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ASSESSING HOUSEHOLD FOOD WASTE IN ITALY: A METHODOLOGY FOR DETECTING DRIVERS AND QUANTITIES

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"It should be noted at this point that nearly all respondents deny 'wasting food' as their first response to questioning even if subsequent questioning reveals this not to be the case. It is a complex issue and embedded with psychological background noise that probably varies from generation to generation." (WRAP, 2007, p. 10)

Food waste: its prevalence throughout the entire food system and its extent are truly astonishing, its perpetuation is among the most offensive demonstrations of human irrationality.

(Smil, 2004, p. 18;25)

Contents

List of acronyms

EFW	Edible Food Waste
EPEFW	Edible and Possible Edible Food Waste
FW	Food Waste
Q	Questionnaires
D	Diaries
WS	Waste Sorting
GR/HH/YEAR	Grams per household per year
GR/PP/YEAR	Grams per person per year
HFW	Household Food Waste
NEFW	Not Edible Food Waste
NHFW	National Household Food Waste
PEFW	Possible Edible Food Waste
RHW	Residual Household Waste

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Introduction: Food Waste as a global issue

Food waste is estimated to be roughly one-third of food produced for human consumption, globally (FAO, Global food losses and food waste – Extent, causes and prevention, 2011). In this computation, both food losses and food waste (as from FAO theoretical framework, elaborated on Parfitt definition (Parfitt et al, 2010)) are considered. What does this data mean? Actually, if true, it would mean that 1/3 of the overall food destined to human consumption never gets to final consumption, because it is discarded at some stage of the food supply chain. In low income level countries (Global South), the most of food waste happens at the first stages of the supply chain (FAO, 2011), while in high-income level countries (Global North) it typically happens at the consumers 'stage.

Overall, on a per-capita basis, much more food is wasted in the industrialized world than in developing countries. Standing to FAO (FAO, Global food losses and food waste – Extent, causes and prevention, 2011), per capita Europe and North-America waste is an average value between 95-115 kg/year, while it is 6-11 kg/ in sub-Saharan Africa and South/Southeast Asia.

In the low income level countries, the most frequent causes of food waste are related to lack of proper infrastructure for storage and transportation, absence of technical tools for the harvesting and packaging and insecure marketing. All these conditions contribute to the perpetration of a state of food insecurity in a large part of the Global South, where demand for food is increasing due to the global pressures on land on one side and increasing of population rate and life expectancy on the other side.

In high income level countries, among the most cited causes of food waste there are consumers' behavior and lack of coordination among different actors in the Food Supply Chain (from now on, FSC). For instance, consumers could be not interested in reducing food waste as it does not represent a concern for them; they could not be aware of their food waste and the way they can reduce it or they could have difficulties in interpreting labels. FSC could improve its efficiency by coordinating actions to recover wasted food at any stage, for example through social innovation initiatives or economic and fiscal incentives.

In both cases, producing food that will be wasted means using resources that could have been employed differently and more efficiently and, also, it means a disposal of food products as waste. Hence, FW is a matter of resource consumption and waste disposal.

In the Global South, when food waste (or *losses*, if the FAO definition is taken into account (FAO, Global food losses and food waste – Extent, causes and prevention, 2011)) is generated in condition of meaningful resource scarcity (such as food insecurity, land access unavailability, absence of technological tools for agriculture, etc.), the inefficiency in the resource use can be considered a priority on the waste disposal. In this case, food loss is considered as a problem to be possibly overcome through enhancement of the FSC efficiency.

In the Global North, instead, food chains are considered more efficient in the first stages, while they are less efficient at the consumption stage, even though an improvement of efficiency overall the entire FSC can still be implemented. Hence, FW can be approached as an issue of waste disposal/resource consumption, other than food access/security.

In Europe, for example, food access/security is not actually a priority issue nowadays, since many political instruments have been put in place in order to provide food access to the entire population since decades – food security has been one of the main aims of the Common Agricultural Policy since its born in 1957[1]. On the other side, waste disposal is currently an issue- along with a new model of "resource efficient economy". Indeed, in the communication "Roadmap to a resource efficient Europe" (EC, 2011), Member States were called to "*Address food wastage in their National Waste Prevention Programs (2013)"*. More recently, European Union (EU) has proposed a FW definitional framework which contains not edible products as well as still edible ones. In fact, FUSIONS defines food waste as "*any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including - composted, crops ploughed in/not harvested, anaerobic digestion, bioenergy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea). The definition covers both food and drink waste, and hence both solid and liquid disposal routes.*" (Östergren et al., 2014, p. 6). If this definition is applied on Households' Food Waste (from now on, HFW), the result is that FW corresponds almost totally the humid fraction of the garbage[2]. Moreover, animal feed and production of bio based materials thanks to discarded food is defined "valorization and conversion", and not food waste. The choice of this theoretical framework suggests that the European approach to food waste is largely focused on waste management and resource efficiency, rather than on food security (*not edible FW,* which corresponds to fruit peel or chicken bones, for example, cannot be considered a waste in terms of

[1] Trattato di Roma, 1st of January 1957

[2] Depending on the waste collection method, the humid fraction is commonly *only food waste* or *food waste+ green residues*.

resources consumption, while it can be considered an issue in terms of waste disposal). In the paragraph 2.2, a description of the definitions is proposed.

Apart from definitions and approaches, HFW in Global North has been studied for the first time very recently, and more often through methodologies that could be improved. The aim of the present research is to analyze critically the studies undertaken in Europe and USA/Canada, and to formulate a methodology for detecting drivers and quantities of HFW in Italy, through a pilot test undertaken in 2015. The final goal of such a study, whether undertaken at a national level, would be to feed an effective awareness raising campaign, able to talk to the majority of population- so that the widest knowledge of perceived and effective behavior is needed.

In the first chapter, the preset research is shown: (Estimating HFW in Italy, Scope and methodology of the study, Research hypothesis and Limits of the present study).

The second chapter illustrates Food Waste (volumes and definition) and Household Food Waste (methodologies to detect it and their limits, pros and cons of each method, possible biases affecting the reliability of questionnaires in literature).

The third chapter is a literature review. It reports data gathered through the selected methodologies with their limits and a discussion on cognitive bias influences on existing questionnaires is undertaken (*paragraph* 3.5).

The fourth chapter is the description of the experiment, based on general introduction, pre-test phase and pilot test.

Chapter five illustrates data emerging from the pilot test study while Chapter six discuss them.

Conclusions and appendix, reporting the material used in the experiment, follow.

1 Estimating HFW in Italy

1.1 Scope and methodology of the study

In the Global North, some analysis of FW at the consumption stage has been developed yet, based on different methodologies, typically questionnaires, diary studies and waste sorting/weighting. Since a standardized definition of FW and a common methodology of quantification have not been developed internationally, existing studies cannot be easily compared. However, an impressive difference among data gathered through waste sorting/weighting and through questionnaires and diaries has been recorded, with weekly households food waste close to 3kg/hh/week in certain cases, such as Canada ((Parizeau et al., 2015)) and between 0.3-0.5 kg/hh/week in other studies, among which Greece and Italy (Abeliotis et al., 2014) (Camillo & Adorno, 2013). A median value converging on 1 kg/hh/week has been estimated through diary studies conducted in UK and Finland (WRAP, 2013; Koivupuro et al., 2012).

This difference can be both explained in terms of different food & shopping habits, which can meaningfully vary between countries (due to different food traditions or price of food) and in terms of methodology. Whether there is a "cultural" influence on food issues and wasted food, it is not be enquired into the present work, though it could be an important issue to be explored. The aim of the present work is to enquire into the three methodologies, trying to explain the differences among existing data and, finally, to optimize a reliable method for future studies aimed at estimating HFW in Italy.

It is not rare that studies based on questionnaire list, among their limits, the possible underestimation of the wasted food quantity declared by respondents (Abeliotis et al., 2014), due to "feelings of shame", for instance (Lebersorger & Schneider, 2011). Nevertheless, questionnaire on food waste are still a common method, while neither value nor definition of possible underestimation factors have been published nor specifically enquired into by any study, until now. Italian data on HFW, as well as Greek data (Abeliotis et al., 2014), have been estimated only through questionnaires (Waste Watcher, 2014; Camillo & Adorno, 2013; Gaiani, 2013; Garrone et al., 2012). Dairy methodology, on the other side, has been used more rarely in national representative studies (WRAP, 2013) (Silvennoinen et al., 2014) and more often on little samples (Langley et al., 2010), yet it is actually the only method to gather qualitative indication on food waste from a meaningful sample. Other methodologies to enquire into daily routine and habits of families have been applied, too, yet not involving national samples (*see* (Porpino et al., 2016) (Evans, 2012; Raquel. et al, 2015; Magnussen & Refsgaard , 2009)).

No waste sorting or weighting, specifically aimed at quantifying food waste, has been implemented in Italy at the present time. An interesting statistical estimation of FW as from Fusions' definition has been proposed by Azzurro[3] (Azzurro, 2015); yet, as it is not an empirical estimation, it is not considered relevant to the present study.

Since literature suggests an important divergence among data estimated through the three mentioned methodologies, a detailed review of data will be proposed. Reasons for such a phenomenon will be explored (2.3.2) in the field of behavioral economics and by borrowing useful suggestions from social psychology. A list of the possible cognitive biases affecting the reliability of answers in questionnaires is proposed.

Eventually, the hypothesis will be confirmed or rejected through an experiment enquiring into HFW data produced through the three methods on the same sample (4). Discussion on results will be proposed in chapter 6.

The results of this work aims at proposing a reliable methodology finalized at gathering qualitative and quantitative data on HFW in Italy. Whether funding would be available for a comprehensive and extensive study on HFW, this methodology might be applied entirely (the three phases); otherwise, data produced through survey might be "corrected" on the basis of what it might be called the "underestimation" factor.

1.2 Research hypothesis

The first hypothesis is that wasting food is intrinsically related to a moral judgment. Starting from the assumption that wasting food can be seen as wrong, immoral or, in general, it can be perceived as a negative action, the respondent to a questionnaire of food waste habits might be biased by a self-indulgence effect aimed at reducing the feeling of discomfort deriving from it, when asked to answer to food waste-related actions. This process might affect the reliability of answers when behavior and quantities related to the action of wasting food are asked through simple questions.

Hence, the hypothesis would be that the feeling of shame deriving from the idea of wasting food could undermine the reliability of answers gathered through questionnaires on the issue, either

[3] Not published. Available at the link: http://amsdottorato.unibo.it/ starting from June, 2016, in Italian.

intentionally or not. How to test it? The first and easier method is by auditing answers, for instance by making a *waste sorting and weighting* analysis in the garbage of the respondents'[4].

There are no self-reporting or self-perception limits in waste sorting analysis, especially if respondents are not aware to be checked. Yet, some cons are to be considered in this case. First of all, there is no way of recording food disposed out from garbage bin, such as disposed down the sink or given to pets. Moreover, this method provides no info on the reasons why food has been disposed. In other words, waste sorting and weighting is not influenced by cognitive bias since the respondent is not directly involved in the experiment, yet it has important methodological limits with reference to the goal of detecting drivers of waste. It is the best solution for a quantitative analysis and perhaps the less suggested for a qualitative one, among all the methodologies shown in literature.

Therefore, how to detect also the drivers of HFW, in order to verify the self-reported behavior emerging from questionnaires? As a matter of fact, many methodologies are able to describe the phenomenology of HFW. Approaches vary- some studies have been developed through ethnographic methods, other studies through mixed methodologies, such as deep interview and focus groups. The most common limit to those methodologies is that they are time consuming, so that they are more proper for little samples. Among all, Food Waste Diary is the only method that consents a detailed qualitative analysis of the main HFW drivers on a large number of respondents: since it is based on self- reporting, it can be done by hundreds of units at the same time. On the other hand, it could be affected by -aware or not aware- under-reporting, due to feeling of shame (as for questionnaires) as well as to carelessness. In order to verify those limits and quantify them, a waste sorting analysis in the garbage of the same sample (or of a sub-sample) could be a possible solution.

Taking inspiration from methodologies applied in earlier studies, a mixed methodology that can possibly overcome all the limits has been built and tested twice, on two different samples.

1.3 Limits of the present study

The hypothesis that existing data are underestimated due to methodological limits has been tested only over a small sample, due to logistical limitations and time constraints.

The sample is not nationally representative, so that findings of this study need to be inquired further and, eventually, be confirmed. The selected sample was located in the city of Bologna, due to

[4] Discourse analysis might be useful as well to inquire into respondents' point of view on the issue but, differently from waste sorting, it could be developed only on a small sample.

logistical needs especially related to the waste sorting phase. Moreover, since the study was a pilot, only a small sample of families was involved.

Apart from sample, budget limits influenced the waste sorting analysis stage if compared to initial plans or diary sample. Actually, the lack of availability in means (tools and human resources) made it possible to develop a waste sorting phase only on a sub-sample, once or twice per week. Since no door to door separate collection method is on set in the city of Bologna, the waste sorting was available on a timeline that was not weekly, yet it covered some days of the week- so that the collected garbage made no reference to the entire week but only to some specific days.

Finally, no conditions on performances were set on in this experiment. Some diaries were not properly filled and some families did not show up any of the days established for delivering the garbage to the researcher[5], yet they received the reward anyway as all the other participants. That is, a different grade of participation has been recorded by the families, depending on their involvement in the waste sorting phase. Among the differences shown between the two groups, a sensitive lower redemption rate of diary has emerged in the group not involved in the sorting phase. This is a finding, on one side; yet, it is also a limit of the study, on the other side, since the sample was affected by the point.

The hypothesis of deepening subjective feelings and believes over food waste (in other words, a phenomenology of the issue), through deep interviews, discourse analysis, focus groups has been considered, yet it has been finally discarded because it would not be a feasible methodology for a national study, which would need a sample of 300 families at least. Moreover, such methodologies allow a harder generalization of results, not only due to smaller sample sizes but also to the important work of interpretation that is needed. Independently from the present research, a phenomenology of food waste should be enquired into- perhaps it could be useful for an awareness campaign on the topic, along with findings emerging from a national diary study.

Even considered all the mentioned limits, findings from the present study are still promising, considering that the quantitative difference emerging from the three methodologies is much higher than any previous hypothesis.

Details about the experiment's limitations, boundaries and achievements are described in paragraph 5.3 and sub-sections.

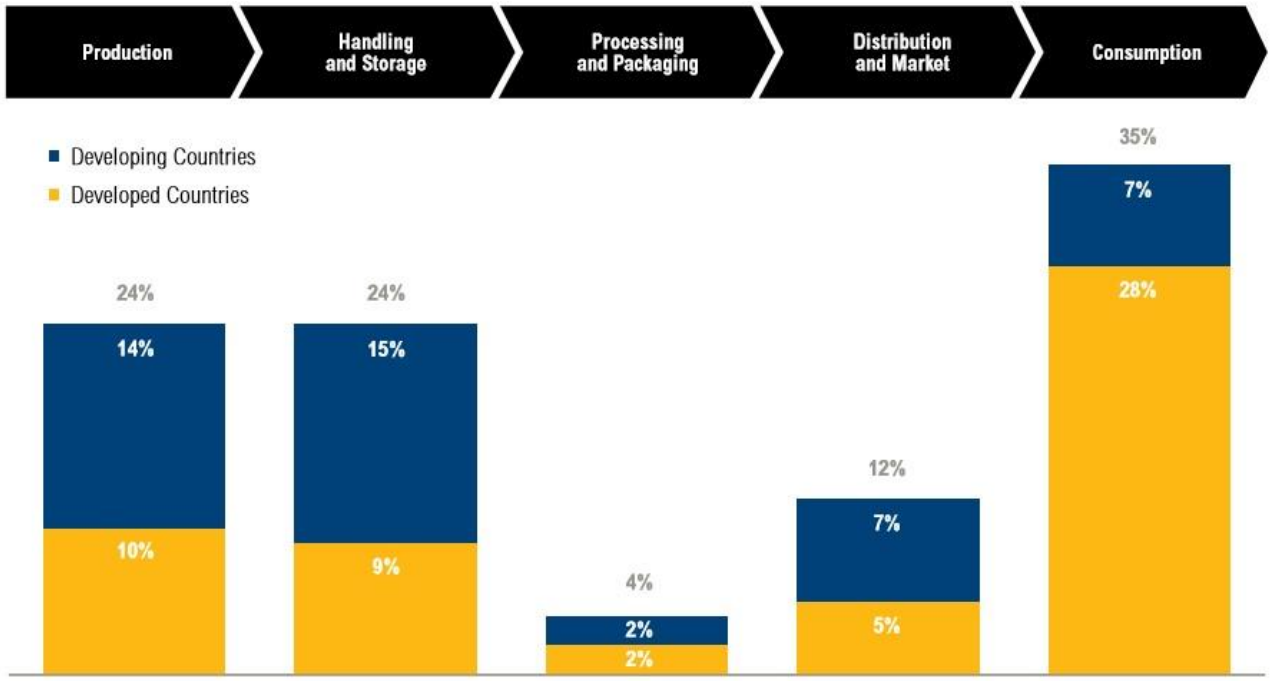
[5] More details are provided in Chapter 4.

