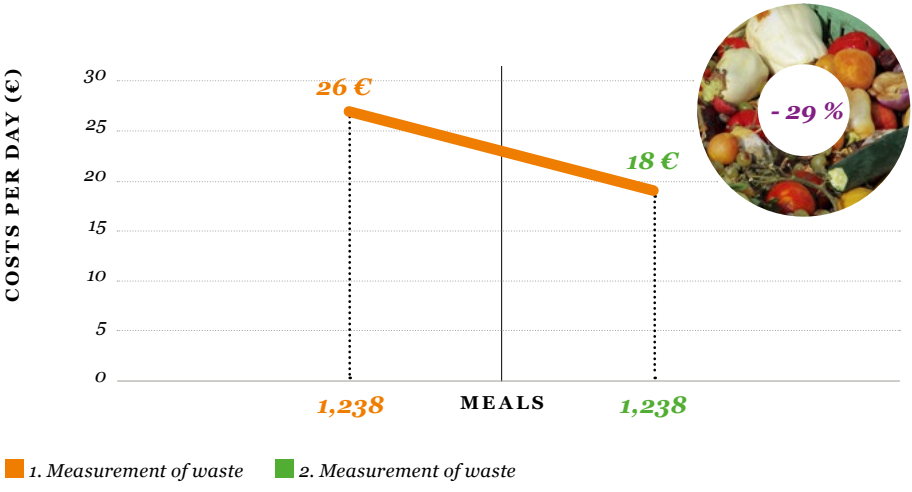

Figure 4: ***Comparison of the 1st and 2nd waste measurement – Average cost per day***

The following results can be mapped by the tool:

- results of the four measuring ranges for different time periods
- total waste in kilograms and percent (divided between the four measuring areas)
- measurement period (measurement days individually or in total per calendar week)
- waste per meal (grams)
- cost per day (euro)
- environmental indicators (greenhouse gas emissions in CO_2 equivalents, water consumption in litres, land consumption in square metres)
- number of waste bins used
- meal averages per day, total waste and waste per meal
- “winner” and “loser” dishes
- waste quantities of breakfast, lunch and dinner

The results are available to the participating companies online in a protected area at any time. The companies are provided with an account.

Development of measures of reduction

Simple measures – such as a changed offer (e.g. different portion sizes, improved management of buffet and serving, portioning) – can be implemented directly and make a significant contribution to the avoidance of waste.

After the first waste measurement, a waste analysis report is prepared. On the basis of this, the reduction potential per company is discussed in a joint workshop with the UAW team on site and individual measures are developed. These come into play where the highest amount of waste is generated. After implementation, the measures are documented in the form of a checklist. The measures differ depending on the catering concept or gastronomic facility (company restaurant, hospital, hotel, etc.).

A second waste measurement shows whether the measures are actually effective and lead to a reduction. In order to check (stabilize the reduction), spot measurements lasting one to two weeks are carried out at certain intervals in agreement with the companies.

Costs and effort

UAW offers three modules that can be used independently of each other:

- Module 1: On-site analysis – recording of processes and workflows on site
- Module 2: Using the Waste Analysis Tool Online
- Module 3: Workshop – Development of individual measures for reduction

For modules 1 and 3, consultancy costs are incurred in the form of an analysis or an on-site workshop, for which daily rates of 1,250 euros are charged. For the use of the waste analysis tool from Module 2, a monthly lump sum of 50 to 130 euros is charged, including daily use, access to hosting and external support. The duration is 12 or 24 months. The installation of additional software or hardware on site is not necessary. For waste collection, four transparent bins can be ordered from UAW for 150 euros. Scales should already be available.

Users do not need any previous knowledge. The tool can be used at any time via web browser. Telephone training (presentation of the measuring method and operation of the waste analysis tool) will be provided. This one-time training lasts approx. 20 minutes. Approx. ten minutes per day is the extent of the effort involved. Before beginning with the first measurement, all employees can be trained to use the tool by someone designated from within the enterprise. The training materials are provided by UAW.

Consistency of data collection – usability for the companies

Results of previous measuring periods are saved. In this way, new results can be compared with older ones and displayed over longer periods of time. The waste analysis tool can also be used for other businesses within an enterprise. Several outlets of a catering company can, for example be compared with each other.

Customers can receive a mandate for several branches of their company. The waste analysis tool can be used for benchmarking and calculate averages for diverse catering facilities (e.g. care home, canteen, hotel, nursery and school catering). However, these can only be viewed by the administrator and are anonymized.

| Link: www.united-against-waste.de

Kitchen monitor

Consumer advice centre North Rhine-Westphalia

The kitchen monitor was developed as part of the project “Pathways to Reduce Food Waste” (ReFoWas) for independent and detailed evaluation of waste data.

Description of the tool

With the free kitchen monitor, kitchens and caterers can independently evaluate their waste data. For this purpose, production quantities, output and plate remains must be recorded and entered into the Kitchen Monitor after one-time registration. The evaluation is automatically displayed in easy-to-understand graphics.

The graphics can be used to identify approaches to waste avoidance from production planning to the scullery, but also at the level of menus and recipes. The implementation of measures reduces food waste, protects the environment and climate and enables the quality of food to be improved through cost savings. This way, community catering facilities can set off towards low-waste catering.

