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## **Preliminary results of a methodology for determining food waste in primary school canteens**

Reducing food waste (FW) is seen as a way to improve sustainability of food systems, both in itself and as a way to improve the efficiency of resource use. A first step is to improve data collection of FW.

The paper presents the results of a test conducted in a primary school located in the Bologna province. The aim of this study is to define a new methodology to assess FW in school canteens that can be applied in large-scale studies involving all stakeholders.

The results show that a methodology for data gathering on FW in school canteens involving all the concerned actors can be implemented. However for the success of the monitoring it is necessary the involvement of teachers that remain the key to success, but also it is necessary to adapt the methodology to the capabilities of pupils.

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### **1. Introduction**

Numerous studies (Monier *et al.*, 2010; HLPE, 2014; FUSIONS, 2014) have stressed the need to improve data collection and analysis of main causes of food waste (FW) in the last parts of the food chain.

REDUCE (Research, Education, Communication) is a national project supported by the Italian Ministry of Environment (REDUCE, 2016) that aims at collecting data on FW in the last stages of the food chain and at providing innovative solutions to prevent and reduce it. It builds upon the progresses realized these last years including through the approval of the National Waste Prevention Programme (MATTM, 2013), the implementation of the National Food Waste Prevention Plan (Segrè, Azzurro and Giordano, 2014) and the Bologna Charter against food waste (MATTM, 2014).

The project faces the issue of FW with an integrated approach, through three main intervention strategies: (a) research activities to prevent and reduce FW at the last stages of the food supply chain; (b) technical support and advice for decision-makers; and (c) awareness raising and education oriented to prevention and reduction of FW.

One of the main research activities is focused on FW in school canteens, with the aim to collect data about food waste quantities and causes. Italian data on FW at this stage of the food chain is scarce and does not enable to have a correct assessment of the situation, as are only available qualitative data conducted on large samples (ORICON, 2015) or quantitative data but obtained from a limited number of schools (Vezzosi *et al.*, 2014; Falasconi *et al.*, 2015). The experiment consists in the collection of data on food waste in a sample of approximately 100 school canteens, located in three Italian Regions (Emilia-Romagna, Friuli Venezia-Giulia, Lazio).

The paper presents the preliminary results of a test conducted as part of REDUCE project, conducted in a primary school located in the Bologna province and monitored during a period of two weeks. The aim of this study is to define a new methodology for quantifying food waste in school canteens that can be applied in large-scale studies involving all stakeholders: kitchen employees and teachers, as well as the students themselves, so that monitoring becomes an instrument of active learning. At the same time the new methodology must however be accurate, easy to transpose, does not require external support, provides the comparable data on quantity and nutritional quality of food waste.

## **2. Material and methods**

### *2.1 Involved actors*

The concerned actors were directly involved in the quantification of food waste and in the data collection.

The kitchen employees were responsible for the quantification of the food prepared in the kitchen, whereas pupils, under the supervision of teachers, conducted the quantification of the non-consumed food left in the refectory after the lunchtime. The idea of involving pupils in the quantification phases of school wastes partially comes from the Waste Wise Schools Program promoted by the Department of Environment and Conservation of Government of Western Australia (Ralph, 2015).

To avoid potential bias due to pupils' desire to show a better behaviour with respect to everyday life, they were not aware of the real reason of the experiment. Although teachers and janitors were aware of the objectives of the study, it was asked to them to do not modify their habits.

## 2.2 Data collection

The classification of monitored food waste is inspired by Comstock *et al.* (1979): aggregate selective food waste measurement involves collecting tray from all, or a sample, of the students in a lunchroom and separately scraping the waste from each food item. The monitored food can be divided into three stages: 1) prepared food, which is the food that has been prepared for a determined meal and is ready to be served; 2) non-served food, which is the amount of food not distributed to diners and remaining in the serving bowls; 3) and served but not consumed food (plate waste), which is the amount of food rejected by diners and left on their plates. At each stage, food is quantified at aggregated level, separated by dish type. The dish type classification for food waste collection reflects the typical structure of the Italian meal: first course, generally composed of pasta or rice, second course, consisting mainly of animal products, side dish of vegetables, bread and fruit, as already used in previous studies on food waste in Italy (Iapello *et al.*, 2011; Vezzosi *et al.*, 2014; Falasconi *et al.*, 2015). Each dish type was quantified separately, for a total of five weight measurements per stage. The quantification was realized with a precision scale, except for bread and fruit of the prepared and non-served stages, for which average weight of individual portions were used and multiplied by the number of untouched portions. The average weights for bread items were established in the catering contract, while the average weight of the fruits has been empirically calculated from a sample of fruits served at school.