2 Food waste and domestic food waste: definition, global values and methodologies

2.1 Food waste volumes on global scale

FAO (FAO, 2011) estimates the FW at the consumption stage representing about the 30% of the overall FW in the Global North.

Lipinski et al. (Lipinski et al., 2013) synthetized FAO results in a figure:



Note: Number may not sum to 100 due to rounding.

Source: WRI analysis based on FAO. 2011. *Global food losses and food waste—extent, causes and prevention.* Rome: UN FAO.

Figure 1 - Share of Total Food Loss and Waste by Stage in the Value Chain, 2009 (100% = 1.5 quadrillion kcal) (Lipinski et al., 2013, p. 8)

The study proposes an overview of the food waste in the world, using existing data taken from FAOSTAT 2007. As from the methodology (p. 12), *"The production volumes were compiled from the FAO Statistical Yearbook 2009, except for the production volumes of oil crops and pulses which were collected from FAO's FBS, 2007."*

Starting from this source, the authors estimates a mass flow of total purchase of each product (namely: cereals, roots and tuber, oilseeds and pulses, fruits and vegetables, meat, fish and seafood, milk) per area (Latin America, South and Southeast Asia, Sub-Saharan Africa, Maghreb and west/central Asia, North America and Oceania, Europe incl. Russia, industrialized Asia). Then, to each category of products they associated a conversion and an allocation factor, which means the percentage of product that, is edible (conversion factor) and part of the product which is allocated to

human consumption (allocation factor). Data for these factors are from scientific literature, hence they are not necessarily primary sources.

Findings from this study (see Figure 2) show that:

1. Food losses in Global North are as high as in developing countries, yet while in the first case waste happens mostly at retailing and consuming phase, in the second is more a post-harvest and processing issue: the value is more than 40% of the total FW in both cases.
2. Food waste at consumer level in Global North is almost equivalent to entire net production of food in sub-Saharan Africa (222 million tons of food waste at consumer level in the Global North, 230 million ton of food produced yearly in Sub-Saharan Africa).
3. Per capita food wasted by consumers in Global north is 95-115 kg/year, while it is 6-11 kg/year in sub-Saharan Africa and South/Southeast Asia.
4. Per capita food loss in Europe and North America is 280- 300 kg/year. In sub- Saharan Africa and South/Southeast Asia it is 120- 170 kg/year. The total per capita production of edible parts of food for human consumption is, in Europe and North America, about 900 kg/year and, in sub- Saharan Africa and South/Southeast Asia, 460 kg/year.

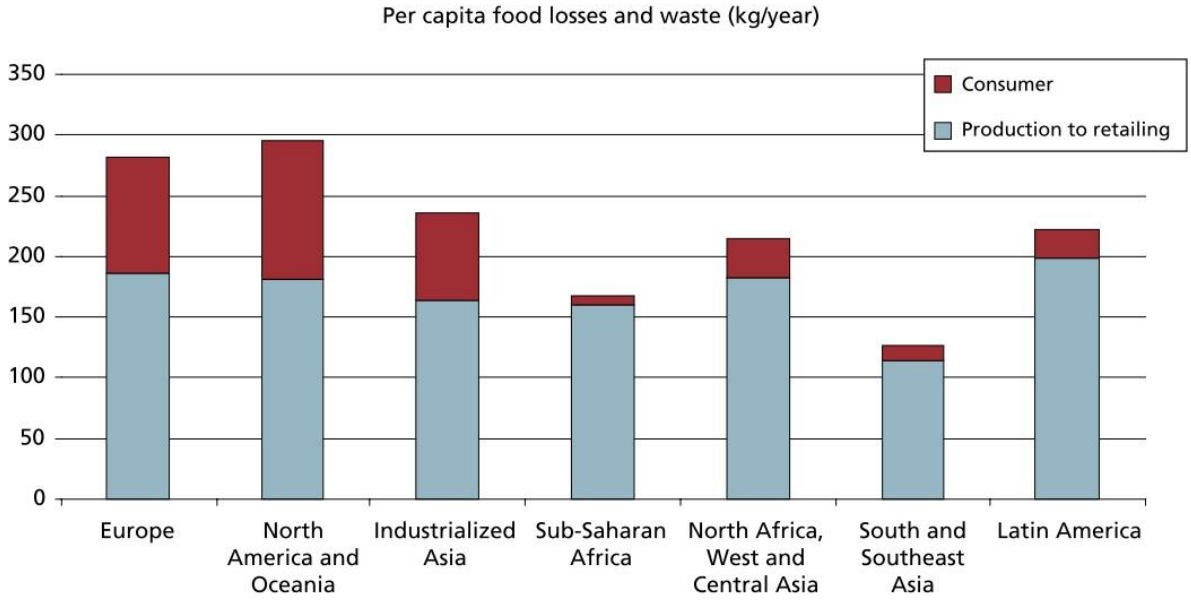


Figure 2 - Per capita food loss and waste at consumption and pre-consumptions stages, in different regions (FAO, 2011, p. 13)

A later report, titled "Food Wastage Footprint. Impacts on Natural Resources" (FAO, 2013) translate those data in environmental impact, calculating the GHG corresponding to waste. Indeed, the main findings are that fruit and vegetables are responsible of a high carbon footprint, due to the huge wasted quantity (Europe and Asia). Meat, even if its wasted quantity is less than other products, is responsible of land occupation and carbon footprint, especially in the Global North;

waste of cereal in Asia is a major concern with regards to its impact on blue water, carbon footprint and arable land. As the author points out, the most of GHG emissions happens at the production stage. With reference to global GHG emissions deriving from food waste, if all sum up they would be the third most polluting country after China and USA (FAO, 2013 quoting (WRI, 2012)).

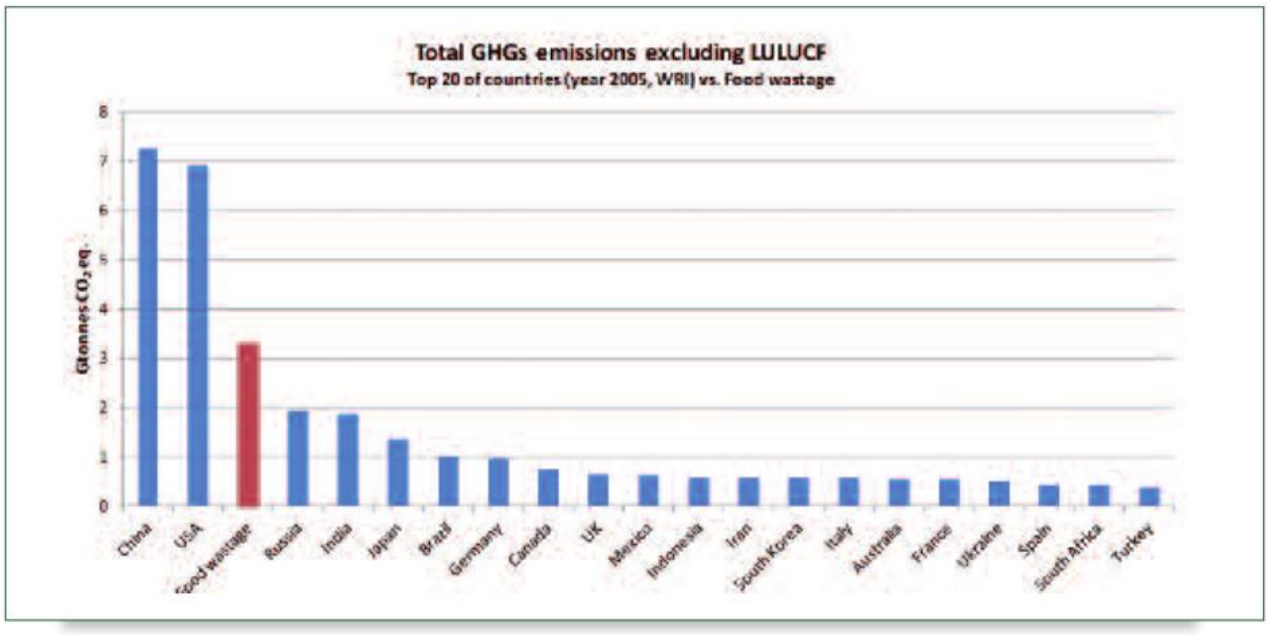


Figure 3 - Top 20 of GHG emitting countries vs. food wastage (FAO, Food Wastage Footprint. Impacts on natural resources, 2013, p. 17)

Other studies got other results as well. For instance, Kummu et al. (2012), estimate that about one quarter of the food produced globally is wasted (614 kcal/pp/day), with a subsequent loss of 24% of total freshwater resources used in crop production, 23% of the total global cropland area and the 23% of the total global fertilizer use.

In USA, Gunders (2012) estimates that up to 40 % of the food goes wasted. As a result, almost 25 % of U.S. methane emissions are produced by the uneaten food in landfills. Hall (Hall et al., 2009) instead, estimates FW in kilocalories and its trends over years. He records an increasing trend in food waste as following: in 1974, approximately 900 kcal per person per day was wasted; in 2003 Americans wasted about 1400 kcal per person per day or 150 trillion kcal per year. Finally, Buzby and Hyman (Buzby & Hyman, 2012) estimated the FW economic value at retail and household level in USA, based on their previous studies (Buzby et al, 2009) (Buzby et al. , 2011). Their findings reveal that this value was $165.6 billion in only 2008.

At a European level, food waste was estimated to be about 89Mt (179 kg7PP/year) in 2006 (Monier et al., 2010). The losses over all stages of the food value chain except agricultural production are estimated between less than 50 kg/pp/year (Greece) and more than 500 kg/pp/year (Netherlands), with an average of 180 kg/cap/a for EU 27. The overall environmental impact was at least 170 Mt of CO2 eq. emitted per year (approximately 3% of total EU27 emissions in 2008). The study was based on Eurostat data plus national single studies.

In a later study conducted by FUSIONS[6] (Fusions, 2016), results indicate that EU-28 produce about 100 Mtonnes of food waste every year, and that about 45% of this is generated from households (data make reference to the year 2012). Yet, a severe lack of reliable data in EU is recorded, as shown the following overview (FUSIONS, 2015) (Stenmarck & Östergren, 2015):

[6] The study is still unpublished. Quoting from the web site "The amounts will be presented in detail via a final FUSIONS report **"Food waste data set for EU-28"** in spring 2016". Source: http://www.eu-fusions.org/index.php/about-food-waste/10-food-waste-wiki/282-food-waste-data, last access on March, 8th, 2016.

Country	(NACE 1-3)	(NACE 10-11)	logistics (NACE 46)	(NACE 47)	(NACE 56)	7. Household
Austria	No data available	No data available	No data available	No data available	Data of sufficient quality	Data of sufficient quality
Belgium	No data available	No data available	No data available	No data available	No data available	Data of insufficient quality
Bulgaria	No data available	No data available	No data available	No data available	No data available	No data available
Croatia	No data available	No data available	No data available	No data available	No data available	No data available
Cyprus	No data available	No data available	No data available	No data available	No data available	No data available
Czech republic	Data of insufficient quality	Data of sufficient quality	Data of insufficient quality	Data of insufficient quality	Data of insufficient quality	Data of insufficient quality
Denmark	Data of sufficient quality	Data of sufficient quality	No data available	No data available	No data available	No data available
Estonia	No data available	No data available	No data available	No data available	No data available	No data available
Finland	No data available	Data of sufficient quality	No data available	Data of insufficient quality	Data of sufficient quality	No data available
France	Data of insufficient quality	Data of sufficient quality	Data of insufficient quality	Data of insufficient quality	Data of insufficient quality	Data of insufficient quality
Germany	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality
Greece	No data available	Data of insufficient quality	No data available	No data available	No data available	Data of insufficient quality
Hungary	No data available	No data available	No data available	No data available	No data available	No data available
Ireland	No data available	No data available	No data available	No data available	No data available	Data of insufficient quality
Italy	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality	No data available	Data of insufficient quality
Latvia	No data available	No data available	No data available	No data available	No data available	No data available
Lithuania	No data available	No data available	No data available	No data available	No data available	No data available
Luxembourg	No data available	Data of insufficient quality	Data of sufficient quality	Data of sufficient quality	Data of insufficient quality	Data of sufficient quality (excluding sewer and home composting)
Malta	No data available	No data available	No data available	No data available	No data available	Data of sufficient quality (excluding sewer and home composting)
Netherlands	No data available	No data available	No data available	Data of insufficient quality	Data of insufficient quality	Data of sufficient quality (excluding home composting)
Poland	No data available	No data available	No data available	No data available	No data available	No data available
Portugal	Data of insufficient quality	Data of insufficient quality	No data available	No data available	No data available	No data available
Romania	No data available	No data available	No data available	No data available	No data available	No data available
Slovakia	Data of insufficient quality	Data of insufficient quality	No data available	No data available	No data available	No data available
Slovenia	Data of insufficient quality	Data of insufficient quality	Data of sufficient quality	Data of sufficient quality	Data of insufficient quality	Data of insufficient quality
Spain	No data available	No data available	No data available	No data available	No data available	No data available
Sweden	Data of insufficient quality	Data of insufficient quality	No data available	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality
United Kingdom	No data available	Data of insufficient quality	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality	Data of sufficient quality

Figure 4 – "Matrix describing to what extent data was taken into account when estimating the total food waste amounts". (FUSIONS, Food waste data set for EU-28. New Estimates and Environmental Impact , 2015, p. 6)

Another review report on FW in Europe has been conducted by STOA (Priefer & al., 2013). Differently from Fusions, STOA literature review contains much of studies done in Europe, independently of methodological characteristics of the studies[7]. Here, dissemination reports, such as Barilla (BCFN, 2012) are considered too.

Among national studies conducted on representative samples, a leading role is played by WRAP (also for its policy intiatives to reduce food waste in UK). WRAP started its studies in early 2007, and made the first national study on the issue in the same year through a national survey (WRAP, 2007), followed by a diary study (WRAP & Exodus Market Research, 2007). Many studies have been conducted by the agency lately. At the current state, WRAP estimated that the total food waste in UK amounts to 15 million tons/year, with households generating 7.2 million tons/year of which 4.4 tons are avoidable (WRAP, 2016).

The Swedish Environmental Protection Agency (Jensen & al, 2013) produced a report where a total estimation of food waste for Sweden was given: 1.211.000 tons corresponding to 127 Kg/pp/2012. Finland, instead, calculated an average of 330–460 million kilos of edible food wasted in the food chain per year (Katajajuuri et al, 2011). A study conducted on Swiss FW (Beretta et al., 2013) showed that the avoidable losses are 299 kg/pp/year and roughly 1/3 of the edible calories produced for human consumption in Switzerland are wasted.

2.2 Definitions of food waste

As food waste has been faced in different contexts and for many different purposes, no unique definition exists on the issue. Depending on the focus of the study, (human nutrition, resource consumption or waste management) the definition varies. Recently, EC has proposed a definition through Fusions project[8], though there is little hope that it would affect the entire academic and scientific production in the near future, since it applies a very broad definition that would make analysis on food waste more complex.

Once again, Fusions definition of **food waste** is the following (Östergren et al., 2014):

Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bioenergy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea). The definition covers both food and drink waste, and hence both solid and liquid disposal routes.