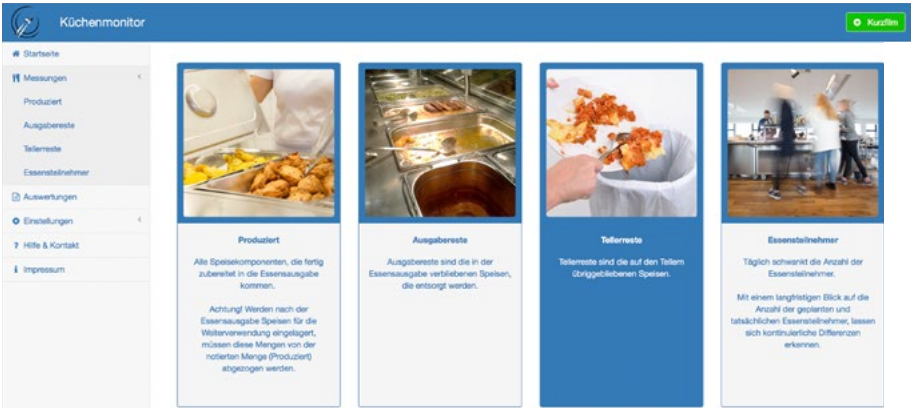

Figure 5: ***The Kitchen Monitor***

Target audiences

So far, the Kitchen Monitor has only been aimed at schools. In spite of this, the Kitchen Monitor is also being used by daycare centres and youth hostels. In a further development phase, the Kitchen Monitor will be adapted to address all community catering facilities.

Data collection and analysis

The Kitchen Monitor measures the amount of waste from the time the finished food is produced, i.e. the amount of leftovers from serving and on plates is recorded. Storage and production losses are not considered. Measurement is therefore independent of whether the food is produced on site or delivered by a caterer. Furthermore, every facility can use the waste measurement method.

The total amount of produced food is the starting point for measurements. A differentiation is made between individual food components (e.g. potatoes, shredded meat, salad). The already prepared components are usually filled in gastro standard containers or bowls. Before the food leaves the kitchen and enters the serving area, it is weighed and the weight (minus the container) is noted. The total quantity is the sum of the individual component quantities. When the food has been served, the food from the food serving area is also weighed component specifically. Afterwards, the leftovers on plates are collected and weighed. The number of planned and actual catering participants is also noted after the meal has been served.

For recording the individual measuring parameters (production quantity, output remains, leftovers on plates, deviation between planned and actual catering participants), documentation lists are available for printing. The results are then transferred to the online tool. The waste quantities are measured in grams. A measurement over at least ten catering days is recommended. A longer collection and evaluation of the data would be useful. The “Help and Contact” section of the online tool provides instructions on the kitchen monitor.

Evaluation and presentation of the results

After entering the data in the online tool, an evaluation can be created for a specific measurement period, which can be opened as a PDF document.

In addition to the waste data, the kitchen monitor can also show the monetary savings potential. In addition, a “winner”/“loser” list is created, which shows the ten food components with the lowest and highest waste quantities based on residues in the food out-put area. This makes it possible to see at a glance which dishes are more or less popular and which are produced as needed or in excess.

The following results can be mapped by the tool:

- total waste quantity in relation to production quantity (kilograms and percentage)
- output and plate leftovers in relation to production quantity (kilograms and percentage)
- production quantity, output and plate leftovers by days (kilograms)
- output leftovers by components (kilograms)
- "winner" and "loser" lists
- planned and actual catering participants and the difference (number)
- average planned and actual portion size (grams)
- plate leftovers per participant in relation to average portion size (grams and percentage)
- saving potential in euros (calculated at 2 euro per kilogram [calculatory figure for food waste[3]])

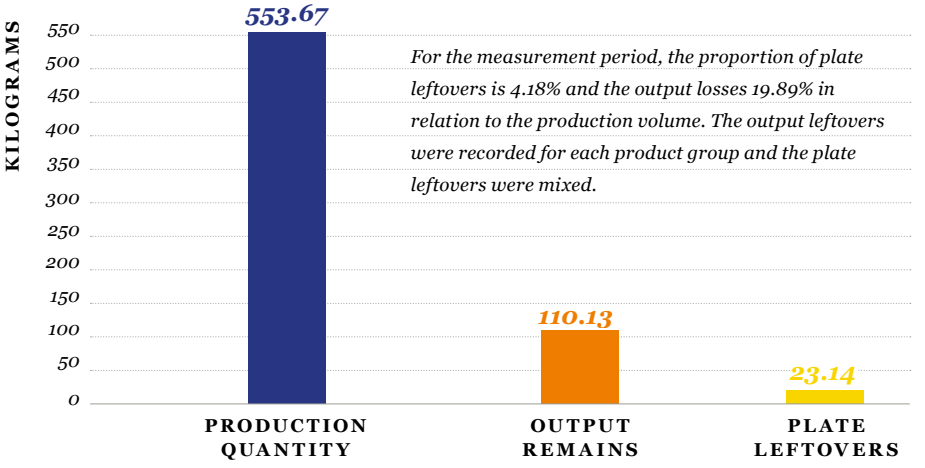

Figure 6: ***The Kitchen Monitor – Production Quantity, Output Remains and Plate Leftovers***

3 2 euros per kilogram was calculated from: buying and paying for raw product, cooling and production of product (energy costs) and disposal of product (disposal costs).

At present, the kitchen monitor can record a maximum of ten days in a report. An adjustment is currently being carried out so that a measurement period of 21 days can be evaluated in future. A daily evaluation as well as several ten-day evaluations are also possible.