Data are adjusted to account for non-avoidable<sup>1</sup> food waste (WRAP, 2011; FUSIONS, 2014). To estimate the proportion of unavoidable food waste, a sample of non-edible parts was weighted, multiplied by the number of portion served and then subtracted from the overall weight of the waste collected.

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<sup>1</sup> 'avoidable' refers to any food waste item typically intended for consumption. Food that is not edible because it has gone off or been damaged is still classified as avoidable because it was, at some point prior to disposal, edible. Examples include half-eaten sandwiches, part-eaten dinners, uneaten fruit, unopened or partially eaten yoghurts, dinners that have not been served etc.

'possibly avoidable' refers to items that are eaten by some people but not by others for reasons of personal taste, and to waste items that are the result of particular method of preparation. Examples of possibly avoidable food waste are edible vegetable peelings, potato skins, apple skins, bread crusts etc.

'unavoidable or non-avoidable' refers to all waste from food that one would not expect people to eat; it is mostly composed of food preparation waste. Examples include egg shells, meat and fish bones, orange and banana skins, tea bags, coffee grounds etc. Food that is inedible because it has gone off is not classified as unavoidable, because the waste could have been avoided by using the product before this time. (WRAP, 2011, p.19)

### 2.3 Quantification phases

Before the field observation, four moderator focus groups (two with teachers and two with kitchen employees) were performed. They enabled to collect key information, such as on non-edible parts generally found and on the final destination of non-served bread and fruit. For this last type, since they are untouched portions sometimes they are left in the refectory, otherwise teachers brought them in classroom to be eaten by the pupils during the afternoon.

The kitchen employees were responsible for the quantification of prepared food, whereas pupils and teachers were involved in the plate waste separation and in the quantification of non-served and non-consumed food. The kitchen provided the precision scale, while the Department of Agricultural and Food Sciences of the University of Bologna provided the garbage bags and the garbage bins for the disposal of food waste. Kitchen employees weighed the cooked dishes (first course, second course and side dish) and counted the portions of bread and fruit. After lunch, the pupils and the teachers separated their plate waste in the five bins, corresponding to each dish type. In order to facilitate the separation, a label marked the bins indicating each dish type with the help of pictures.

After the separation phase the pupils of each class counted the non-served portions of bread and fruit. In order to record the final destination of non-served bread and fruit, the register distinguishes between portions left in the refectory and portions brought in classroom, generally to be eaten by the pupils during the afternoon.

One single class per day performed the quantification of remaining non-served food (first course, second course and side dish) and of plate waste dishes collected in the five bins, in order to do it in a less crowded environment and to limit the risk of errors.

## 3. Results

The school has 174 pupils, 167 of whom normally eat at school every day. It has an internal kitchen managed by a private catering company. During the period of the study, 1626 meals were prepared, with an average of 162.6 meals per day. Percentages of food waste stages are calculated as ratio of the total amount of prepared food. Data are reported as percentage of waste per single food stage (non-served and non-consumed food) and as total percentage of wasted food, intended as the sum of non-served and non-consumed food. Food waste data of non-served bread and fruit are related only to the portions left in the refectory since those brought in the classroom are assumed to be eaten.

**Tab. 1.** Percentage of total food waste

First Course	Second course	Side dish	Bread	Fruit
29.6%	38.3%	57.7%	13.1%	13.4%

Source: Authors' elaboration.

**Tab. 2.** Percentage of non-consumed food

First Course	Second course	Side dish	Bread	Fruit
22.4%	31%	43.6%	6.6%	8.2%

Source: Authors' elaboration.

**Tab. 3.** Percentage of non-served food

First course	Second course	Side dish	Bread		Fruit	
			Non-served	Refectory	Non-served	Refectory
7.2%	8.0%	14.1%	57.1%	6.5%	62.1%	5.2%

Source: Authors' elaboration.

During the period of investigation the total amount of wasted food represented an average of 29.4%. The percentage of wasted food amounted to 29.6% for the first course, 38.3% for the second course and 57.7% for the side dish, while for both bread and fruit portions it amounted approximately to 13.0% (13.1% bread and 13.4% fruit).

The percentage of non-consumed food had the highest percentage of food waste, corresponding to 22,36%. Plate waste amounted to 22.4% for the first course (25.1% during the first week, 19.7% during the second week), to 31% for the second course (31.5% during the first week, 30.5% during the second week), 43.6% for the side dish (40.0% during the first week, 47.2% during the second week). The percentages of bread and fruit plate waste remain lower: 5.3% for bread and 5.8% for fruit during the first week, 7.9% for bread and 10.6% for fruit during the second week.