[7] See STOA references. (Priefer & al., 2013, p. 135-144)

[8] See pag. 7, chapter *introduction*

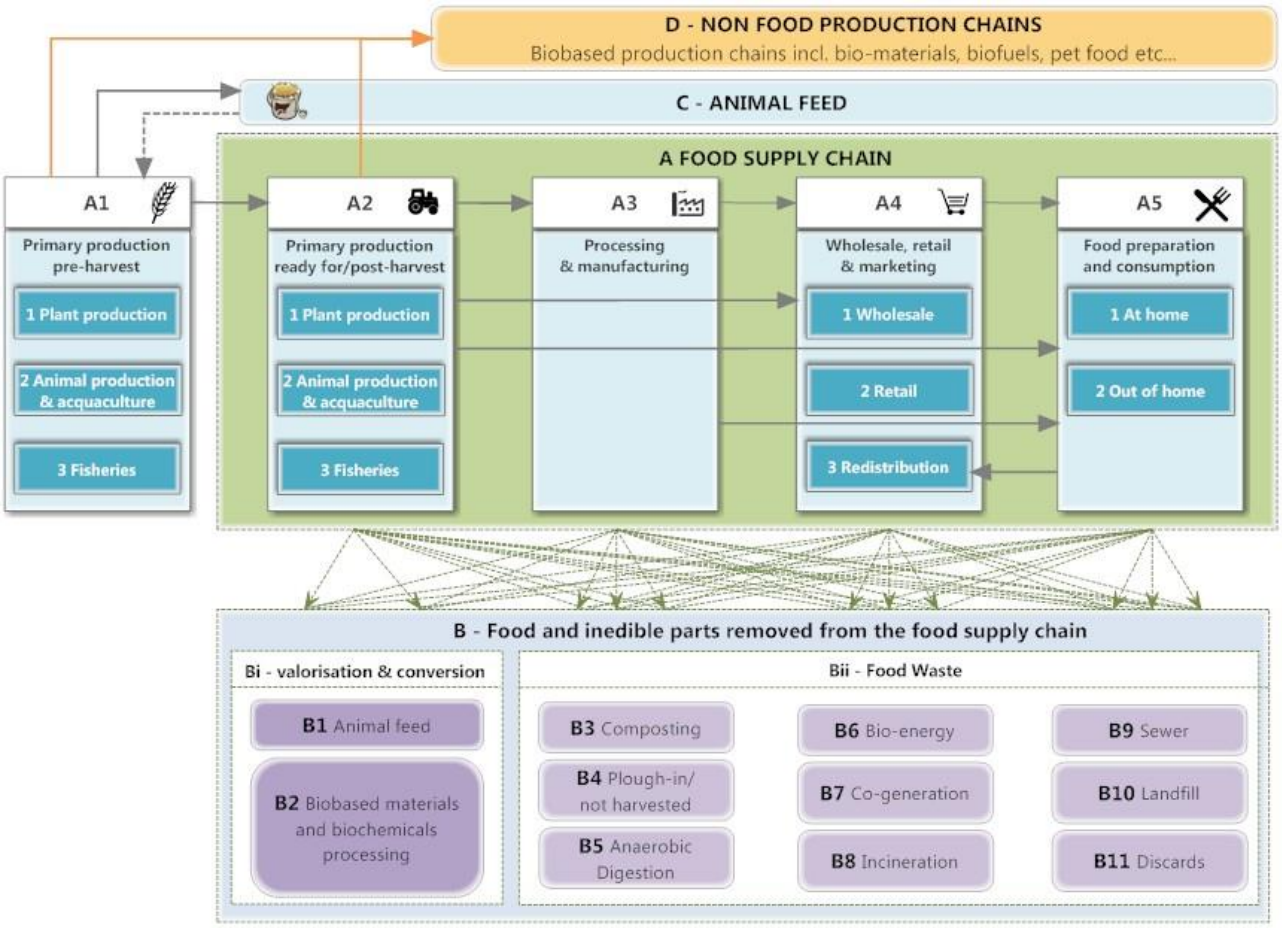
Where **food** is defined as:

Any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be* ingested by humans. 'Food' includes drink, chewing gum and any substance, including water, intentionally incorporated into the food during its manufacture, preparation or treatment

And **food supply chain** is defined as following:

The FSC is the connected series of activities used to produce, process, distribute and consume food.

The result of such a definitional framework is the following:



(Östergren et al., 2014, p. 7)

Food waste, in the figure, is represented by the boxes *Bii* (*B3* to *B11*). *A1* Is not considered part of the food supply chain as from the proposed definition; hence it is not considered food waste either. *Bi* is defined as valorization or conversion.

Is this a new approach to food waste? If considered all the existing definitions, it is.

First of all, the non-edible part of food is included. Apparently, this decision was due to the need of a definition that would be as inclusive as possible. In fact, if a difference between avoidable and not avoidable was proposed in the definition, a subjective influence would have been put in place: food costumes due to age, resources, religions & cultures, and other exogenous conditions might have led to different ideas of what is edible and what is not. While this is, perhaps, the best way to get comparable data, it is a controversial element with reference to some methodologies: in case of HFW studies, for example, it requires the researcher to collect data on *not edible* food waste as well as *edible*, in order to produce comparable data- with a significant difference in terms of efforts required to the participants to diary studies, for example, and perhaps also with a meaningful influence on the experiment itself[9].

Secondly, food losses occurring before crops are ready for harvesting or before animals are ready for slaughtering are excluded, since they are actually excluded from the definition of Food Supply Chain (box *A1*).

Finally, food (and inedible parts of food) leaving the supply chain and entering the feed chain is excluded.

What are the main differences with FAO definition?

FAO (FAO, Global food losses and food waste – Extent, causes and prevention, 2011) defines food waste as following:

Food losses refer to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, post-harvest and processing stages in the food supply chain (Parfitt et al., 2010). Food losses occurring at the end of the food chain (retail and final consumption) are rather called "food waste", which relates to retailers' and consumers' behavior. (Parfitt et al., 2010). "Food" waste or loss is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible. Per definition, food losses or waste are the masses of food lost or wasted in the part of food chains leading to "edible products going to human consumption". Therefore food that was originally meant to human consumption but which fortuity gets out the human food chain is considered as food loss or waste even if it is then directed to a nonfood use (feed, bioenergy...). This approach distinguishes "planned" non-food uses to "unplanned" non-food uses, which are hereby accounted under losses.

(FAO, Global food losses and food waste – Extent, causes and prevention, 2011, p. 10)

FAO definition contains a stress on human feeding as a priority, so that even if the discarded food gets to animal feed or bioenergy it is still considered as food waste or loss instead of "valorization and conversion", (as from Fusions' definitional framework). "Planned non-food use", which could be represented by maize planted for bioenergy purposes and "planned for food use", which instead can be represented by maize given to bioenergy production due to a lack of safety standards of a

[9] This hypotesis has been considered in the present experiment. More details in chapter 4.1.

certain harvesting, for instance, are both considered as food waste. Moreover, a difference between food loss and waste is proposed, to distinguish between what is discarded during the production phase and what is thrown away at a consumer level.

In past studies, however, not only FAO definition has been taken into account (Fusions definition is still too recent). Each project has usually its own definition, even though the main difference is usually focused on what FAO defines "planned for food-use/for non-food use".

Segrè e Falasconi, (2011) for instance, defined food waste as "(still) edible food products that lost their commercial value[10]". Their studies covered the entire agro-food chain, yet they focused the attention on big retail sector, where actually this definition is more proper- food in the retailing sector is often discarded due to the loss of its commercial value (broken packaging, products close to spoiling, safety standards on some fresh products that do not allow the seldom one day after the production-such as bread- and so on).

WRAP (2013), which conducted the higher number of studies on HFW, proposed just a distinction among *avoidable*, *possibly avoidable* and *not avoidable* food waste, with reference to the single items discarded.

- ✓ *Avoidable* food waste refers to food and drink thrown away because they are no longer wanted, for instance because they perished or exceeded their expiration date. Most avoidable losses are composed of material that was, at some point prior to the disposal, edible, even though a proportion is not edible at the time of disposal due to deterioration (e.g. rotting, decomposition).
- ✓ *Possibly avoidable* refers to food and drink that some people eat and others do not (e.g. apple peels), or that can be eaten when prepared in one way but not in another (e.g. potato or pumpkin skins), or that is sorted out due to specific quality criteria (e.g. bent carrots).
- ✓ *Unavoidable* comprise waste arising from food and drink preparation that is not, and has not been, edible under normal circumstances. This includes apple cores, banana skin, tea leaves, coffee grounds, meat bones.

This definition has been often used by other studies in the sector, even included the present one. The overall computation (sum of the three sections) is close to what FUSIONS defines as food waste.

[10] Translated by the author.

2.3 The methodologies to detect households food waste at a national level: pros and cons

Literature suggests that the most common methodologies used in order to detect quantities and drivers for household's food waste with a national representativeness are mainly three.

The three methods are:

- survey and questionnaires, most often based on CAWI methodology;
- diary studies hold on for one or two weeks;
- waste compositional analysis or weighting.

The three of them show important limits, as well as each one is more proper for some specific aim. Some studies have written about the issue, by offering useful frameworks (Lebersorger & Schneider, 2011), (WRAP, 2013).

Even though most of the existing data on NHFW are obtained through the over mentioned methodologies, data comparison is often not possible, since all studies are based on methodological characteristics, from length of the experiments to sample size. Hence, synchronic comparability on results is often not possible.

Fusions project[11] is running a task aimed at developing a standardized quantification methodology for all countries in Europe, through a food waste quantification manual, expected to be published on February, 2016[12]. In the report titled "Report on review of (food) waste reporting methodology and practice" (FUSIONS, Report on review of (food) waste reporting methodology and practice, 2014), some FW estimation studies have been analyzed, yet the general conclusion of the authors is that a comparison is not actually a real possibility, due to all the differences in the experiments, samples and definitions of FW. Another consideration made in the same report is that only the 17% of the existing HFW quantification studies has been repeated over years, hence a diachronic comparability among data is still rare. In Europe, only WRAP (WRAP, 2014) and Waste Watcher (Camillo & Adorno, 2013) (Waste Watcher, 2014) repeated their studies more than once, while Parizeau (Parizeau et al., 2015) did the same for Guelph (Canada). Except for the mentioned studies, all the other studies have been conducted only once, probably due to the high costs of carrying out these researches.

In the first section of this chapter, a critical analysis of the three main methodologies will be carried out. In particular, the cognitive biases that might affect reliable answers in questionnaires will be accurately described.

[11] Link: http://www.eu-fusions.org/

[12] Link: http://www.eu-fusions.org/index.php/publications Apparently, the manual will be out on March, 31st 2016.

In a second section, the specific case studies (relevant to the present research) will be presented. Relevance is based on the following criteria:

1. Sample size and national representativeness in questionnaires and diary studies (more than 100 units).
2. Sample size and municipal representativeness in the case of waste sorting (more than 50 units).

Other studies will be mentioned but not accurately described.

2.3.1 Survey and questionnaire: pros & cons

Most of the studies on HFW are based on questionnaires; some of the best examples of HFW studies contain at least one questionnaire (Koivupuro et al., 2012) (Love Food Hate Waste, 2009) (Neff et al., 2015) (WRAP Q. T., 2009) (WRAP, 2013) (Parizeau et al., 2015) (Camillo & Adorno, 2013) (Gaiani, 2013).

The advantage of questionnaires mainly resides in their costs and feasibility: they can be sent on line (CAWI methodology) through specialized survey centers that often have national representative panel. Moreover, they are easier to analyze if compared with more time-consuming methods (such as diary or waste sorting). In case of handling (sometimes they are given personally by a researcher, instead that online, for instance in the study conducted by Guelph University (Parizeau et al., 2015)), the cost of this operation is still lower than a waste sorting analysis. Due to all these reasons, the panel can be meaningfully larger than any other in case of using survey.

Survey allows establishing correlations among food waste, shopping habits, perception and awareness of the issue, food storage and management. Sensitiveness to the environment or food ethics can be detached, too. Some variables such as number of family components, salary and education can be detected and used as clusters. Indeed, questionnaire provides many insights that are hardly detectable through other methods and it allow larger sample.

On the other side, questionnaire show some important limits. As Lebersorger and Schneider (2011) pointed out, questionnaire represent "the participant's subjective point of view" (Lebersorger & Schneider, 2011, p. p.1925). Regardless Schneider's objection is widely accepted in literature, most of the studies on HFW are based on questionnaires (for the above mentioned advantages of the method) and the grade of knowledge bias related to the issue is empirically not demonstrated and still unknown. C*ognitive bias* and *cognitive dissonance* might be interesting key of lectures to explain what affects the reliability of answers in questionnaires, in relation to socially sensitive

issues such as politics, religion, ethics and environment (Grimm, 2010). As Barr (2008) notably points out, with reference to methodologies that estimate green behavior by self-reporting:

> **"*Caution should, however, be exercised when interpreting these results in a wider context, because the dependent measures of behavior were measured on a self- reported basis. Although such measurement is commonplace in behavioral research, the inflation provided by respondents is difficult to calculate […] as such, over-reporting […] is somewhat of an inevitable consequence of self enhancement by the respondent who may be keen to show their green credentials. […] there is still a conceptual difference between intention and behavior*".**

2.3.2 Survey and questionnaires: potential biases

Social Psychology, first and behavioral economics, lately have both taken into account the knowledge and awareness bias that might affect rational and reliable answers on the self. While in the field of Social Psychology the phenomenon called "cognitive dissonance" is able to provide a theoretical answer to an insufficient representativeness of answers affecting emotional aspects of the self, the cognitive biases (developed in the field of behavioral economics) provided more detailed explanations, verified through experiments, for a wide set of phenomena that might be included into the definition of cognitive dissonance. To our study, the both of them have been considered.

Cognitive dissonance is a phenomenon theorized by Leon Festinger, in the field of social psychology. Similar concepts and idea have been applied to other disciplines, lately, such as behavioral economics (Tversky & Kahneman , 1973) (Simon, 1957), (Tversky & Kahneman, 1974).

Standing to Festinger (A Theory of Cognitive Dissonance, 1962) , a cognitive dissonance "*[…] can be seen as an antecedent condition which leads to activity oriented toward dissonance reduction just as hunger leads toward activity oriented toward hunger reduction.*"

An alternative explanation is given by Akerlof and Dickens in "The Economic Consequences of Cognitive Dissonance", (Akerlof G.A. & Dickens W.T., 1982, p. 3).

> ***Much social psychology is based on the theory of cognitive consistency. At the most abstract level, this means that persons are uncomfortable in mantaining two seemingly contradictory ideas. Cognitive dissonance theory is one application of cognitive consistency theory.***
>
> ***In practice, most cognitive dissonance reactions stem from people's view of themselves as "smart, nice people". Information that conflicts with this image***

tends to be ignored, rejected or accomodated in other beliefs.

In other words, the cognitive dissonance is an unconscious and automatic process that leads the individual to align its ideas and perceptions to an action already done, whether this action was originally overt to its beliefs. This principle can be applied to decisions as well as to forced behavior. Two examples are cited from literature in order to easy the comprehension of such a phenomenon.

In case of decisions, for instance, Knox & Inkster (Knox & Inkster, 1968) make an experiment by interviewing bettors at a race track[13]. The hypothesis, confirmed, is that people that have just made a bet place much higher odds to their horse than people standing in the queue.

In case of forced behavior, an example cited by Knox and Inkster (1968, p. 4) is the experiment conducted by David Glass (1964) on cruel behaviors. The hypothesis is that if the individual is forced to act brutally, he/she will change his/her mind accordingly. For instance, in its experiment "*student that gave electric shock to victims lowered their opinion of their victims".* Another example of what cognitive dissonance means in practice is offered by Festinger & Carlsmith in the experiment presented in "Cognitive consequences of forced compliance" (*see* (Festinger & Carlsmith, 1959).

Another most cited example of cognitive dissonance is about smoking habits (McMaster & Lee, 1991).

When asking to people about their smoking habits, it is rare to get answers such as "I smoke so much that I am possibly go through a cancer for this reason". That would be an odd answer. As McMaster and Lee (1991) showed in their study, smokers' most common answer is that the probability they are going through a cancer due to smoking is still less than the average of other smokers'. This answer is usually followed by statements that reduce the threatening impact of the action, by lessening the importance of smoking as a cancer factor or by denying smoking as much as other people they know.

Standing to Festinger (A Theory of Cognitive Dissonance, 1962), a possible answer to such a question could be *"I Know that smoking is bad for health, yet I do not smoke so much to put myself in danger"* (no matter the real quantity of cigarettes are actually smoked). Or "*I am not so sure that*

[13] Cited in (Knox & Inkster, 1968), p.4.

smoking causes cancer more than other factors". The third option, of course, would be to quit with cigarettes.

As he writes in his book (Festinger, 1962, p. 5-6), three reactions are possible to the acquired knowledge of "smoking causing cancer" information:

1. *Focus on more supportive beliefs that outweigh the dissonant belief or behavior by acquiring new information*

   For instance, in the case of smoking, people that believe smoking to be something bad (for health reasons, for example) could feel discomfort if acknowledged to put their selves in danger. Hence, a possible solution could be finding a study that denies the bad consequences on health of smoking or, anyway, starting to change believes on health consequences of smoking.

2. *Change the conflicting belief so that it is consistent with new beliefs or behaviors- change action*

   This is the most difficult solution to solve a dissonance: it consists in changing the idea/belief related to an issue in order to coordinate it with the actions (it consists in changing point of view on things, hence it is considered the less common way to deal with a cognitive dissonance). In the case of smoking, if a person realizes to put him/herself in danger, he/she would quit cigarettes.

3. *Reduce the importance of the conflicting belief- change action perception*

   This is the most important phenomena to our study: people who experience a conflict could choose to overcome it by reducing the negative impact of the action someway, such as "I do not smoke as much as to put myself in danger"/ I compensate my dangerous action by running everyday/eating healthy/etc…" or, in alternative, by choosing a more "live for today" life-style.

   The result of this mechanism is a self-indulgence tendency that might serve to reduce the discomfort, in the following terms "*I am not so bad*". Unconsciously, it might lead to declare a reduced quantity of the cigarettes smoked daily, if asked[14].

The third phenomenon of the list is the most common with reference to the survey method inquiring into a personal belief of the respondent or a habit, especially in case it would be related to a social

[14] To better understand this mechanism, an interesting and easy reading is McLeod, S. (McLeod, 2014).

desirability acting/belief. As Grimm (2010) points out, questions related to politics, religion, environment, caring behavior are usually more exposed to this kind of contradiction. At the same time, such a question could lead to a "social desirability bias", which leads the respondent to reduce the importance of the undesired action by reducing its frequency, due to feeling of shame in front of the interviewer. Social desirability bias is due to the feeling of discomfort and shaming about admitting a behavior perceived as negative or socially deplorable to another person. (Paulhus, 1991).

Hence, cognitive dissonance is not the only possible bias when inquiring into food waste habits. If the analysis is developed at a bottomless level, behavioral economics provide many reasons able to explain such a phenomenon.

Among those, a key point is represented by *heuristics*, theorized by psychologists Amos Tversky and Daniel Kahneman (Tversky & Kahneman , 1973).