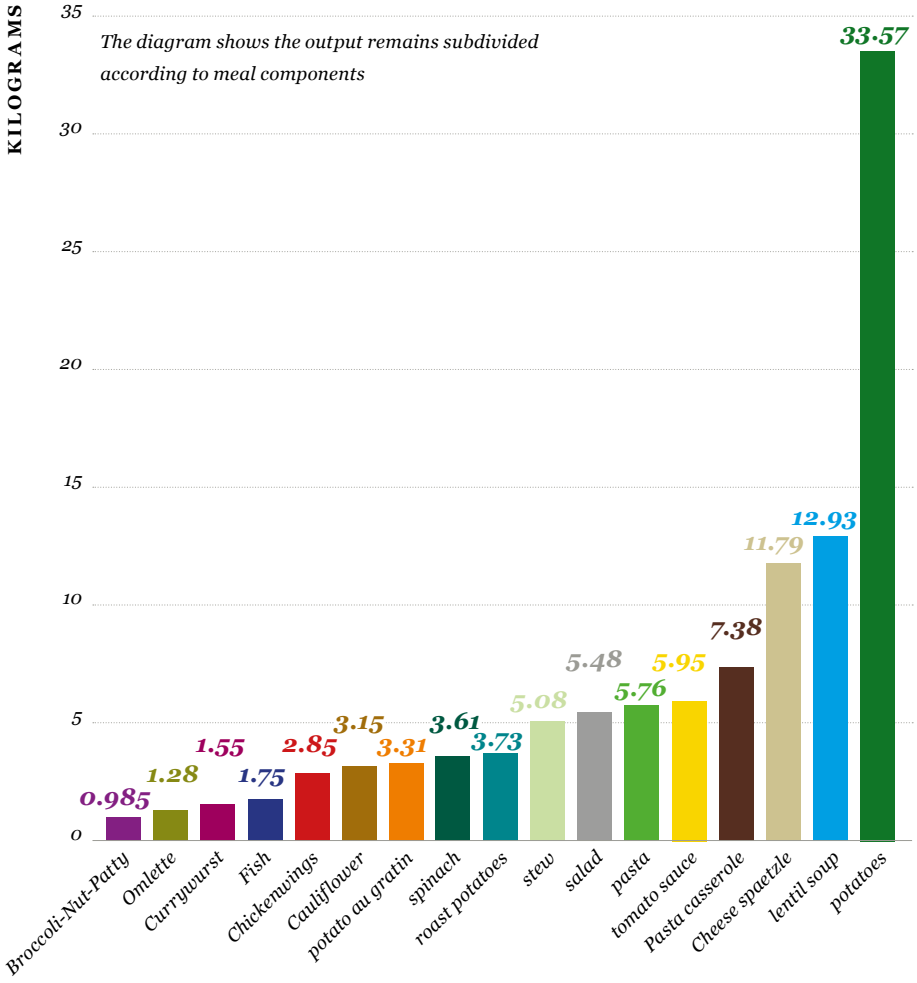

Figure 7: ***The Kitchen Monitor – Output Remains by Menu Components***

Development of measures for reduction

The kitchen monitor is available for independent use. First and foremost, it serves to record the status quo and gives an overview of any leftover food after production. The report that can be generated after data entry, is an initial cause analysis and shows in which step and with which food components the largest amount of waste is generated. Individual advice on possible measures is not offered, but action can be taken independently. In addition, the details of the contact persons are stored, as is a guidebook which lists possible measures and contains explanatory videos.

Costs and effort

The use of the Kitchen Monitor is free of charge, few skills are required to use it and all that's needed to register is e-mail access. For the measurement, the user needs scales that weigh up to 40 kilograms (ideally with a small verification interval). The templates for written records are available online.

The effort involved in waste measurement (data acquisition) depends on the number of food components produced. A facility that offers a menu with four components a day has to put in less effort than a facility that offers a buffet with 20 components. The time required to enter data into the Kitchen Monitor depends on the number of components and days measured.

Example: The data input for a 10 day period, of 2 menus a day with 10 components each, takes about 1 hour.

Consistency of data collection – usability for companies

After registration the tool can be used free of charge without any time limit. How the tool is used and how employees are involved is a matter for the company. A benchmark of different companies with the same catering concept can only be created by the administrator.

Revision and enhancement of the Kitchen Monitor (by the end of Sept. 2019)

Separate recording and analysis of three meal types per day

The Kitchen Monitor is being enhanced to include full board (breakfast, lunch, dinner), currently only lunch can be monitored. The reports are being adapted accordingly, also diagrams and reports will be more professionally displayed (improved legibility, configuration and font size of the diagrams).

Direct display of results on the screen (dashboard)

With a dashboard-like interface, the daily, interim and overall results will be displayed directly on the screen, so that individual analyses can be viewed or individual evaluations scaled without having to print out the entire waste report

Link: kuechenmonitor.de

Winnow Solutions

The instruments of Winnow Solutions are state-of-the-art software-based tools for the collection of food waste in catering businesses.

Description of the tool

Winnow's digital systems provide industrial kitchens with detailed insight into their production process through data and analysis. Kitchens that use Winnow save between three and eight percent on the cost of goods and achieve a return on investment of between 200 and 1,000 percent, depending on the size of the business. Winnow works with over 1,300 kitchens in 40 countries worldwide.

With Winnow, commercial kitchens can precisely record, categorize and analyze their food waste. The results are recorded in regular reports as well as in an online portal and displayed graphically. Savings potentials are identified on the basis of the results. Measures to reduce food waste can then be developed.

The standard system Winnow Waste Monitor (Winnow Waste Monitor) consists of digital scales and a connected tablet computer. The waste is thrown into the kitchen's own waste container and the user manually selects the discarded articles (components) on the tablet. The new Winnow Vision version uses Artificial Intelligence (AI) to identify the waste items (menu components), which automates and significantly speeds up the waste collection process and provides high data quality.

Target audiences

Target groups are canteen kitchens that produce food in advance, e.g. contract caterers, hotels, system restaurants, cruise ships and supermarkets. The instrument is particularly suitable for large businesses with an annual cost of goods of 100,000 euros or more.

Data collection and analysis

At the beginning there is an onboarding phase during which the lists of dishes and articles are created with cost information. There will also be a training session and a practice week. The first two weeks of the measurement are used to determine a baseline. The waste costs incurred are presented as a percentage of sales. On the basis of the baseline, a reduction target is set independently with the support of Winnow.