During the period of investigation the non-served food represented an average of 7.0%. The percentage of non-served food amounted to 7.2% for the first, 8.0% for the second course and 14.1% for the side dish, with an average of 10.2% considering all cooked dishes. The percentage of bread and fruit portions left in the refectory amounted respectively to 6.5% and 5.2%. However,

the total amount of non-served portions amounted to 62.1% for fruit and to 57.1% for bread: this occurred since pupils generally do not consume entire portions, but cut them and share slices with schoolmates.

#### 4. Discussion

The aim of this study was to define a new methodology for quantifying food waste in school canteens, that can be applied in large-scale studies, cost-effective and time-saving, able to provide reliable and comparable data, and able to involve all stakeholders.

The test results underline how the various actors were able to do what they were requested to. The quantification phases conducted by the kitchen employees have been well performed, with no specific difficulty reported.

The phases conducted by teachers and pupils were also well performed. The teachers were generally committed (however some of them were not interested, which could jeopardize the success of the project) even if the plate waste separation phase was partially overlapping with other duties; indeed, one of them has to stay close to the bins during the lunch preventing it for accomplishing other duties. During this test emerged that the arrival of a substitute teacher unaware of the ongoing experiment could be another potential source of errors. In fact, the lack of an adequate training might be a cause of mistakes. The plate waste separation phase conducted by pupils needs to be monitored by an adult when effectuated by pupils of less than 8 years to avoid errors, as the youngest children showed uncertainties in the plate waste separation phase. Finally, another critical aspect is related to some foods that stick to the plate, like rice used for risotto, which can result in underestimation of its non-consumed part.

The aim of the present study was not to provide quantitative results and data summarily reported do not intend to be statistically significant. However the results of this test are in the broad range of results of previous studies. The total wasted food amounted to 29.4%, while Vezzosi *et al.* (2015) found 40% and ORICON (2015) 13%.

It is necessary to clarify that ORICON detected its data through questionnaires based on visual estimates of canteens staff, which could justify the smaller quantities, whereas Vezzosi *et al.* detected their data through the support of their researchers, which can lead to greater accuracy but an impossibility to replicate large-scale detection.

The amount of non-consumed food represented an amount of approximately 22.4%, in line with the 20% found by Vezzosi *et al.* (2015). The amount of non-served food represented an average of 7.0% in line with the 8.48%

found by Falasconi *et al.* (2015), but lower than Vezzosi *et al.* (2015), whose results were approximately around 20%. Finally, as in previous Italian studies the side dish represented the most wasted, both as non-served and/or non-consumed food (Vezzosi *et al.*, 2014; Falasconi *et al.*, 2015; ORICON, 2015).

## 5. Conclusions

Results from the test phase do not intend to be statistically significant since they were obtained from a single case study. However, the percentage of both non-served and non-consumed food per dish type remained comparable during the two monitored weeks. Referring to cooked dishes (intended for first course, second course and side dish) of non-served food, the average of 10.2% is quite low and in line with what was declared by kitchen employees during the focus groups: in order to be able to address unexpected events (e.g. a tray that get burned during preparation or spilled out during transportation), chefs generally prepare 10% more food than needed. On the contrary, the percentage of non-served bread and fruit are really high, linked to the obligations of the catering contract, which stipulates that one portion of bread and fruit per person must be served at every meal.

However the test highlights how this new methodology don't allows to detect in detail the drivers of food waste in school canteens. In any case it is necessary to underline that this methodology was designed to fill a gap in the detection of quantitative aspects of the phenomenon in school canteens. For detection of qualitative aspects we suggest to set up focus groups among the stakeholders, as proposed by Falasconi *et al.* (2015).

The test has shown that a methodology for data gathering on food waste in school canteens involving all the concerned actors can be implemented. However, even if they were interested in the experiment and willing to participate, the monitoring requires a very well designed methodology, adapted to the needs and capabilities of children, with appropriate support and monitoring for the youngest, as well as paying attention to time constraints and other duties of teachers during and after meals. The involvement of teachers remains key to success; in order to improve their collaboration, a teacher for each school will be designated as supervisor responsible for the project and trained. Finally, even if it can be implemented in different countries, it has shown the importance of taking into account and using national specificities such as the meal structure for the collection of food waste, as well as for what can be considered as edible.

In order to definitely test the methodology and the capability of involved actors to perform what is requested to them, a pilot study will be conducted during October 2016 over a sample of three schools.

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