On the basis of Simon's theory of bounded rationality (Simon, 1957), the researchers discovered that the decision making process is not rational as classical economics suggest, yet it is built on mind shortcut that produce biases. A short explanation of the authors follows:

> ***People rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operation"*** **(Tversky & Kahneman, 1974, p. 1124)**

.

Heuristics are lots, though just some of them might affect a questionnaire on households' food waste. Generally speaking, in the case of a questionnaire the respondent may answer not on the basis of all existing information on the matter, but just with selected ones that comes up to its mind in the specific moment for irrational (in the mean of not computational) reasons (such as *availability bias*). On the other hand, if the respondents are provided a set of answers (even partial) to pick up, they might be affected by them (*anchoring effect*). Moreover, since the food waste questionnaire affects a "self-judgment field" in relation with a possible "negative" action (wasting food), it might be affected also by a so-called "*positive illusion bias*" (Taylor & Brown, 1988), standing to the opinion that the unit has of the issue. A way to detect the judgment that the individual have on the issue is by asking it, as one of the first questions, in the survey. A more detailed explanation of the heuristics follows.

The answer to a question that enquires into the frequency of a determined action might be biased by the anchoring effect or the availability bias. To explain them, Tversky and Kahneman report some useful examples taken by their experiments.

The anchoring effect has been described as follow:

> ***In many situations, people make estimates by starting from an initial value that is adjusted to yield the final answer.***
> ***The initial value, or starting point, may be suggested by the formulation of the problem, or it may be the result of a partial computation. In either case, adjustments are typically insufficient. That is, different starting points yield different estimates, which are biased toward the initial value. We call this phenomenon anchoring.***
> **(Tversky & Kahneman, Judgment under Uncertainty: Heuristics and Biases, 1974, p. 1127)**

Hence, one example of possible anchoring is related to questions that provide some exogenous elements for the computation- such as the multiple answers in a questionnaire that might suggest some elements for the answer (as a starting point for the computation). To explain the "insufficient adjustment", the example reported by the authors follows:

> ***In a demonstration of the anchoring effect, subjects were asked to estimate various quantities, stated in percentages (for example, the percentage of African countries in the United Nations).For each quantity, a number between 0 and 100 was determined by spinning a wheel of fortune in the subjects' presence.***
> ***The subjects were instructed to indicate first whether that number was higher or lower than the value of the quantity, and then to estimate the value of the quantity by moving upward or downward from the given number. Different groups were given different numbers for each quantity, and these arbitrary numbers had a marked effect on estimates. For example, the median estimates of the percentage of African countries in the United Nations were 25 and 45 for groups that received 10 and 65, respectively, as starting points. Payoffs for accuracy did not reduce the anchoring effect.***
>
> **(Tversky & Kahneman, 1974, p. 1127)**

Another anchoring effect occurs when the answer is not provided, as in multiple answers, yet the computation is uncompleted for some reason (lack of time or proper tools). In the experiment that showed this bias (Tversky & Kahneman , 1973) the researchers asked the respondents to calculate a computation in five seconds (or what they would have been able to, estimating a number most

likely to be similar to the final result). Not only any of the respondents was able to guess the right result, yet the result was meaningfully underestimated in both cases (the experimental groups were two). Moreover, the way the sequence of numbers were disposed made the difference in the result proposed by the groups: one group of respondents had an ascending sequence (1x2x3x4x5x6x7x8) while the other group had the opposite (8x7x6x5x4x3x2x1). The median estimate for the ascending sequence was 512, while the median estimate for the descending sequence was 2,250. The correct answer was 40,320. Hence, since the computation was partial and it started from left to right, the first group provided a lower estimation (their partial computation started from "1"), while the second provided a higher result (their computation started from 8). So, also the way info is provided can lead to a different kind of mistake.

However, the same phenomenon- the underestimation of food waste quantities- can be explained in many other ways, such as through bias related to availability heuristics (Tversky & Kahneman , 1973). Availability heuristics means estimating a more likely quantity by what is more available in memory- so, a bias close to anchoring's, yet anchoring can make reference to a set of answers provided to the respondents, while availability bias is based just on the memories of the respondent.

The positive illusion bias (Taylor & Brown, 1988), on the other side, suggest that an intrinsic element of mental wellbeing is the positive over estimation of the self.

> ***[…] far from being balanced between the positive and the negative, the perception of self that most individuals hold is heavily weighted toward the positive end of the scale. […]. Here exists a pervasive tendency to see the self as better than others. Individuals judge positive personality attributes to be more descriptive of themselves than of the average person […] In sum, the perception of self that most individuals hold is not as well-balanced as traditional models of mental health suggest. Rather than being attentive to both the favorable and unfavorable aspects of self, normal individuals appear to be very cognizant of their strengths and assets and considerably less aware of their weaknesses and faults. Evidence that these flattering self-portrayals are illusory comes from studies in which researchers have found that (a) most individuals see themselves as better than the average person and (b) most individuals see themselves as better than other see them. For these reasons, overly positive views of the self appear to be illusionary.***
> **. (Taylor & Brown, 1988, p. 195-196)**

Hence, when asking something related to (possible) intrinsic negative judgment, the opportunity to face a positive illusion bias needs to be taken into account.

Summing up, while in the discipline of social psychology an explanation key to possible underestimation is offered by the so called cognitive dissonance, in behavioral economics it is offered by the following biases:

1. **Availability bias**, related to the most relevant information coming up to the memory of the respondent (for instance affected by timing);
2. **Positive illusion bias**, which leads the respondent to project his "desire" related to a determined action, instead of a "real" behavior- aimed at reducing the feeling of discomfort related to a possible negative behavior- this concept is very close to cognitive dissonance;
3. **Social desirability bias**, which might affect the answer of the respondent, consciously or not, to accord the self-report behavior to a "social desirable" behavior;
4. **Anchoring effect**, for instance determined by a series of answers provided by the researcher (in case of multiple choice answer);

Other possible limits emerging from questionnaires, especially whether obtained thought CAWI methodology, are (DJSresearch, 2014):

1. Respondents do not feel any pressure or incentive to provide accurate answers, so answers may be inaccurate for simply carefulness. A possible solution is the face-by-face questionnaire, which is, on the other hand, more expansive and time consuming and might lead to an increased social desirability bias.
2. CAWI tends to underestimate some social categories, such senior citizens who have ore difficulties in accessing the web.
3. Respondents may be recorded in more than one survey panel and being often required to compile many questionnaires. This phenomenon could lead to a reduced attention[15].
4. Respondents could not answer in accurate way so that the questionnaire is not valid or, in alternative, the response rate can be too low for the specific research needs (higher probability to quit the questionnaire by the respondent, low redemption rate)
5. Respondents could provide answer not completely honest, in case they would be presented in an unfavorable manner (see (Paulhus, 1991) & (King & Bruner, 2000).

2.3.3 Diary method: pros & cons

Some studies have been conducted through the diary method.

[15] Personal communication made by SWG, based on their experience.

The positive sides of using a diary method will be listed first. Accurate description of the method has been provided by WRAP (WRAP, 2013) , (Langley et al., 2010) and Schneider (Lebersorger & Schneider, 2011).

The diary method has a major advantage: it is the only method that allows recording an answer to the questions "what do you waste/ how much/ why" in real time[16].

Since it is based on a self-recording made by the consumer at the meal time (or soon after), it is considered the most reliable methodology to obtain qualitative information on food waste. It can be done for one or two weeks (depending on funding). Other methods could be as much reliable, such as an ethnographic research, yet they would be largely more expansive and time consuming. In the diary method, instead, food waste is recorded during one/two week, at every meal, and it can be done by the family itself, so that many families can be involved in the experiment at the same time. Moreover, other useful information can be asked such as disposal routes and the opinion of the respondent on the "edibility" of what is thrown away. Food given to pets or poured down the kitchen sink can be recorded, too.

This is the easiest way to collect the hugest amount of information by a sample and it allows to build a sample composed of some hundreds respondents in the same period of time (hence, it avoids discordance within the sample due to seasonality effect, which would heavily affect an ethnographic approach). Since diaries are sent to the families and sent back to the researcher by mail, the sample can be easily based on geographical strata (urban/semi-rural/rural areas, anywhere in the country). Collection of background information on socio-demographics, attitudes and beliefs enables statistical analysis on the influence of each factor on the HFW production (Koivupuro et al., 2012) . Differently from questionnaires, diary's answers are not based on memory or self-perception, if properly filled.

On the other side, diaries can still suffer of social desirability bias. The respondent could lower its FW quantity (or record it just partially) because of feeling of shame in relation with quantities or real reasons of wasted food. This is one of the major challenged faced by Langley (Langley et al., 2010), who reported that subjects attending to their study admitted to have lowered the quantity of wasted food since they were under observation and more aware of the issue. At the same time, respondent could also decide not to report smaller instances of waste that are perceived as not important (given the effort involved). WRAP (2013) writes that diary estimation can be around 40% lower than compositional analysis (Hoj, 2011). Though, the mentioned study is still not published and data are not to be considered as definitive[17]. Other cons of the method are the abandon rate

[16] An ethnographic approach, with participated interview, could be as well, however it would be largely more costly.

[17] Personal correspondence with the author, on17/02/2016

(diary implies efforts that the family could decide not to face anymore, at a certain point of the week) and the deception, such as a completion that not proceed day by day (or meal by meal) and so could be partially "invented"[18]. A time consuming phase of the diary is the data entry phase, depending on the sample and the software used for the experiment (WRAP used excel and manual entry[19]).

2.3.4 Waste sorting and weighting: pros & cons

Waste sorting analysis has been conducted in many studies, yet methodological differences in analysis (computation, definitions and sample) do not allow an easy comparison among existing data.

Waste sorting is a widely used method, due to its reliability (on quantities) and feasibility, especially when conducted in collaboration with municipalities or waste management utilities (Schneider, Prevention of Food Waste in Residual Waste, 2015).

With reference to reliability, as Lebersorger and Schneider (2011) point out, household waste composition analysis has a major pro, which is the absence of respondent's involvement during the experiment; so, differently from diary studies and questionnaires, findings do not reflect the subjective point of view of the respondents; nor, it suffers from underestimation typical of self-reporting, especially if the respondent is not alerted on the exact date of its auditing. Moreover, it is an easier methodology to be developed, whether integrated to pre-existing set-in-place waste separate collection system, regularly performed by local authorities. Analyses performed by householders exist, yet the self-correction factor might be equal to the one affecting diary studies (both for social desirability bias and for carelessness).

Unfortunately, the cons of this methodology need to be taken in consideration carefully, since they heavily affect the scope of enquiring with reference to the edible/not edible fractions of food waste and its drivers (Dahlen and Lagerkvist, 2008).

First, unless the garbage collection and the waste sorting are done every day, the state of degradation of food can be an obstacle to its classification (Lebersorger & Schneider, 2011), (Langley et al., 2010). Since costs of this kind of analysis are considerable high anyway, it is hard to do the collection more often than once a week. Literature confirms this limit: most of the studies using waste sorting analysis as a methodology are based on food/humid collection systems, based on weekly or fortnightly collection (Silvennoinen et al., 2014) (WRAP, 2008). In this case, for instance, it could be hard to distinguish leftovers from simply decomposed food; seasonality might affect the interpretation of results, too, considering the shortest amount of time that the food needs

[18] Consideration emerging from our experiment. More details in the chapter "discussion on results".
[19] WRAP, personal communication of the author.

to get degraded in summer. Furthermore, some collection trucks use a compaction mechanism that can stress the samples and lead to an increased difficulty in sorting (Nilsson, 2010). Indeed, these entire variables affect the weight, too. (Langley et al., 2010). Moreover, reasons why food is thrown away are hardly detectable- this is why waste sorting analysis is often accompanied by a survey detecting habits of food shopping, cooking and food waste perception and feelings (Parizeau et al., 2015), (WRAP, 2007). Another major problem represented by the method of waste sorting is the sampling, especially when the garbage is not picked up by single-family dwelling (curbside collection) but from multi-occupancy dwellings, where clustering is harder. Though, many studies have been conducted on multi-family dwelling anyway ((Lebersorger & Schneider, 2011); (Edjabou et al., 2015) (Bridgewater & Quested, 2011) (WRAP, 2008) (Bridgewater & Quested, 2011) (Silvennoinen & Korhonen, 2013), for example by picking up samples from the common dumpsters.

Except from the present study, the only research that used both a compositional analysis and a questionnaire (face to face) over the same sample is Parizeau (2015). Even though the sample is relatively a little one (68 families), evidences from this study are promising for the future and are also confirming some findings from WRAP ((Tom Quested et al., 2013)) and Finnish study (Koivupuro et al., 2012).

2.4 General considerations on methodologies

Several biases might be able to affect a questionnaire on HFW. If so, most of the existing studies on the issue, relying only on self-perception, would be more likely to show an "intention" rather than a behavior (Barr, 2008), or a "judgment" rather than a computation (Tversky & Kahneman, Judgment under Uncertainty: Heuristics and Biases, 1974).

If literature findings confirm this hypothesis, it will be shown in the next chapter.

With reference to methodologies, the many cons affecting questionnaires would be able to affect reliability of data gathered through this method, yet a survey is still so much cheaper than diary and waste sorting, less time-consuming and it still allows having larger samples. For all this reasons, survey might be still the preferred method to detect HFW behavior and quantities.

As diary method can still suffer of biases due to self-reporting- such as a underreporting or self-correction due to a social desirability bias- it is still a method to be considered less reliable than waste sorting, with reference to quantities.

Waste sorting (and weighting) is the best method among those three, since analysis developed without the awareness of the respondent are not affected by any biases. Though, it is time-consuming, expansive and it needs the collaboration of the waste collection company to be

performed on large samples. Even in this case, cons are a serious issue to be considered, such as the state of degradation of food or the hardest detection of causes for the food to be thrown away.

Considering all those aspects, literature might show a predilection for one of the mentioned methodologies even considering all the listed cons.

In the next chapter, a review of relevant studies will be proposed, where methodologies and data will be illustrated and, eventually, compared (whether possible).

3 Food waste volumes at households' level: an overview

3.1 Overview of the chapter

European Union estimated household FW to be 42% of the total FW (Monier et al., 2010).

Except from statistics, three methodologies have been used to detect households' food waste quantities and behavior at a national level, namely questionnaires, diary studies and waste sorting/weighting. They have been illustrated in the chapter II, while data gathered from them are presented in three separate paragraphs, in this chapter.

General criteria to select researches relevant to the present work are:

- English and Italian based literature
- Quantitative data
- Representative Samples (at national or municipal level)
- Studies from Europe, USA and Canada, Australia (available studies for the Global North).

Each paragraph starts with a synthesis of particular criteria affecting the literary review selection for the specific method.

3.2 Survey and questionnaires: data

To the present analysis, the *self-perception* of food waste gathered by questionnaires is considered as relevant. Whether available, the quantitative data is reported from the studies, with a special focus on Italian data. More often, a qualitative evaluation of household's food waste quantity is asked rather than a specific quantity and it will be reported as well.

Hence, relevance will be given to:

- Studies presented in English and Italian;
- quantitative data from the selected studies, where available;
- qualitative data;
- Behavior leading to waste.

The choice of such criteria is mainly due to the purpose of verifying the presence of the listed cognitive biases, on one side; priority is given to quantitative data that allow a comparison with data gathered through other methodologies.

Studies conducted in Europe, US and Canada will be analyzed as representative of the Global North. We reported also some data from Australia, since studies were conducted along with WRAP.

With reference to studies proposing data for the overall **EU**, apart from Monier (Monier et al., 2010) another survey has been performed on HFW. A survey commissioned by EC in 2011 (The

Gallup Organization, 2011) over a sample of 27.164 units in the 27 countries of European Union revealed that the majority of respondents think not to waste food or to waste a minimum quota of purchased food (respectively, the 11% answered not to waste food at all and the 71% answered to waste 15% or less of the purchased food). As will be shown, this tendency is going to be stressed by all studies proposing the same or similar questions. In the specific, the higher value was given by Cyprus respondents: they answer that 16% or more of the food that they purchased went to waste (43% gave this answer), followed by respondents in Ireland (30%), Greece (29%), and Denmark and Luxembourg (both 26%). Italy shows data close to the average, with 4% answering not to waste at all and 75% reporting to waste less than 15% of purchased food.