Winnow Solutions offers two different systems. The standard tool **Winnow Waste Monitor** consists of digital scales and a tablet computer. In addition, a kitchen waste bin is required, which is placed on the scales. The scales are connected to a tablet in which all articles/meals are stored with the corresponding cost of goods per kilogram as well as portion sizes. Each time a user throws waste into the bin, it is necessary to enter the area from which the waste originates and which article or dish it is. The areas considered are shelf life dates of goods/inventory, cooking errors, production waste/stages, buffet/display returns or leftovers on plates. The waste disposed of is collected in kilograms and costs on the tablet computer. With the standard tool, all discarded items must be entered manually.

Winnow Vision has been newly developed and uses Artificial Intelligence to identify the waste. In addition to the scales and tablet computer, Winnow Vision has an integrated motion camera that provides real-time photos of the waste. The system learns to recognize the waste through the images. To program the model, approx. 100 to 200 images of an article are required. During the learning phase, two to three clicks are made to the tablet each time to enter the article concerned and the waste area in which the article was produced. After the learning phase, the system automatically recognizes the discarded article and only the area from which the waste comes has to be specified. Because Winnow Vision uses artificial intelligence, it requires very little effort to run after the learning phase.

Evaluation and presentation of the results

Reports are generated daily and weekly by the tool. The results are displayed in the form of diagrams and spreadsheets, showing in which areas and for which articles the waste is generated. This makes it easy to derive reduction potentials. In addition to consumption data, Winnow also displays costs (broken down by discarded items). An ecological evaluation of the resulting waste in terms of CO_2 emissions is also carried out.

The following results can be mapped by the tool:

- waste in kilograms (total and by range, group and individual article)
- waste value in euro (total and by sector, group and individual item)
- waste as a percentage of sales
- waste per table guest
- waste compared to the previous day and week
- articles with the largest amount of waste by weight and value
- for the weekly report: waste generated during the various days of the week in kilograms
- waste from breakfast, lunch, dinner
- presentation of CO_2 emissions

Furthermore, the data is presented in an online portal where the user can view the trends and tendencies of one or more companies.

Figure 8: ***Daily reports to indicate immediate action***

Development of measures for reduction

After the onboarding phase, there is an implementation phase lasting eight to twelve weeks. During this time, Winnow's Customer Success Manager in charge reviews the weekly reports and analyses with the businesses to identify areas and items where production can be adjusted and waste avoided. During these telephone calls, possible reduction measures are also suggested. Technical customer support is available to the companies at any time of the day.

Costs and effort

Companies incur one-off training and configuration costs as well as monthly leasing costs for the use of Winnow. The provider does not specify exact amounts. Special knowledge is not required. The Winnow user website and dashboard are

self-explanatory but are also explained in detail in the training sessions. Personnel costs are still considerably higher in the training phase. Entering a transaction takes three to five seconds. In the long term, however, personnel costs are negligible, as the system uses artificial intelligence to identify the waste itself when it's recorded. Only the waste area has to be entered manually.

Consistency of data collection – usability for companies

The use of the system is subject to ongoing monthly costs for the software license, customer service and hardware rental. The minimum duration for the use of Winnow is 36 months. The license is renewed annually thereafter. The hardware can also be purchased in advance. This reduces the monthly license fees.

Link Winnow Vison: www.winnowsolutions.com/vision
Link Winnow Monitor: www.winnowsolutions.com/en/product

Figure 9: ***Weekly reports to record success over a period of time***

Leanpath

Leanpath is a software-based tool for recording food waste in companies, which was already developed in 2004. It is based on the Food Loss and Waste Accounting and Reporting Standard. It aims in particular to raise awareness among employees and change behaviour in the kitchen process.

Description of the tool

With the help of cameras and scales, the produced food is precisely determined and categorized. The results are recorded in an online portal and displayed graphically. Savings potential is shown on the basis of the results. Measures to reduce food waste can then be identified.[4] An important aspect of Leanpath is in particular a change in employees' awareness and behaviour with regard to food waste. The use of cameras serves to visualize the waste.

Target groups

The instrument is suitable for all areas of out-of-home catering. Leanpath offers a range of food waste measurement solutions for kitchens of all sizes.

Data collection and analysis

Leanpath offers various tools to choose from. The standard instruments consist of digital scales, a tablet computer and optionally a camera. In addition, a kitchen waste bin is required, which is placed on the scales. The aim of the tool is to record the type of, reasons for and areas in which food is discarded.

For each discarded food (event), the following is entered on the tablet,

- the food category in question,
- the reason why the food is thrown away (overproduction, spoilage, processing errors, shelf life expiration, waste trimmings, etc.),
- the area from which the waste originates (salad bar, cooking process, grill, bakery etc.) and
- how the waste is disposed of.

4 Leanpath (2018): Leanpath Food Waste Prevention, URL: https://www.leanpath.com/ (Date: 11.04.2018)

The food categories can be defined and programmed in advance by the companies according to individual needs. The collection of this data serves to identify reduction potentials. The waste quantities are measured precisely in grams.

In addition to the collection system, which is normally located in the kitchen, Leanpath also includes an analysis platform and a tool for raising employee awareness. This plays a special role at Leanpath.

Evaluation and presentation of the results

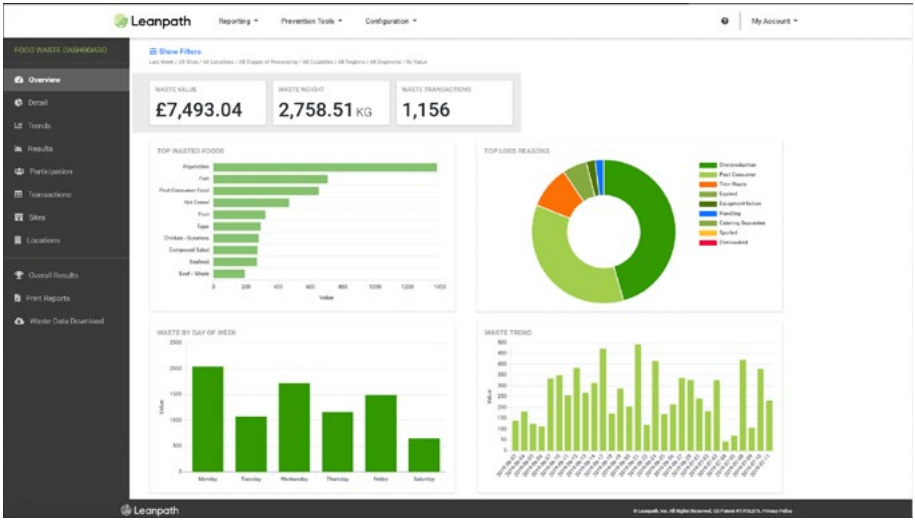

Figure 10: ***The Leanpath Online-Dashboard***

Reports are generated by the tool on a daily and weekly (but also monthly or annual) basis. The evaluations can be carried out for any time period and displayed in the form of diagrams and spreadsheets. The total amount of waste generated is shown. It is also possible to calculate the monetary value of the waste. For this purpose, the raw materials used are offset monthly against the waste generated. An ecological evaluation of the waste is also carried out by calculating the greenhouse gases produced.

The following results can be mapped by the tool:

- waste in kilograms (total and by area/reason)
- waste value in euros
- number of events per day
- waste per table guest
- waste compared to the previous day
- ranking of foods with the highest amount of waste by weight
- ranking of product categories with highest waste volume by weight
- ranking of areas by waste volume
- main reasons for the waste
- waste from breakfast, lunch, dinner
- waste quantities for any periods (e.g. week, month, year)
- savings in kilograms and euros by food, land and area compared to any time period
- presentation of CO_2 emissions

Development of measures for reduction

Leanpath offers a coaching service for companies. Together with the kitchen teams, the results are analysed and potential savings identified. Based on this, reduction measures are developed.

Costs and effort

The costs depend on a number of different factors. Different component parts are available to meet the needs of the respective company. An individual solution can be worked out together with Leanpath consultants. The provider does not specify the exact costs. The amount of effort involved on the part of employees is minimal. A briefing is given initially by the consultants. The input of each event takes approximately ten seconds.

Consistency of data collection – usability for the companies

The software provides a comprehensive overview of the data collected and the company's performance. The tool can benchmark different operations of a company to share best practices. The analysis platform can be used during the contract period. Additional software services and training can be booked at any time.

Link: www.leanpath.com

RESOURCEMANAGER FOOD

The RESOURCEMANAGER FOOD was developed as part of the Technology Transfer Initiative (TTI) of the University of Stuttgart and is used to collect food waste in out-of-home catering.

Description of the tool

The RESOURCEMANAGER FOOD is a hardware/software solution with a database connection for recording food waste in out-of-home catering. It records the current situation, identifies potential optimisation and documents the savings on wasted food.

Figure 11: ***The RESOURCEMANAGER FOOD***

Target audiences

The RESOURCEMANAGER FOOD is aimed in particular at larger out-of-home catering facilities (canteens, restaurants, hotels, care facilities, refectories, etc.).

Data collection and analysis

The system consists of a PC or tablet computer and scales. The software can be specifically configured to the local conditions before use. Any number of food categories can be added (e.g. fish, meat, vegetables, bakery products, rice, potatoes). Costs can be added to the categories. In addition, the weights of the containers (e.g. serving dishes, bowls, plates) can be stored. A weight can also be stored for foods that are discarded as quantities. The user can select the areas of the waste independently (e.g. kitchen, buffet, plate remains, storage losses). An event or the time of the meal (breakfast, lunch, dinner) can also be selected. In addition, reasons for the waste (e.g. returns, shelf life, over production) can be stored.

The use of the RESOURCEMANAGER FOOD is integrated into the daily workflow. Before waste is thrown away, it can be weighed and the food category, container, area, reason and time of day can be selected.

Evaluation and presentation of the results

The results are displayed on the screen in the form of diagrams. The user thus receives feedback directly in the kitchen, which also serves to raise awareness. Daily and weekly evaluations can be called up at any time – the periods can be flexibly selected. Preparation of the data can be provided as a service or carried out by the company itself. In addition to weight, other factors such as costs and climate-relevant emissions can also be mapped using the tool.[5]

The following results can be mapped by the tool:

- waste in kilograms
- waste value in euros
- waste per table guest
- food categories with highest waste generation by weight
- waste quantities by area
- waste quantities by reason
- waste from breakfast, lunch, dinner or special event
- presentation of CO_2 emissions and energy consumption in kJ

5 TTI – Resources (2018): ResourceManager-FOOD,
URL: http://tti-resources.de/resourcemanager-food/ (Date: 11.04.2018)

Figure 12: ***Evaluation of the data in RESOURCEMANAGER FOOD***

Development of measures for reduction

Within the framework of the ELoFoS-Projektes (Efficient Lowering of Food Waste in the out-of-home Sector), a consulting concept and action guidelines for users of the RESOURCEMANAGERS FOOD in out-of-home catering are currently being developed. The development of measures for the reduction of food waste will be integrated into the application process in the future.

Costs and effort

The hardware, including a prior analysis of the kitchen and equipment, costs 3,500 euros. In addition, 10 to 20 minutes are required for input, depending on the day of measurement. The system is set up with a briefing. Special knowledge is not required.

Consistency of data collection – usability for the companies

After acquisition and instruction, the tool can be used without further costs for measurement and result evaluation. The implementation of a benchmark with comparable companies is possible.