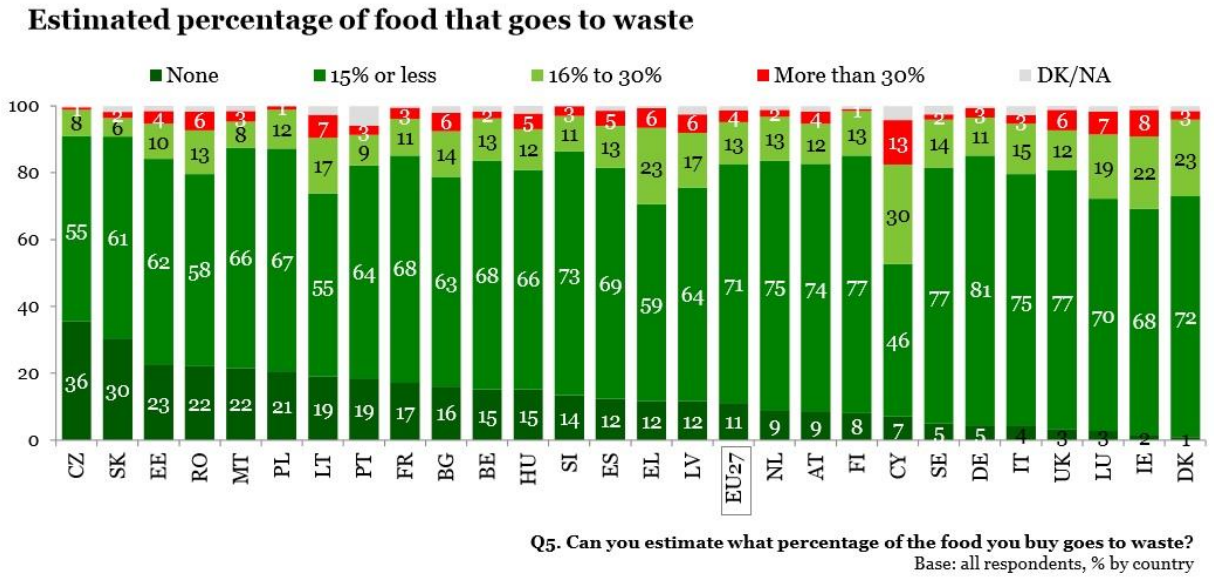


Figure 5 - Self-perceived Household Food Waste in EU27 (The Gallup Organization, 2011, p. 19)

WRAP, which is a pioneer on food waste analysis studies, never provided a quantity based on questionnaires and it has a careful position on answers based on self-perception. In their most recent questionnaire conducted in **UK** (WRAP, 2014), 58% of respondents declared "not to waste food at all/hardly any" but a footnote specifies that data suffers of a gap due to unawareness. Evidences emerging from a thesis (Stine Hoj, University of South Australia) suggest that the gap is meaningful, though the work is not published. Yet in 2007 (WRAP, 2007), in the first survey conducted by WRAP emerged quite clearly that most of the respondents do not think to waste food in their households. No specific quantity was reported, but the statement recurs often in the open part of the answer. As it often happens in questionnaires, with reference to the most direct question of personal food waste habits ("*I try to ensure the food thrown away is kept to a minimum*"), nearly all respondents agreed to some extent with this statement and more than half agreed strongly that they do try to keep the amount of food wastage within the household to a minimum.

Also in the conclusions and recommendations, it is cited:

> ***"It should be noted at this point that nearly all respondents deny 'wasting food' as their first response to questioning even if subsequent questioning reveals this not to be the case. It is a complex issue and embedded with psychological background noise that probably varies from generation to generation."*** **(WRAP, 2007, p. 10)**

Abeliotis et al. (Abeliotis et al., 2014), conducted 231 face to face interviews in shopping areas to a non-representative sample, in **Greece**. Their findings show that among the interviews, only the 13% answered to waste significant amount or quite a bit, while the 87% answered to waste a small amount/hardly any/none. Almost half of the respondents (42%) answered that their food waste decreased a lot if compared to one year earlier; 22% answered that it decreased a little and 34% answered that it was the same, while no one answered it increased. When asked the reason why their waste would change, 62.8% answered that the reason is the economic crisis. The conclusion of the authors is that people in Greece has a positive attitude to food waste prevention, strongly influenced by the severe recession experienced in the country.

Hanssen & Moller (Hanssen & Moller, 2013) present a report on Food waste in **Norway**, where the consumer food waste is estimated through a periodic survey, conducted over a sample of 1000 units each year (part of the ForMat project). While this survey does not provide a weight or a cost of food waste, it asks whether the consumers think they reduced their food waste during last year. 50% say they have become more aware of the problem during the past year, and almost 40% believe that they have reduced food wastage in their own households. Authors state that it can be due to the ForMat awareness raising campaign[20]. With reference to drivers of food waste, 40% of the panel declares that the first reason to throw away food is the expiration date, followed by 20-25% declaring a bad quality (tasted/smelled bad).

In **Australia**, three studies have faced the issue, giving two economic values results and one weight value result. The first study is titled "What a Waste: an Analysis of Households Expenditure on Food" (Baker et al., 2009) and, standing to what reported on "National Food Waste Assessment: Final Report" (Mason et al., 2011), the author asked to 1644 households member to estimate the value of the discarded food for that year. The national estimation was 5.2 billion dollars of discarded food (around 5% of food expanses). The second study, titled "Food Waste Avoidance Benchmark Study" (Love Food Hate Waste, 2009) estimated a value of 2.5 billion dollars of discarded food, calculated on a survey conducted on 1200 households. The study that reports a

[20] For more info, see ForMat project web-site at http://matvett.no/

result expressed in weight is "the National Waste Report", that estimates a HFW corresponding at 7.5 million tons in the years 2008/2009. Though, this value is calculated through an estimation of the food contained in the humid fraction, so it is not related to questionnaires (yet it is the only available data expressed in weight).

On the other side, **US** made one of its first HFW study in 2014, through a representative survey realized by the Johns Hopkins University (Neff et al., 2015). This survey is likely inspired to WRAP's, as the authors specifies. It is managed by a specialized institute and the panel is representative for the 97% of the US population. The response rate is 50% - that lead the number of participant families to 1010. The methodology is carefully described and it is comparable with other studies. With reference to data of HFW, 70% of respondents declare: not to waste at all (13%) and to discard up to 10% of purchased food (56%). Behaviors in relation to shopping and beliefs were analyzed too.

Finally, also Italy has conducted many questionnaires on households' food waste behavior.

The most important HFW study in **Italy** has been conducted by Waste Watcher, a joint research project run by DISTAL[21], SWG[22] and Last Minute Market[23]. The study was inspired to a PhD thesis titled "Lo spreco alimentare domestico in Italia: stime, causa ed impatti[24]", realized by Silvia Gaiani (Gaiani, 2013) who, in a joint study with Joint Research Center at Ispra (JRC), set up a survey on households food habits and perceptions related to food waste. The panel, even though self-selected, was composed of around 3000 units, so it provided meaningful insights- most of the results were confirmed in a later study conducted by Waste Watcher on a representative panel. With reference to the question D31 "*How much edible food does your family waste in one week, on average*", 65% of the sample answers not to waste any edible food, 17% declares to waste less than 250gr, 9% declares to waste between 250 and 500 gr, 3% declares to waste between 500 and 1000 gr, 1% declares to waste between 1 and 2 kg, 2% does not know. D32 asks whether the respondents think to waste less, more or the same of two years earlier; the 52% answer to waste less, while the 28% answer to waste the same quantity.

A first follow-up of this work was the comparative work between the two research centers involved (**JRC and KIT**), where the same survey was answered by employees (Jorissen et al., 2015). At the question "*How much do you think to waste weekly- with reference to EFW?"*- 37% of the

[21] Department of Agricultural and Food Science, University of Bologna. Source: http://www.distal.unibo.it/it
[22] http://www.swg.it/
[23] http://www.lastminutemarket.it/
[24] "Households food waste in Italy: causes, estimations and impacts". Translation of the author.

respondents of the JRC (139 out of 372) and 28% of Karlsruhe (120 out of 422) stated that they do not throw away any edible food, while only one household with four persons at JRC conceded that they dispose more than 2 kg[25]. The average value of food waste emerging from this study is 140 g per person/week in Karlsruhe and 127 g per person/week at JRC. If to be up scaled on the two populations, results would be: 597,000 tons of food waste per year for Germany and 408,000 tons per year for Italy.

The second follow up of Gaiani's study (Gaiani, 2013) has been the creation of the **Waste Watcher** observatory. The Observatory is composed by SWG (a survey center located in Trieste) and Last Minute Market[26]. Two surveys were conducted in April, 2014 and May 2015, on a sample of 1500 families, and previously in May 2013. The sample is representative of the Italian population, based on the ISTAT[27] panel- strata are based on gender, age, area of residency. The questionnaire is based on computer-assisted web interviewing (CAWI) methodology and it is conducted by SWG. Findings from the three surveys are meaningfully different.

The HFW declared in the first Waste Watcher report (Camillo & Adorno, 2013) is around 213 gr per family per week (a value estimated to be around 8.7 billion euros for the year 2013). Annually, it would be 271,000 ton/year in Italy. The value makes reference to what we defined as avoidable food waste. Both the weight and the economic value are the results of the respondents' self-perception. Standing to the authors of the questionnaire[28], the question was made as following: "*how much food do you think your family waste on average, weekly?"*

In the second report, published in 2014 (Waste Watcher, 2014) the average of HFW expressed in euros is 6.5 euros/week (apparently, it is slightly reduced from the previous year). The methodology adopted for this study is the same of the year earlier, yet the question on self-perceived food waste was built differently from the previous year and it was as following: "*How much food did you waste yesterday*? The answer was about 80 gr on average. The final data was gathered by multiplying the daily average per seven days, for a weekly, average value of 560gr/hh/week.

The survey made in 2015 made both the questions, in order to enquire into possible different answers due to the question itself. Both the questions were to be answered in the same questionnaire

[25] The question was a close answer one and the the specified categories were: nothing, less than 250 g, 250–500, 500–1000, 1000–2000, and more than 2000 g per household/week.
[26] http://www.lastminutemarket.it/media_news/english/
[27] http://www.istat.it/en/
[28] Personal correspondence with the author, 21stof March 2016

- "*Considering that: a banana weights about 200 gr, a (cooked) pasta portion weights 250 gr and a yogurt weights 120 gr, how much food do you think to waste weekly (in grams)?"* and
- *"How much food did you waste yesterday*?"

While the average value from the first question was 176,8gr/hh/week, in the second case the result was 630 gr/hh/week, based on a daily average of 90 gr. Waste Watcher usually communicate the second data, on the basis of a major reliability of such an answer [29]. Starting from this data, estimation is proposed of NHFW/2015:

Data	Value
EHFW/hh/week	630gr
Nr of weeks in one year	52
Nr of families in Italy (according to ISTAT; 2014)	24 611 766

NHFW (gr/year)= gr/hh/week * nr of weeks in one year* nr. of families in Italy
NHFW (gr/year)= 630 * 52* 24 611 766
HFW (gr/hh/year) = 630*52= 32 760
NHFW (tons/year) = 32 760* 24 611 766/ 10^6 = 806 281.454
NHFW (tons/year) = 806 281.454

Table 1- NHFW Italy, 2015 (elaboration of the author based on Waste Watcher data 2015)

Another study, titled "Dar da mangiare agli affamati" (Feeding the hungry[30]) (Garrone et al., 2012), provided data on household's food waste in Italy. The study analyzes the entire agro- food chain through an innovative method; quoting the authors from their paper titled "Opening the black box of food waste reduction" (Garrone, Melacini, & Perego, 2014), the model is a "*conceptual model of surplus waste generation and management called ASRW*", acronym standing for "*availability, surplus, recoverability, waste*" (Garrone, Melacini, & Perego, 2014, p. 132). Through this model, the authors estimate that 8% of the overall wasted food is due to households in Italy, corresponding to 2 513 500 tons/ year (2011). Standing on their conceptualization, HFW is characterized by "low recoverability". The panel is not known– the families have been contacted by Nielsen, a specialized survey center- the methodology shows some elements of uncertainty that will be examined in the

[29] Personal correspondence with the author;
[30] Translated by the author

next paragraph. There is no mention to the methodology of HFW in the paper, yet, as far as it is possible to read in the book (Garrone et al., 2012), a data crossing between the self-perceived value of FW and bought food has been made. The question on quantity was, namely:

- "*Thinking to the last month, how much food you wasted from those you served on the table (in percentage)*". Some answers were provided (<5%, 5-10%, 10-15%, >15%).

70% declared to waste less than 5%, while 3% of the panel declared to waste more than 15% (Garrone et al., 2012, p. 197).

3.3 Diary method: data

In this paragraph, the most important diary studies will be analyzed. The first criterion used to select the studies is the national representativeness of data, which allows significant comparisons of the results, even though different methodologies have been used. Hence, some important studies will not be considered due to their unrepresentative samples, yet they will be mentioned. Secondly, only diary studies presenting results in English and Italian will be considered.

Standing to the above mentioned criteria, only two studies have been selected.
WRAP made many studies on sample composed of hundred units; at the same time, the government of Finland launched the "Foodspill programme"[31] that included a significant research on HFW and was conducted by the University of Helsinki. Both of them are available in English, both as reports and peer-reviewed studies.

WRAP's first diary experiment was in 2007 (WRAP & Exodus Market Research, 2007), a second experiment was done in 2008 (just referred to the food and drink disposed through the sewer) (WRAP, 2009) and a third experiment related to all FW was done in 2012 (WRAP, 2013).
The 2007's experiment was conducted on a sample of 284 diaries; the 2008 experiment was conducted on 319 households. The 2012 experiment was the most reliable (Tom Quested et al., 2013), since it integrated some suggestions and methodological findings emerged in the previous experiments and it had the larger sample (948 households, in England and Wales).
In this case, the recruitment for the questionnaire phase (phase 1) involved a 2061 unit sample that became 1962 in the diary phase, on the basis of a 16% abandon rate that instead was slightly higher. Sample was designed to be representative of the UK population on the basis of: households size and composition; gender and age; employment status; ethnicity; housing type; household activity for

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composting food; presence and type of FW collection; rurality. The experiment started on the 24th of May and it lengthened one week. It was composed also of two questionnaires, one to be filled before and one after the experiment, of around 25 questions each, to detect habits, opinions and attitudes of respondents on FW.

Results of the entire research (2007-2012) undertaken by WRAP show that households between 24-35 age and families with children are the two groups that waste the most. In the second case, waste pro-capita is lower than the average. With reference to quantities, while in 2007 HFW was around 22% of purchases of a family (8.3 million tons) in 2012 it were 7 million tons. When expressed per household, the total amount of HFW reduced by 19% over this time period, from 320 Kg to 260 kg per household per year. (WRAP, 2013). Other insights on data (such as the avoidable portion of HFW) are reported in the following box.

Of the 1.3 million tonne reduction, 1.1 million tonnes was food and drink that could have been eaten (avoidable), a 21% reduction from 5.3 million tonnes in 2007 to 4.2 million tonnes in 2012. This reduction is enough to completely fill Wembley Stadium. When expressed per household, the amount of avoidable food and drink waste reduced by almost a quarter (24%), from 210 kg to 160 kg per household per year. This equates to a reduction of 1 kg per week for the average household.

This large reduction in avoidable food and drink waste was concentrated in five categories, each with reductions of more than 100,000 tonnes:

home-made and pre-prepared meals, bakery, drink, fresh fruit, and dairy and eggs. For other categories, there were either smaller reductions (such as in fresh vegetables and salad) or very little change (such as for meat and fish). This reduction is reflected in the equivalent number of items thrown away per day in the UK for 2007 and 2012:

Bananas have reduced: from 1.7 million to 1.4 million wasted per day.

Tomatoes: from 2.0 million to 1.5 million.

Yoghurts: from 1.7 million to 1.2 million.

Home-made meals: from 1.8 million to 1.5 million.

Bread: from 37 million slices to 24 million slices.

The avoidable food and drink waste that was subsequently thrown away would have cost £12.5 billion across the UK, or £470 per household per year, at 2012 Food prices.

If the amount of avoidable food and drink waste had remained at 2007 levels, this would have cost £15.8 billion to purchase at 2012 food prices. Therefore, the reduction in food and drink waste between 2007 and 2012 saved UK households £3.3 billion in 2012 alone –that's around £130 for the average household. The reduction in food waste in our bins 6 will have saved local authorities around £85 million in avoided landfill tax and gate fees in 2012 alone. **(WRAP, 2013, p. 6)**

Silvennoinen (Silvennoinen et al., 2014) conducted a similar research with reference to Finnish households. Differently from WRAP, the diary was kept by the families for two weeks and the shopping purchases were asked as well. Only edible food waste was considered in this case. The sample was composed of 380 families, representatives of the Finnish population. Results show that

the amount of food waste in Finland was about 120 million kg/year, corresponding to 23 kg per capita and 63 kg per household. The average weekly data is 1.211 kg/hh/week. Differently from UK results, the average waste was about 4-5 per cent of the total purchased food, while similarly to it the main discarded foodstuffs were vegetables (then, home-cooked food and milk products). The first cited reason was spoilage. When examining waste per person, singles generally produced most waste per capita. In the paper titled *Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households* (Koivupuro et al., 2012), based on the same experiment, it clearly emerges that the sex of the household influences the FW, with a statistical, significant higher volume of wasted food in case of single women. Other factors of influences were the sex of the household usually doing the shopping (once again, where women are in charge of food shopping, FW is higher); the habit to buy cheap and discounted food (FW is higher where "Buy One, Get One Free" products and discounted food are NOT bought). The awareness in the reduction potential is directly correlated with the FW: people claiming to have the potential to reduce HFW show a higher volume of FW. As the author notice, this finding is the opposite of WRAP's (2007), where people declaring to waste the less or nothing actually waste as much as others (and most of respondents fall in this category). Type of employment, level of education and age have no a clear correlation on the amount of avoidable food waste, differently to what stated by Austrian studies, for instance (Wassermann & Schneider, 2005) and (Schneider & Obersteiner, 2007).