Link: tti-resources.de/resourcemanager-food

EXCURSUS

RMFood.de

RMFood.de is a simplified and free online version of RESOURCEMANAGERS FOOD, accessible via web browser. It was developed on behalf of the Bavarian State Ministry of Food, Agriculture and Forestry and is already available as a prototype. The comprehensive implementation is planned for 2020. At RMFood.de, emphasis was placed on the simplest possible application in order to give the user a quick overview of the efficiency of their system. The simplified online tool RMfood.de contains twelve food categories that have already been defined, in contrast to the RESOURCEMANGER FOOD software, where categories and areas can be defined by the user. The food waste is weighed in the company and the results are entered into the online system. A goal of RMfood.de is to provide enterprises, which are still not that familiar with the topic of the collection of food waste data, an easy and free start.

RMFood.de has been enhanced with a benchmark function:
depending on the type of institution, benchmarks are automatically calculated. These can be compared in a dashboard with the measurements entered, in order to enable a quick classification and evaluation of the individual system.

Excursus:

Instruments for forecast planning

Food waste in out-of-home catering can be reduced not only by collecting the waste generated in the kitchen process, but also by improving demand and sales planning. This is where forecast planning instruments come in.

Delicious Data

One example is Delicious Data, formerly FoodOracle/noyanum. The model serves to improve forecast planning in order to ensure that the cooking carried out upstream is in accordance with demand. The instrument is a pioneer in the field of intelligent planning support for catering businesses. The Munich AI start-up was founded in 2017 by Valentin Belser and Jakob Breuninger. The Software-as-a-Service (SaaS) solution is currently online in more than 30 canteens, cafeterias and bars throughout Germany.

Description of the tool

Using Artificial Intelligence, Delicious Data analyzes its customers' historical data and combines it with other external factors that influence demand patterns to make accurate and robust predictions about the future. Customers cannot only reduce avoidable food losses, but also significantly reduce operating costs and gain new insights into their operations through data-driven analysis.

Target groups

Delicious Data is aimed at out-of-home catering facilities, in particular community catering and food service.

Data collection and analysis

Delicious Data uses interfaces from the existing cash or merchandise management system of the catering business to create a data basis for the forecasting system. In addition, external factors such as the weather or calendar events are automatically linked. Thus, forecasts are always automated and precisely calculated on the basis of the latest available information. The planning improvement is made visible through the target/actual comparison between planning and sales figures. Any food waste produced is not recorded directly. However, thanks to improved planning, overproduction and thus food waste can be actively reduced.

Evaluation and presentation of the results

The web application offers a visual representation of the planning improvement and additional knowledge that catering businesses can use to optimize their offer. The savings potential is calculated on the basis of the planning improvement. Forecasts and evaluations are made available for retrieval. Optionally, it is possible to integrate the forecasts into the respective merchandise management system.

Development of measures for reduction

By using this tool, companies can obtain sales forecasts and use them as a basis for concrete purchasing optimization.

Costs and effort

The software is provided by the external provider as an SaaS solution. SaaS license fees are charged for the use of the system. The costs depend on the number and size of locations. No special knowledge is required to use the system. The prerequisite is that the data history is available. There is no additional personnel expenditure during the use of the system. Optimised planning even saves working time.

| Link: www.delicious-data.com

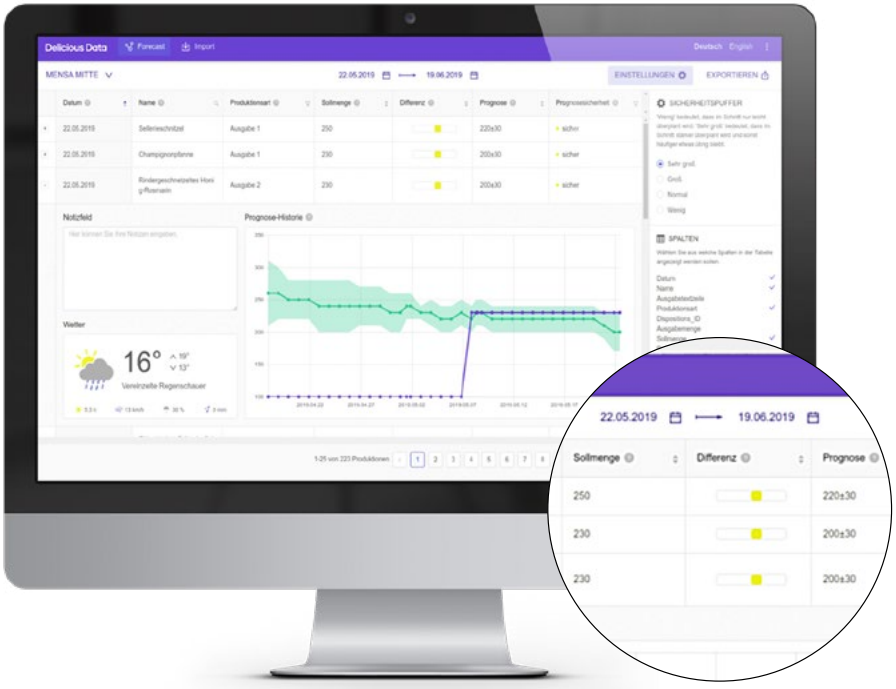

Figure 13: ***Presentation of results in Delicious Data***

Mitakus

Mitakus is another forecasting model that serves to improve planning and calculation and thus leads to a reduction in food waste. The forecasts are based on methods from the field of artificial intelligence.

General description of the tool

Mitakus is an SaaS solution for out-of-home catering companies that publishes precise sales forecasts and menu or meal recommendations based on historical sales data. On the basis of this information, the purchase of raw materials can be optimized and cooked according to demand. By doing this, overproduction and use of goods can be reduced in the long term and considerable costs can be saved.

Target groups

Mitakus is aimed at out-of-home catering facilities.

Data collection and analysis

The historical transaction data from the POS or ERP system is used as the basis for calculating the forecasts and also recommendations for dishes or combinations in menus. Product and menu data such as recipes, ingredients, nutritional values etc. are also used. This internal data of a business is mixed with external factors, such as weather or calendar data, to create a precise forecasting model. Mitakus is automatically connected to the external data sources. The internal data can usually be exported from the POS or ERP system. If Mitakus is permanently used, an interface to the database or to the POS system is set up.

The actual sales figures of each individual dish or product are compared with the forecasts of the chef or planner and the Mitakus forecasts. This allows over and underproduction to be determined. Together with the respective cost of goods sold, this figure serves as a basis for calculating the savings potential in the company. By reducing surpluses, both the cost of goods can be improved and food waste can be permanently avoided.

Evaluation and presentation of the results

The software is responsible for the entire data preparation, model creation and representation or provision to the customer.

The following results can be mapped by the tool:

- the forecasts of Mitakus and the chef
- the actual sales figures
- all historical numbers: guests, turnover etc.
- over and under production
- the savings potential and also the actual savings on the cost of goods
- menu and dish recommendations, e.g. to achieve a higher turnover
- if desired, an ecological evaluation can also be displayed in the dashboard: CO_2 savings, water and energy savings as well as potentially avoidable food waste.

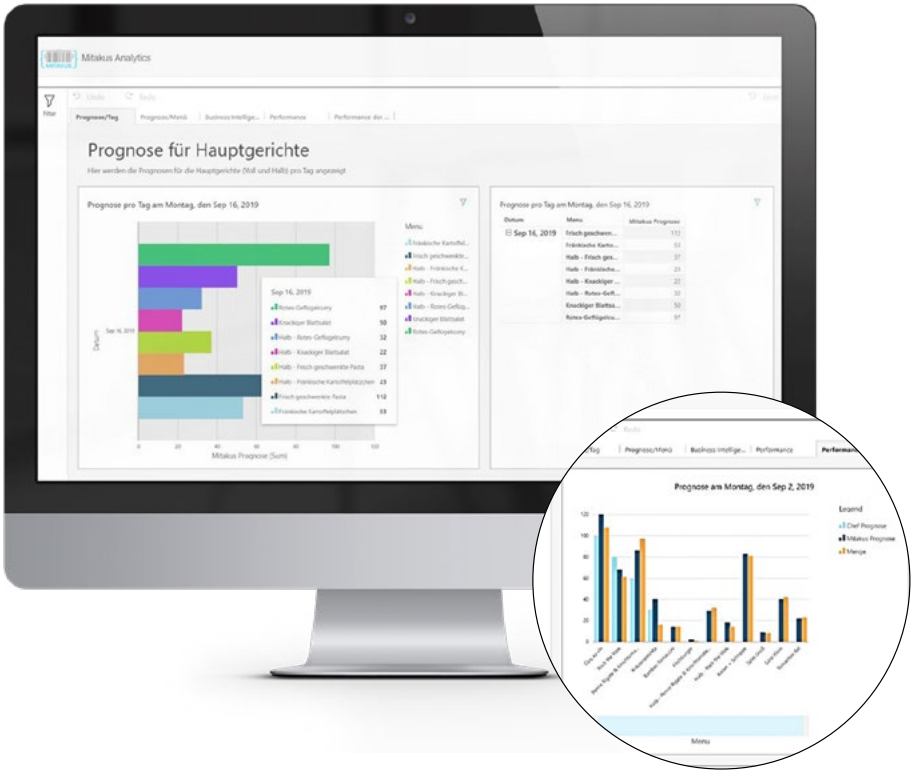

Figure 14: ***Presentation of results in Mitakus***

Development of measures for reduction

By using this tool, companies can obtain sales forecasts and use them as a basis for concrete purchasing optimisation. The optimal purchasing quantity is recommended via the forecasts. In addition, the recommendation system displays alternative dishes and menus to the user.

Costs and effort

A fixed one-time flat fee is charged for the data preparation in advance and a monthly fee for the use of the Mitakus software. The monthly fee depends on the size of the company, more precisely the average number of guests in the company. The monthly fee is fixed for one year and can then be adjusted if the number of guests changes. The employees are trained at no additional cost.

No special knowledge is required for the application. The dashboard is tailored to the respective company. In addition, the operation is simple and the presentation intuitive. Access can be made available to any number of persons in the company.

If required, the possibility of data evaluation, e.g. for process or purchasing managers, can also be extended. Additional filter and evaluation tools are provided, which are not available in the normal dashboard view.

Link: mitakus.de

Overview Recording Tools

	Waste Analysis Tool
Provider	**United Against Waste e. V.**
Target group	Suitable for all out-of-home catering areas
Waste areas/ places of production	Stock; production; overproduction; plate waste
Waste tracking	*Waste areas* Separate collection per waste area *Components and causes* Food components weighed mixed
Meals recorded	Optional
Measurement periods	2 measuring periods of 4–6 weeks each; 1 measurement per day
Key figures/units *1. Waste by area; 2. Waste in relation to production volume; 3. Waste per meal; 4. costs; 5. Environmental impact*	1. Waste by area (g/kg and %) 2. - 3. Waste per meal (g) 4. Cost of the waste (€) 5. Environmental impact (GHG, water, land use) per kg of waste
Presentation of results	Summary of results at the end of the measurement period. Individual evaluations in any interval of your choice
Strategy for developing measures	After the 1st waste measurement, reduction measures are developed in a workshop together with UaW
Costs	During the contract period: monthly fee of 50 – 130 € depending on module; consulting costs: coaching + workshop depending on effort
Time required	Low effort (10 minutes per day)
	www.united-against-waste.de