Standing to their findings, both Foodspill and Wrap provided important feeding for awareness raising campaigns. WRAP launched its Love Food Hate Waste Campaign[32], while Finland was included in the United against Food Waste Nordic[33] that provided funding for advocacy in the Nordic Council countries.

A very inspiring research through diary has been conducted by Langley (Langley et al., 2010) on a not representative sample of the UK population.

No other studies conducted on meaningful samples are recorded at the present time.

[32] Link: http://www.lovefoodhatewaste.com/

[33] Link: http://www.norden.org/en/theme/green-growth/the-prime-ministers-green-growth-projects/developing-techniques-and-methods-for-processing-waste/reducing-food-waste/united-against-food-waste-nordic

3.4 Waste sorting and weighting: data

As for questionnaires, also waste sorting analysis and weighting has been widely used as a method to estimate food waste in household garbage, directly or indirectly. Although many studies have been performed, only some of them will be presented here. Relevance criteria to the present study will be applied for the selection. Namely, both criteria on sample size and representativeness have been applied:

- Italian and English based literature, (totally or partially, so that also extended abstracts and synthesis have been included);
- Sample: over 50 units; representative of a municipality or more than one (until national representativeness);
- Aggregated data.

As for all the studies in the food waste sector, **WRAP UK** was a pioneer in the computation of food waste through waste sorting analysis over meaningful samples, since it started its activities in 2007. The first case study was made in 2007, when 19 local authorities were funded in order to collect food waste separately (WRAP, 2008). Starting from this experience, further researches and reports (Bridgewater & Parfitt, 2009), (Mills & Andrews, 2009) were produced lately.

Standing to the final report titled "Household food & drink waste in UK" (WRAP, 2013), the total amount of households food waste in UK was 4,670,000 tons per year, or 175 kg hh/ year in 2012.

In 2010, 4,620,000 tons per year or 172 kg/hh/year had been estimated (Bridgewater & Quested, 2011), which corresponds to 3.30 kg/hh/week. Research made in 2010 was developed only in England, so a diachronic comparison was allowed in this region between 2007 and 2010: "The amount of food waste drop from 4,650,000 tons in 2006/07 to 3,820,000 tons in 2010 […] a reduction of 18%. The amount of food waste per household per year has reduced by 46 kg/hh/year (corresponding to 2.42 kg/hh/week) - or 21% over the same time period." (Bridgewater & Quested, 2011, p. 17-18).

Silvennoinen and Korhonen (2013) conducted a waste sorting and weighting analysis for one week in September 2012, in Helsinki. The total volume of all samples (34, from 13 areas in Helsinki metropolitan area) was 3400 kg. Their findings suggest that avoidable food waste varies between 15-22 kg/pp/year. by type of the housing. If considered also food waste from bio-waste containers, the value is 22-27 kg/pp/year (average: 23 kg per citizen). When estimated per household, it is 63 kg/hh/year, corresponding to 1.21 kg/per capita/week. Surprisingly, the most

wasted type of food were group "other", including ready-made food, pastry, snack and candy, followed by bread, vegetables and meat. In their study of 2014 (Silvennoinen et al., 2014), the most frequently wasted product are vegetables, accordingly to other studies in the sector. As Silvennoinen points out, data on food waste emerging from this study is further lower than others (see (Jensen & al, 2013), (Parizeau et al., 2015), (WRAP, 2013), yet it confirms data emerging from their diary study (Silvennoinen et al., 2014).

In Sweden (Jensen & al, 2013) about 771,000 tons of food waste was generated in households in 2012, which is the equivalent of just under 81 kg per person, corresponding to 1.55kg/pp/week. Around 35 percent of these volumes (270,000 tons) were avoidable or possibly avoidable food waste.

Edjabou et al. (Edjabou et al., 2015) conducted a residual waste[34] sampling and sorting analysis in three Danish municipalities. The sample was composed both from single and multi-family dwellings, for an overall sample counting 1442 families. The authors analyzed 17 tons of residual waste and divided it into three main levels, composed of 10 groups (1st level) and many sub-groups[35]. Their findings highlight that food waste is the first quota of the residual waste, covering around 45% of the overall garbage, where the residual household waste generation rate is 3-4 kg/ pro capita/ week. Considering that the average household size is 2.1 persons in 2012 (Statistics Denmark, 2014), we could estimate household food waste to be 1.35- 1.8 kg/hh/week, only in the residual waste fraction.

[34] Residual Household waste refers to the remaining mixed waste after source segregation of recyclables and other materials, such as bulky, HHW, WEEE, gardening ((Edjabou et al., 2015) quoting (Christensen et al., 2010).

[35] The ten groups of the first level are, namely: Food Waste, gardening waste, paper, board, plastic, metal, glass, miscellaneous combustibles, inert, special waste. For the second and third level analysis, see (Edjabou et al., 2015, p. 16) .

Composition (% mass per wet basis) of RHW as function of housing type and associated probability values from the permutation test.

Fractions (Level1)	Single-family (%w/w[a])	Multi-family (%w/w[a])	*p*-value
Food waste**	45 ± 1.3	36.2 ± 3.9	0.003
Gardening waste	3.9 ± 1.2	3.7 ± 1.7	0.799
Paper*	7.6 ± 1.4	10.0 ± 1.0	0.030
Board	7.0 ± 0.9	8.4 ± 1.4	0.375
Plastic	13.1 ± 0.5	12.9 ± 0.5	0.931
Metal	1.9 ± 0	2.8 ± 0.6	0.065
Glass*	1.7 ± 1.6	2.8 ± 1.0	0.042
Miscellaneous combustible	17.3 ± 3.1	17.2 ± 3.8	0.638
Inert	1.9 ± 1.9	4.9 ± 2.8	0.286
Special waste	0.5 ± 0.5	1.0 ± 0.8	0.353
WGR (kg per person per week)	3.7 ± 0.8	4.0 ± 1.5	0.652

Data are presented as Mean ± Standard deviation.
* Significant level 0.05.
** Significant level 0.01.
[a] % mass per wet basis.

Figure 6 - Presence of FW in RHW in Denmark (Edjabou et al., 2015, p. 21)

Schneider (2011; 2005; 2007) conducted several analyses with reference to HFW in Austria. As shown in the paper "Wasting food: an insistent behavior" (2008), on the basis of two studies conducted in different regions of Austria, almost 30% of food found in the garbage is classified as "preparation residues"[36], which means that 2/3 of food could have been prevented. Her analyses have been conducted over two regions and respectively on 745 samples (with 1,700 kg food) and 478 samples (with 1,700 kg food). Each sample was composed of 220l (samples of 220l were chosen out from bins of 1100 and more).

One of the most interesting researches and data is **Parizeau's** study on households' food waste in Guelph (Parizeau et al., 2015). The methodology used is a waste weighting on a sample composed of 68 households and a questionnaire made to the person most responsible for shopping on the same families. Findings form their studies show that household organic waste production is 4.2 kg per capita, which corresponds to 218.4 kg per capita annually (data 2013). As authors point out, this data is higher than many data estimated through other methodologies: for instance, Statistics Canada (2009) reported a post-retail food waste of 183 kg per person for 2007 as average. With reference to qualitative findings of the study, while some of them are confirming previous studies made by Ventur and Koivupurto et al. (Koivupuro et al., 2012) (Ventur, 2008), others are presented for the first time with a statistical confirmation. First of all, food waste quantities are directly

[36] The classification proposed for the analysis is: preparation residues, which is the equivalent WRAP's "not edible"; partly used food; leftovers; original food.

proportional to food awareness (measured with the interest in healthy food) and waste awareness (measured with interest and attitude to separate collection method). Respondents that show a higher interest in healthy food and recycling/separate collection, waste less. Incidentally, data from WRAP (Ventur, 2008) and Koivupuro (2012) are confirming this hypothesis. Furthermore, a higher level of HFW is recorded among those who eat out more often but spend on average the same amount of money for groceries and those who buy more pre-packaged food, arguably because of a lack of time and planning due to work/unplanned social opportunities/leisure which "*impedes conscientious food planning and preparation, and sometimes led to buying more food than was needed or intended*" (Parizeau et al., 2015, p. 216).

No data are reported on HFW estimated through waste sorting in Italy, at this time.

3.5 A critical review of on HFW data related to survey

As shown from Italian data, there is a considerable oscillation in data on HFW, mainly depending on the way the question is made. In all the other cases, there is a notable convergence on answers that report a low food waste both in qualitative and quantitative studies. If true, those answers would show that people all around the global north do no waste at all or almost at all. Yet, waste sorting and diary studies show different data.

What causes such a difference in estimations of HFW perception? Two hypotheses are proposed: First of all, methodology; secondly, cognitive biases produced by the issue.

In the first case, a slight variation in methodology from a questionnaire to another can be reason of important differences in emerging data. Secondly, if potential cognitive biases are not put under control, they might affect emerging data both for social desirability biases and difficulty in computation. The latter might also depend on the way a question is formulated, other than on the simple difficulty of the required computation, so methodology and cognitive biases are related. Incidentally, while there is wide-accepted awareness about the fallacy of questionnaire as a methodology to estimate HFW (Abeliotis et al., 2014) (Neff et al., 2015) (WRAP, 2007), no data on how much those questionnaires underestimate the real HFW are available, nor the method is put aside due to its uncertainty.

First of all, there is a considerable convergence over a "good-behavior" narrative (also called "positive attitude to food waste prevention" (Abeliotis et al., 2014)) in all the above mentioned studies. When asked whether they waste food and how much, most of respondents answers "a

little", or equivalent answers[37]. Such a tendency in answers might show a truth as well as the presence of a moral judgment on the issue, projected in the answer as predicted by the "positive illusion bias". If considered the cognitive dissonance and all other relevant biases described in the paragraph 2.3.1.1 (such as social desirability bias), we can assume that all answers provided in questionnaires might be biased, revealing a projection of a moral judgment on the issue rather than a real quantity. How to test this hypothesis? It is possible to make a comparison between the self-perceived quantity and an empirical one, where available.

Secondly, when a quantitative of HFW is asked, the difficulty of such a computation might affect the reliability of the answer *per se,* especially if expressed in percentage or euros- since it implies a double computation. Availability bias might affect such an answer, in first instance, since such a computation is composed of many phases. In this case, a worsening factor in terms of reliability could be represented by the multiple choice answer, because of its *anchoring* potential.

In other words, asking such a difficoult task in a questionnaire might lead the respondent to perform a *"simple judgmental operation"* instead of assessing probabilities and predicting real values[38].

With reference to the Italian data, the following analysis provides an insight on the issue.

Waste Watcher Survey (2014): between the 2013 and the 2014, the quantity in HFW increased almost three times (213 gr in 2013 and 560 gr in 2014). Standing to the authors[39], the only methodological difference is in a different measurement provided in the *how much you waste weekly* question. Whilst in the first questionnaire (2013), the question was formulated as following "*How much food do you think you waste weekly? (Consider that an apple is 120 gr on average and a yogurt is 120 gr*)", in the 2014 survey the same question was the following: "*Considering that an apple is 200 gr on average and a yogurt is 120 gr, how much food did you throw away yesterday*?" where the answer was multiplied for seven days. Specifically, the average answer was 80 gr for one day. The same question lead to an average answer of 90 gr, for an average weekly food estimated to be 630gr/hh/week. The question *"how much do you waste weekly*" was still on set in 2015 and lead to an average value of 176.8 gr.

Hence, two important variables might have affected the answer and the quantities as from literature:

1. the anchoring bias, due to the apple weight;

[37] When given scale, the equivalent value such as in Garrone, Schneider, Abeliotis, Neff, Gaiani and Waste Watcher studies.
[38] See the definition of *heuristics* in paragraph 2.3.3.1.
[39] Personal interview, January 2016

2. the timing chosen to express the self-perceived HFW (yesterday or weekly average). By expressing the self-perceived HFW based on one day earlier recalling, the *availability bias* effect might have been mitigated. Though, if in 2015 the same question- just made in two different ways- lead to such a difference in the results (176,8 versus 630), it is also possible to suppose that food waste estimation, with reference to one week, contains a higher judgmental driver than an attitude to perform a reliable computation.

Garrone & Melancini survey (Garrone et al., 2012); (2014). As from the methodology described in their book, they obtained the HFW quantitative result by crossing the purchases of food bought during one week with a self-estimated value of food wasted within the "last month". The question was structured as a close answer, hence some answers were provided.

Closed questions might lead the respondent to an anchoring (most of the respondents declared to waste less than 5%, the first answer available among the possible choices).

Moreover, another critical element is the unit of measure (percentage) that could be possibly confusing as well as the economic value (euros). Those units are not easily evocative of a standardized quantity and the computation required for such an answer is a double computation (1. Recall the answer in the memory 2. Traduce it in percentage). Hence, respondents might be affected by error in computing (such as availability bias, or insufficient adjustment).

In both the cases (Waste Watcher and Garrone & Melancini questionnaires), self- perception show a very low food waste quantity, even confirmed by Gaiani's survey, where more than 50% of the sample declared not to waste at all.

According to the opinion that the respondents have of the issue, cognitive dissonance and many biases (such availability, positive illusion or social desirability biases) might have affected the results by underestimating the real quantitative.

Whether all these variables affect the answers, it can be shown by comparing data gathered through diary study and waste sorting analysis.

3.6 General considerations on literature review

As from the review, a remarkable presence of WRAP studies is recorded. UK based studies, along with researches in Australia, have been conducted by the agency, which influenced the following studies in the methodological choices.

As a matter of facts, there is a difference between HFW quantities revealed by questionnaires and other methods. Though, not many studies over large samples have been conducted through diaries,

while waste sorting analysis showed a heterogeneity of definitions and scope that affected the possibility to compare results effectively.

Notwithstanding, the difference between declared and waste sorted FW suggest that the initial hypothesis is confirmed in available literature.

A synthesis with all results is proposed in the following tables.

	Question	Percentage of FW on purchased food
EC, eu 27	Not reported	- 11%: not to waste at all - 71% answered to waste 15% or less of the purchased food
WRAP 2014	Not reported	- 58% not to waste at all/hardly any
Neff 2015	Not reported	- 13%: not to waste at all - 56%: to discard up to 10% of purchased food
Gaiani 2013	*How much edible food does your family waste in one week, on average?*	- 65% of the sample answers not to waste any edible food - 17% declares to waste less than 250gr
Jorissen 2015	*How much do you think to waste weekly- with reference to EFW?*	- 37% of the respondents of the JRC (139 out of 372) and 28% of Karlsruhe (120 out of 422) stated that they do not throw away any edible food
Garrone Melancini Perego 2014	*Thinking to the last month, how much food you wasted from those you served on the table (in percentage)*	- 70% declared to waste less than 5% - 3% of the panel declared to waste more than 15%

Table 2- Self perceived FW, qualitative

	Question	Weight (national)	Weight (gr/HH/week or gr/pp/week)
Jorissen 2015	*How much do you think to waste weekly- with reference to EFW?*	- Germany: 597,000 tons/year - Italy: 408,000 tons/year	- 140 gr per person/week in Karlsruhe - 127 gr per person/week at JRC.
Waste watcher 2013	*How much food do you think your family waste weekly, on average?*		213 gr/hh/week
Waste watcher 2014	*How much food did you waste yesterday?*		560gr/hh/week (80 gr a day)
Waste watcher 2015	*How much food did you waste yesterday?*	- 806 281.454 tons/year	630 gr/hh/week (90gr a day)
Garrone Melancini Perego 2014	*Thinking to the last month, how much food you wasted from those you served on the table (in percentage)*	- 2 513 500 tons/year	

4 Setting up a combined methodology: the experiment

Households' food waste is supposed to be the higher value in the food chain, as shown in the second chapter. Though, most of the existing studies estimated its value by survey, which is a highly uncertain tool when it comes to estimating data related to behavior. As previously shown, questionnaire is an uncertain tool if used to estimate behavior socially blamed or judged as negative, and food waste could be labeled as a negative behavior (WRAP, 2007). So, while on one side there is a need for new data on households' food waste, on the other side a more proper methodology to collect them is highly recommended. As from the previous chapter, Italy HFW estimation has been computed only through questionnaires (Waste Watcher, 2014) (Gaiani, 2013) (Garrone et al., 2012) or statistics (Azzurro, 2015), (Monier et al., 2010).

A review of the studies has been proposed in the second chapter, with diversified methodologies. Conclusions emerging from the existing analysis suggest that the most reliable methodology to quantify food waste is waste sorting analysis or simple separate collection weighing. They are considered as the most reliable methods since they are not affected by the self-indulgence effect, by any influence made on the unit or by any carelessness in data reporting (see paragraph 2.3.3 for the list of cognitive biases). On the other side, the waste sorting is not able to provide the reasons why the food is wasted, nor it is always possible to understand it through a simple analysis, due to the degradation of food (sometimes, the analysis is made 5 or 6 days after the meal consumption, so it is hard to detect the reasons that led the unit to throw the food away). Moreover, it does not catch any food discarded out of the bin (sink, pets, etc.).

Perhaps, the most complete way to analyze both quantities and drivers of the food waste at a national level could be a mixed method that contains the advantages of the diary study (a deepen qualitative analysis of the reasons) and an audit phases to record a reliable value of the wasted quantity.

This is what the present pilot experiment purposes.

In the next chapter, a complete description of all the steps follows.

4.1 Creation of a combined methodology: two phases

4.1.1 Purpose, scope and boundaries of the experiment

The experiment aims at creating a methodology for the quantification and analysis of the households' food waste in Italy.

It is built starting from the literature review that shows a predominance of three methods: questionnaire, diaries and waste sorting. The literature review started with the analysis of pros and cons of any method; then, an analysis of data emerging from the existing studies followed.

Finally, a mixed method has been tested and proposed, in a pre-test and a pilot phase. The final methodology aims at reducing the cons of the three methods. Furthermore, an analysis of reliability of the three is made- such as the reliability of self-perception detected through questionnaires, the redemption of the dairy studies, the pros and effectiveness of the garbage sorting (*for more details on literature findings, see chapters II and III*).

4.1.2 Methodology

The experiment is composed of three steps, partially close to the methodology adopted by WRAP in different studies (for a comprehensive synthesis, see (WRAP, Household Food and Drink Waste in the UK 2012, 2013)). As WRAP's experiment, it is mainly focused on the results given by a diary study and it is preceded and followed by questionnaires. Questionnaires had the double aim to inquire into:

1. Habits related to food shopping, storage, cooking and management of waste, leftovers, expiration date
2. Perception and self-perception of food waste as a general issue and as an issue affecting the family; self-perceived quantity of weekly food waste

An auditing phase has been conducted on a sub-sample, through a waste sorting analysis. The auditing by waste sorting has been primarily aimed at estimating the difference in FW quantity between the questionnaire, the diary and the garbage. Secondly, it has been performed as a pilot test for a following experiment, whether its effectiveness would be confirmed.

While for the pre-test a sample was selected through snowball methodology and a radio call, the pilot test was based on a random sample (no segmentation applied), except from a geographical selection and some exclusion parameters, namely:

- The sample had to be located in Bologna, out of the centre (for waste sorting logistical needs);
- it had to be based on the same waste collection system (since collection method is considered as a variable that can influence food waste production, from literature);
- it had to be included in the SWG panel (so that respondents were easier to be reached and rewarded);
- it had to be composed of 30 units. Substitution was not included at this stage of the experiment.

More details on each single methodology are provided in the following paragraphs.

Two statistical tests (Paired t-test of equality of means and Wilcoxon matched- pairs signed-ranks test) have been performed on the final results (the difference between means Questionnaire/Diary, Diary/Sorting, Questionnaire-Sorting), to confirm the hypothesis that they were actually different ($(\mu_q = \mu_d), (\mu_d = \mu_s)(\mu_q = \mu_s)$ were all refused at 5, 1 and 10 %).

The Wilcoxon test has been chosen since the final sample was composed only of 20 units and no info about the distribution was available, while two important outliers were recorded.

4.2 The pre-test phase

4.2.1 The pre-test format

In the pre-test phase, a diary format was tested[40].

As anticipated, the reference for the present experiment was WRAP's 2012 work (WRAP, 2012).

The first ten pages contained instructions on how to fill the diary, a privacy statement made by SWG and University of Bologna, a page with the request of personal data, divided in three sections:

1. Contact information: name/surname/address/ phone number/email.
2. Family information: nr of components over 18 years old/nr of components between 11 and 17 years old/ nr of components under 10.

[40] The format of the pre-test diary is available in the chapter "appendix" (SPECIFICARE), while a similar version, in English, is available at the link http://www.wrap.org.uk/sites/files/wrap/Kitchen-Diary-2012-Final-Low-Res.pdf (WRAP, Your Household's food and drink waste diary (24th 30th May 2012), 2012)

3. Family employment information: Full time workers/part time workers/self-employed/unpaid/students/homemaker-housewife/retired/unemployed (looking for job)/ long term sick- disabled/other

The section to be filled was composed as following:

- Open answers:

1. What did you throw away? (product with brand name, where possible)
2. Why did you throw it away?
3. How much did you throw away? (how to estimate in the instructions)

- Closed answers

1. Way of disposal (mixed garbage, humid fraction garbage, sink, pets, other)
2. Type of product (frozen, tinned, fresh, takeaway, home-made)

A separate tick was dedicated to "out" meal. Meals consumed out of home were not to be included, while food bought and consumed at home was (so, take away was, while lunch at the canteen was not, as well as dinner consumed at restaurant. Though, indication about it was required). At the end of each day, a separate box was available to note any exceptional circumstances that could have affected the consumed or wasted quantity of the day (illness, parties, etc.).

A last page for free comment concluded the format.

At this stage, the diary had to be printed, filled and sent to SWG, at a given address.

4.2.2 The pre-test timing and sampling

The first pilot (pre – test phase) was developed during the week 9th -15th of February, 2015, by an open call for volunteers launched on a radio show broadcasting on the national channel (radio 2) and, lately, by a snowball sample. The pre-test was aimed at testing the instructions and the data collection format.

This part of the experiment was exclusively aimed at testing the model and it was completely free of charges for the university. Participants were asked to print their own diary - available for the download on Last Minute Market website- and to send it to SWG at their own expenses. The diary was available three days before the experiment would start- the communication management was independent from the researchers as well as the radio call for volunteers. On the other side, a

snowball was managed by the researchers: the initial subject was an environmental –sensitive subject (member of pro- environment associations', etc.), which was asked to spread the web link to people possibly interested to attend the experiment.

The result was a sample composed of 14 families. 9 families answered to the radio call, 5 families were reached through snowball. While the snowball sample showed an affecting bias due to certain characteristics of the units- such as a predominance of a high education degree and an earlier familiarity with the topic- the radio sample was more heterogeneous, except for a common strong interest in the topic. Among the boundaries of this phase, hence, there is a clear self-selection of the sample. Though, it was very helpful to modify the format and the instructions, even if number of participants were low at this stage.

In the next paragraph, the two instructions prototype and the diary format will be commented.

4.3 The pilot test

4.3.1 The pilot test format

Format of the pilot test was slightly modified from the pre-test phase.

While the main structure remains the same (personal data, instructions and dairy to be filled out), some important variations have been applied.

1. Two different tables were built at this stage (edible/possible edible and NOT edible) front / back of the page, for each meal, every day *(see appendix*).
2. Also, the second pilot started on Wednesday instead of Monday, so that any lack of information due to an increased carelessness would have not affected the week-end. From literature (WRAP, 2013) and pre-test, we assumed that the week-end could have provided different information from the working days.
3. Instructions were improved in the "how to" section, with more detailed specifications and a dedicated section on "how to report food in packaging".

Diaries were printed and sent to the participants by the University, with all the necessary material to allow the return of the diary, once it had been filled out.

4.3.2 The pilot test phase timing and sampling

The second pilot was conducted during the week 17th -26th of June, 2015. At this stage, the experiment was composed by a mix of the three methods, as the final one will be: two

questionnaires sent online to the panel, at distance of two weeks each from the diary week (one pre and one post experiment, to record any self-perception variation of FW), the diary study and a waste sorting analysis that involved a sub-sample of 14 families.

The first questionnaire was sent to 97 units located in Bologna and province, among which we made a selection based on the logistical needs for the garbage sorting analysis. The sample did not intend to be representative at this stage either, so we selected some families whose location answered to our logistical needs.

The result was a sample composed of 30 units, located in the first periphery[41] of Bologna. From this final panel, we received back 27 diaries (2 units just drop off the experiment during the first three days while one diary was never returned to university).

The sample was selected only on logistical needs of the research; hence, socio-demographical characteristics were not taken into account for the selection.

The result was a sample with the following features (age, education and composition of the household expressed per unit):

[41] First periphery: it is an area also defined as "semi-central crown" and it is not inside the medieval walls that enclose the centre of the city. We did it for logistical needs of waste collection, yet also because some areas of the centre are covered by an experimental waste collection management.

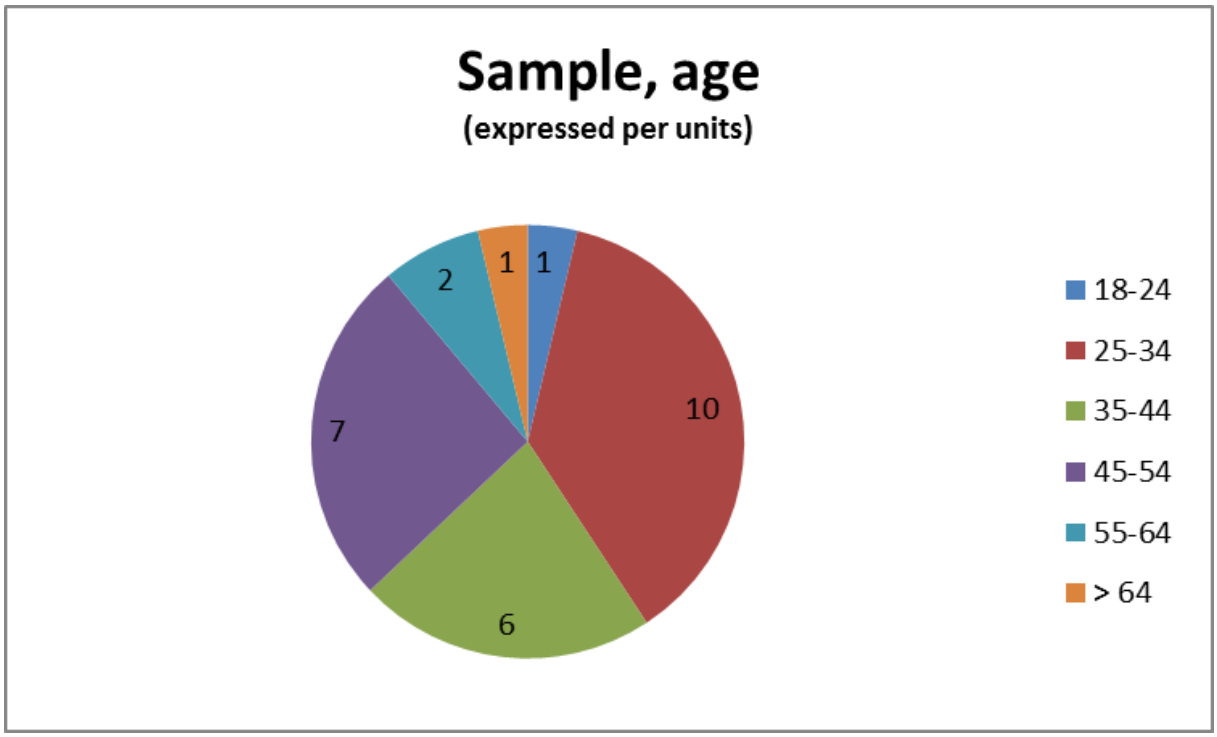


Figure 7 - Composition of the sample (age)

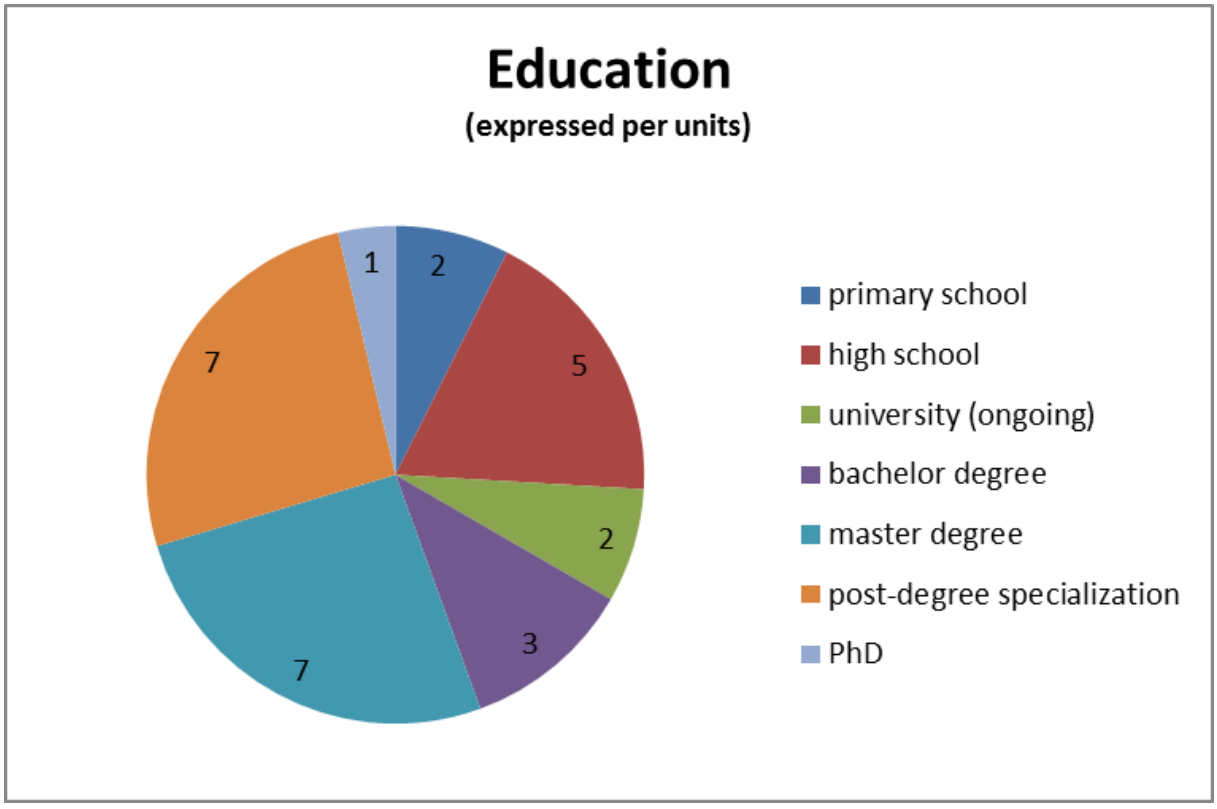


Figure 8 - Composition of the sample (education)

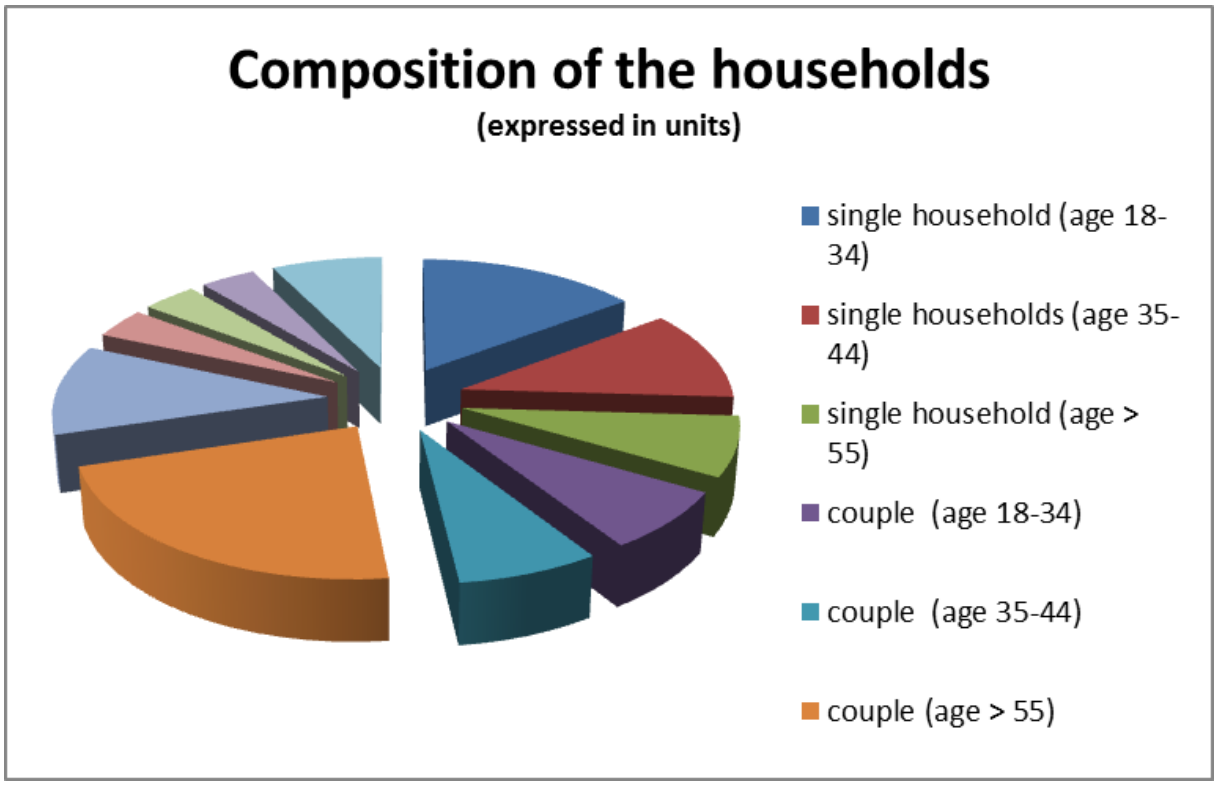


Figure 9 - Composition of the sample (nr. of components of the households)

Among them, 20 units were pre-alerted with a phone call to have been selected for the waste-sorting. 14 were actually audited. At this stage, the sample was provided by SWG[42].