	Kitchen Monitor
Provider	**Verbraucherzentrale NRW**
Target group	Schools, day-care centres, youth hostels; in future all community catering facilities
Waste areas/ places of production	Overproduction; plate waste
Waste tracking	*Waste areas* Separate collection per waste area *Components and causes* Overproduction is weighed separately by meal components; plate leftovers weighed mixed
Meals recorded	Optional
Measurement periods	At least 10 catering days
Key figures/units *1. Waste by area;* *2. Waste in relation to production volume; 3. Waste per meal; 4. costs;* *5. Environmental impact*	1. Waste by area (g/kg) 2. Total waste in relation to production volume 3. Waste per meal (g) 4. Cost of the waste (€) 5. -
Presentation of results	Daily result report or evaluation of several days (max. of 10 days)
Strategy for developing measures	None, as the instrument is available for independent use; further information can be found on the website
Costs	Free of charge
Time required	Depending on the number of food components produced
	www.kuechenmonitor.de

Overview Recording Tools

	Winnow Vision KI
Provider	**Winnow Solutions**
Target group	Suitable for all out-of-home catering areas
Waste areas/ places of production	stock; production; overproduction; plate waste
Waste tracking	*Waste areas* Separate collection per waste area *Components and causes* Food components weighed mixed
Meals recorded	Optional
Measurement periods	Ongoing
Key figures/units *1. Waste by area; 2. Waste in relation to production volume; 3. Waste per meal; 4. costs; 5. Environmental impact*	1. Waste by area (g/kg) 2. - 3. Waste per meal (g) 4. Cost of the waste (€) 5. Environmental impact (GHG)
Presentation of results	Regular results reports (daily, weekly, monthly, annually)
Strategy for developing measures	Throughout implementation, telephone analysis of the results and advice on reduction measures
Costs	Running license costs during the contract period. The amount depends on system components and number of measuring points. The supplier does not provide any information about the exact amount.
Time required	During the learning process (artificial intelligence), the input effort is higher. In the long run little personnel expenditure is necessary.
	www.winnowsolutions.com/vision

	Winnow Waste Monitor
Provider	**Winnow Solutions**
Target group	Suitable for all out-of-home catering areas
Waste areas/ places of production	stock; production; overproduction; plate waste
Waste tracking	*Waste areas* Separate collection per waste area *Components and causes* Food components weighed mixed
Meals recorded	Optional
Measurement periods	Ongoing
Key figures/units *1. Waste by area; 2. Waste in relation to production volume; 3. Waste per meal; 4. costs; 5. Environmental impact*	1. Waste by area (kg) 2. - 3. Waste per meal (g) 4. Cost of waste total and per component 5. Environmental impact (GHG)
Presentation of results	Regular results reports (daily, weekly, monthly, annually)
Strategy for developing measures	Throughout implementation, telephone analysis of the results and advice on reduction measures
Costs	Running license costs during the contract period. The amount depends on system components and number of measuring points. The supplier does not provide any information about the exact amount.
Time required	Consistent input effort
	www.winnowsolutions.com/en/product

Overview Recording Tools

	Leanpath
Provider	**Leanpath**
Target group	Suitable for all out-of-home catering areas
Waste areas/ places of production	Waste areas can be individually programmed (e.g. kitchen, buffet, plate waste, storage losses).
Waste tracking	*Waste areas* Separate collection per waste area *Components and causes* Recorded separately according to feed component and waste reason (e.g. overproduction, spoilage, processing errors, BBD)
Meals recorded	Optional
Measurement periods	Ongoing
Key figures/units *1. Waste by area; 2. Waste in relation to production volume; 3. Waste per meal; 4. costs; 5. Environmental impact*	1. Waste by area (kg) 2. - 3. Waste per meal (g) 4. Cost of waste total and per component 5. Environmental impact (GHG)
Presentation of results	Regular results reports (periods can be selected as required)
Strategy for developing measures	As part of a coaching service, analysis of the results and advice on reduction measures
Costs	Running license costs during the contract period. The amount depends on system components and number of measuring points. The supplier does not provide any information about the exact amount.
Time required	Low input effort
	www.leanpath.com

	Resourcemanager Food
Provider	**Universität Stuttgart**
Target group	Suitable for all out-of-home catering areas
Waste areas/ places of production	Waste areas can be individually programmed (e.g. salad bar, cooking process, grill, baked goods, buffet)
Waste tracking	*Waste areas* Separate collection per waste area *Components and causes* Recording separated by food component and waste reason (e.g. return flow, BBD and overproduction)
Meals recorded	Optional
Measurement periods	Ongoing
Key figures/units *1. Waste by area; 2. Waste in relation to production volume; 3. Waste per meal; 4. costs; 5. Environmental impact*	1. Waste by area (g/kg) 2. - 3. Waste per meal (g) 4. Cost of waste total and per component 5. Environmental impact (GHG, energy consumption)
Presentation of results	Regular results reports (periods can be selected as required)
Strategy for developing measures	So far none; a consulting concept is currently being developed.
Costs	One-time costs for hardware and training of 3,500 €
Time required	Low input effort
	tti-resources.de/resourcemanager-food

Overview Recording Tools

	Rmfood.de
Provider	**Universität Stuttgart**
Target group	Suitable for all out-of-home Catering areas
Waste areas/ places of production	Storage; cooking waste; overproduction; buffet leftovers; plate return; other
Waste tracking	*Waste areas* Separate collection per waste area
	Components and causes Recorded separately per food component and waste reason (breakage/spoilage, misplanning, BBD, portion size, quality)
Meals recorded	Optional
Measurement periods	Ongoing
Key figures/units *1. Waste by area; 2. Waste in relation to production volume; 3. Waste per meal; 4. costs; 5. Environmental impact*	1. Waste by area (g/kg) 2. - 3. Waste per meal (g) 4. Cost of waste total and per component 5. Environmental impact (GHG, energy consumption)
Presentation of results	Evaluation follows immediately.
Strategy for developing measures	No consultation available for the online version
Costs	Free of charge
Time required	Low input effort
	rmfood.de