This second pilot was useful to improve the methodology and the instructions and it showed some details that will be corrected in the final version- such as some influence on the respondent made by the question that could have led to confirmation biases. Hence, in the final version the two questionnaires will be slightly updated as well.

Moreover, the second pilot provided an idea of budget estimation related to the experiment, since at this stage respondents received a reward at the end of the experiment.

With reference to data, the second pilot was able to give back an answer to the research questions: the difference in average resulting by the three methods confirmed an important difference between self-perception and produced food waste, even in those subjects that showed a higher self-confidence to face the issue.

[42] SWG is a research and survey center that started analysis on households food waste trough survey three years ago, supported by the University of Bologna and Last Minute Market. SWG helped with some statistical elaborations and with preliminary analysis of the cognitive biases, too.

Data will be discussed in chapter 6.

4.3.2.1 Evidences from the analysis of the first format and changes for the second format

The first format has been meaningfully revised after the pre-test.

First of all, a revision of all the terms that could have affected the respondent has been made. Words as "spreco" (waste) and pictures were deleted after the pre-pilot (p.20) or, in alternative, their use were reduced as much as possible. An Italian synonym for the word spreco would have been used if found: yet, no convergence was found on a more proper synonym. After the second pilot, an agreement on the word "rifiuto" will be found, even if it's not exempt of a negative judgment in the specific case.

Moreover, since data emerging from diaries underlined a predominance of *not edible food* (peel, bones, etc…) and a very low level of food waste. Participants were particularly careful of food and food consumes, so they apparently did not waste any or almost any edible food. To interpret this phenomenon, we formulated two hypotheses:

1. Expected hypothesis: the *self-selection* affected the sample, so that most of our participants did not waste food almost at all- because they have high environmental sensitiveness or they are devoted to food justice, food ethics, etc…;
2. Alternative hypothesis: The way the format was built (just one slot for the wasted product with no distinction between "edible" and "not edible") encouraged people to write something to fill the slot, at least once a day, as the easiest/quickest option. For example, a redundancy of "banana skin" or "tomato stem" has been recorded. We assumed that another possible explanation could be *under-reporting* due to laziness, lack of motivation (there was no reward at this stage and no auditing), presence of many family members that did not record their waste, etc.…The assumption was related to the doubts that have been reported by Wrap in relation with the cost-effectiveness of the diary study, related to the difficulty in the diary completion along the entire week (WRAP Q. T., 2009). We analyzed also the flow of answers during the week and verified a slight reduction in the answers' rate in the last three days, which corresponded to the week end.

At the end of the diary, the section "free comments" suggested that our first hypothesis was highly probable, since most of our participants told us about their love for food/ environment/etc., sometimes even suggesting useful modifications to the format. Moreover, we know that attending

the pre-test required much efforts- since the costs were up to the voluntaries themselves. One of the cases suggested us to insert "urban garden" as an option among the shopping habits, for example. Other units have an employment in the environmental protection sector. Besides, a difference between the radio sample and the snowball was recorded in terms of FW quantity, since the snowball sample seemed to record more edible food waste. Data are not reported at this stage.

4.3.2.2 Data collection

4.3.2.2.1 Questionnaire, diaries and sorting waste

In order to fill the questionnaire, the respondents have been given two weeks each.

The first questionnaire was sent by email with instructions regarding the entire experiment and the consent to the elaboration of personal data. Privacy on the elaboration of personal data has been guaranteed by SWG.

The questionnaire was composed of 27 questions, inquiring into:

1. Households' meal preparation habits & Food Shopping habits (Q 1-13)
2. Management of surplus food, leftovers (Q 13-16)
3. Food waste issue: perception, efforts to reduce it (Q 17-23)
4. Eating out (Q 24)
5. Food perception: health and environmental implications (Q 25-27)

Since CAWI method was chosen, a first sample of around 100 respondents was chosen in Emilia Romagna region for the pre-diary questionnaire. Lately, 30 families were chosen for the following steps of the experiment.

Two days before the diary experiment started, a phone call to 20 families was made, in order to alert that they had been pre-selected for the auditing. In this case, we alerted the families about the hours (6.30-8.30 pm) and we asked them not to throw the garbage away before 8.30 pm.

At this time, we asked our respondents not to change their usual behavior in throwing the garbage away except for the hour (so, we asked not to change frequency or collecting method[43]). Our choice was aimed at influencing our panel less as possible, yet it was a risky decision with reference to the

[43] On a couple of times it was a problem, since the family had thrown the garbage away "just the night before" we came.

experiment itself, since we had just a few units and substitutions were not possible due to logistical constraints[44].

The auditing phase was developed as following: one car was available and the collection was planned two hours per night, so fixed trajectories were planned in advance (one per night) that would have covered all the respondents' houses to be audited. The total number of trajectories was 5. There were from three to five units per night. Starting from Sunday (the fifth day), we planned to insert the re-collection from some of the units, too.

The research group at this stage was composed of three people.

At this time, our logistical needs were mostly related to the location of the households in the city and to the waste collection method (out of the historical centre/ with no special collection method). We needed places easy to be accessed by car and we wanted a unique waste collection method into the panel, since we assumed[45] that it could be a factor of influence in the waste production and could influence the level of awareness of the issue.

Hence, in the end we selected the semi-periphery of the city of Bologna with a standard collection method, which consists in public garbage bins for the recyclables (paper, plastic and glass), close to humid fraction bin and the unsorted bin.

The garbage was collected during the indicated hours and it was carried to the laboratory to be sorted the following morning.

Both the unsorted and the humid fraction were collected, wherever possible. If the unit did not make a separate collection, only the unsorted was taken. As soon as the unit's garbage was put in the university waste collection bag, it was signed with a numerical code that represented the order of collection (starting from one) and was associated to a family. A blinding procedure was guaranteed as the experiment started and it was more important at this stage. Moreover, the units were asked when they threw the garbage bags away last time: the answer was recorded in order to be able to compare findings with information provided by the same units in the diaries.

[44] With regards to the representative sample, it will be possible to discuss this methodological choice. Otherwise, it will be necessary to fix two dates in advance (when the garbage could be thrown away), in order to be sure about the collection. This choice is highly variable and mainly depends on the financial budget: if there is availability, the first option is mostly recommended since it allows not influencing the unit in its usual behavior.

[45] This consideration emerged during the visiting period at Guelph University, where Kate Parizeau (Parizeau et al., 2015) was conducting a similar experiment at its second year.

Every night, the bags were left at the lab to be analyzed the following morning.

The second questionnaire is composed of 21 questions, focused on the self-perception of food waste after the experiment, on the garbage collection method of the family, of the behavior during the week of the experiment with reference to food waste and reporting.

4.3.2.2.2 Auditing (garbage sorting)

The sorting was repeated every morning after the collection, for one week, by two researchers. Since the units were less than six per day, analysis took around three hours per morning.

Tools for the analysis were:

- ✓ A precision scale (electronic)
- ✓ Safety clothes (mask, glasses, gloves, helmet)
- ✓ Pc (connected to wifi and with Office/excel)
- ✓ Camera
- ✓ Block notes and desk tools.

Each garbage bag was emptied, sorted, analyzed, weighted and results were reported on an excel file. A picture to each unit's garbage (for family/code) was taken, to allow later analysis in case of need.

The length of the analysis gradually decreased through days. The last three days, it required around 20 minutes per family. This could be the average time per unit for this analysis.

As the garbage was not referred to the entire week, yet it was referred only to two or three days on average, the analysis was possible even considered all the logistical constraints. Each single product was recorded on the excel file, with info about weight, way of disposal (mixed garbage/ humid fraction), conservation state (presence/absence of packaging). A comparison with information reported in the diary for the same days has been done in a following stage.

In order to get an average of the food wasted along one week through waste sorting, a daily average have been estimated for each unit (from data gathered) and multiplied for seven days. Limits of this method are evident: apart from the possible variations due to meals and days, for some of the units the value of FW produced at lunch has been used as reference for standard food waste for meal. Such a data could be possibly different from the one of the dinner, where all components of the

family are more likely to eat at home- this assumption was easily confirmed since our sample was composed of few units, hence it was possible to analyze case by case. Though, it is possible to assume that, where the waste sorting just catches data for a lunch and this data is used as a reference for the estimation of FW during one week, it could be underestimated as well.

5 Results

5.1 Presentation of the chapter

In this chapter, data are going to be presented.

In the first paragraph, methodological findings will be presented, with the reasons why some diaries were invalidated.

The section "results" will show data (aggregated data). A synthesis of the main data is shown at the end of the present paragraph.

Then, each comparison between aggregated data is reviewed separately. Hence, the difference between questionnaire, diary and waste sorting will be shown with reference to the overall sample, then the sub-sample A, and also with reference only to EPEFW and Fusions definition.

The *matched-pairs t-test of equality of means (two samples) with equal variances* has been performed for each couple of data (questionnaire to diary, diary to auditing, questionnaire to auditing). Since the units are few (20 valid units) and we cannot assume they are distributed as a Normal, a *Wilcoxon matched-pair signed- ranks test* has been performed lately. Statistical significance tests are available at the end of the chapter (see paragraph 5.4.7).

With specific reference to waste sorting, two data are available: data referred to effective waste sorting (which was collected with irregular timing, corresponding to 1 to 5 days) and weekly estimation (daily average estimated on effective quantities, multiplied for seven days). Yet, these data were available only for the sub-sample involved in this phase of the experiment.

5.2 Synthesis of most relevant data

As an introduction, the most relevant data are reported with reference to the sub-sample involved in the three phases (A), as an answer to the first question: Does questionnaire under-report HFW effective quantity?

Sub-sample A is the group 1-14, who attended the auditing phase.

Sub-sample B is the group 15-28, who was not actively involved in the auditing phase.

Subsample A, weekly average per household

1. EPEFW quantity as from questionnaire (self-perceived): 334.16 gr/hh/week (AV, effective)
2. EPEFW quantity as from diary (self-reported): 818.25 gr/hh/week (AV, effective)
3. EPEFW quantity as from waste sorting: 1058.4 gr/hh/week (AV, estimated)

Subsample A, weekly average per capita

1. EPEFW quantity as from questionnaire (self-perceived): 187.01 gr/pp/week
2. EPEFW quantity as from diary (self-reported): 486.79 gr/pp/week
3. EPEFW quantity as from waste sorting: 626.58 gr/pp/week

Overall sample, weekly average per household

1. EPEFW quantity as from questionnaire (self-perceived): 488.45 gr (AV, effective)
2. EPEFW quantity as from diary (self-reported): 1034.5 grams (AV, effective)
3. EPEFW quantity as from waste sorting: NA

Overall sample, weekly average per capita

1. EPEFW quantity as from questionnaire (self-perceived): 232.40 gr (AV, effective)
2. EPEFW quantity as from diary (self-reported): 526.41 (AV, effective)
3. EPEFW quantity as from waste sorting: NA

The percentage of EPEFW, as from diary, over one week and on the overall sample:

EPEFW= 40.6% of the total value (liquid waste and food given to pets included)

EPEFW Liquid waste= 465 gr (sum)

5.3 Methodological findings

First of all, a different approach to the experiment has been shown among participants, especially between those who were part of the auditing and those who did not. Apart from generic differences in the weekly food waste produced (sub-sample B wasting more than sub-sample A in diary), the redemption of diaries were higher in the first group.

A proper compilation of the diary has been assured by the awareness to be potentially "checked" by the auditing: on the overall sample, sub-sample A had been previously contacted to agree a set of days for the researcher to collect their garbage. They were contacted by a telephone call or more than one, in case they did not answer. Some of them agreed the exact day to be home, others were asked to indicate a set of availabilities during the week. Comparing the results between the group A (audit, unit 1-14) and the group B (only diary, unit 15-27), the possibility of being checked influenced the unit's behavior in the proper compilation of the diary (and the meticulous analysis of the instructions) as follow:

- **Group A, unit 1-14 (included in the audit): 12 diary properly filled out**
- **Group B, unit 15-28 (not included in the audit): 8 diaries properly filled out**
- **3 units quit the experiment (two units contacting the researcher the first day, one never sending the diary back)**
- **Overall proper compilation of the diary: 20 diaries**

A brief explanation on what it is meant to be a "proper" compilation of the diary is necessary. It mainly consists in providing the researcher the exact amount of food waste, the reason to throw it away, the way of disposal or, in alternative, some inputs that allow the researcher to estimate this information. As in the instructions provided in the material sent to the families, the right way to complete the diary was composed of four main phases:

1. Writing down which kind of food product is thrown away in "edible" or "not edible" table for each meal. Possibly, write down details of the products (brand, quantity), in order to allow an economic estimation of the phenomena.
2. Reporting the weight obtained by a precision scale (whether possible) or other common kitchen objects (a cup, a spoon, a glass) or, as a last chance, using the unit ("one apple", "half orange", etc…), always to be reported without packaging.
3. Reporting the reason why the food had been thrown away with details (not only "mold", but also description of what seen and felt).
4. Reporting where it has been thrown away (separate collection, sink, unsorted garbage, given to pets)

Among the most common mistakes not invalidating the diaries, there is the systematic under-reporting of the brand and other product information- size, brand, etc… so that the economic estimation was not possible (only the 12% of the respondents did it properly).
A second mistake consisted in writing down all the food products in one table- "edible", which was the front page table. Instructions on how to complete the tables were clear on that, yet this result suggest that the request is not user-friendly.
Instead, among the most common mistakes invalidating the diary, packaging and no weight at all were the two most on the top of the list.
A detailed review is proposed in the following paragraphs

5.3.1 Invalidation of diaries: sub- group A

In the group A, only 2 units showed a sensitive lack of information (unit 7 and 13) that led the researcher to invalidate the diaries.

Unit 7 showed a peculiar feature that invalidated the entire diary. It was inserted in the 1 group of auditing (first three days of checking), where units were asked to provide availability on many dates without establishing the exact one earlier (hence, the checking was meant to be not predictable for the unit itself). On the third day of checking and of the experiment (nobody showed up the first and the second time), the unit delivered the garbage but declared that the dairy had not been filled out at all, yet. When the diary was sent back to university, the first three days had been compiled but there were not any similarity with the products found in the garbage. In the days 4, 5, 6 and 7, presence of packaging and lack of weight were recorded for most of the food products. The diary was invalidated.

Unit 13 showed the presence of 4 mistakes that led the researchers to invalidate data. The reason why all mistakes has shown up in one single unit is that the respondent does not properly speak and read Italian – which is something to take into consideration when the experiment will be extended to a national representative sample that includes more than one unit representative of the foreign-speaking population.

5.3.2 Invalidation of diaries: group B

In group B, ten cases have been invalidated for a sensitive lack of information, in first instance. Some of them were recovered- namely, those who properly filled the diary but reported no personal info on the first page.

Almost all units that reported some mistakes in the compilation actually reported more than one mistake each.

- Three units abandoned the experiment before the end of the week- two of them contacting the researcher earlier (units 28, 29 and 30).
- While one unit reported packaging instead of food (unit 16), unit 26 reported packaging and food weighted together.
- Three units did not report the quantity of wasted food anyhow.
- Four units did not report the weight using the suggestions given in the dairy, yet they most often used “piece”, “slice” and “a little” as unit of measures for all the food.

- In the end, four units did not report their name on the personal data page even if they had given their previous consent.

5.4 Data

5.4.1 The difference between garbage weight between sub group A and sub group B

As reported in the methodological description, the hypothesis that the auditing phase influenced the behavior of the sub-sample A needs to be explored.
Data relative to the garbage of the 2 sub-groups are the following:

Group A, unit 1-14 (included in the audit)

(29 members, 12 units):

- Sum, EPEFW, Diary = 9 819 grams
- Average per household, EPEFW, Diary = 818.25 grams
- Average per capita, EPEFW, Diary = 338.59 grams

Group B, unit 15-27 (not included in the audit)

(19 members, 8 units):

- Sum, EPEFW, Diary = 10 871.4 grams
- Average per household, EPEFW, Diary = 1 358.92 grams
- Average per capita, EPEFW, Diary = 572.17 grams

5.4.2 Respondents' under- estimation of HFW in questionnaires if compared to diaries

This question is the starting point of the study, since all existing data on households' food waste have been calculated on the basis of interviews and so, self-declaration and self-perception. Hence, in the choice of the best methodology, both the errors of under-estimation and under-reporting have to be evaluated, in order to be possibly avoided (or reduced). The experiment answers to this question by comparing the amount of food waste obtained through the three methods.

The first comparison is between the post-diary questionnaire and food waste data reported in the diary. The sample, at this time, is composed only by 20 units, since some units have been invalidate for the above-mentioned mistakes. Self-perceived food waste data emerging from the questionnaire

2 (question 10), and diary's data are compared. In the second case, both definitions of food waste (EPEFW and Fusions') are considered.

In the question 10, the respondents were asked to answer if they had realized to waste less, the same amount or more food thanks to the diary experiment.

If considering the **overall sample (20 U),**

- 50% answered to waste the same amount they expected to;
- 25% answered to waste a little bit more;
- 20% answered to waste a little bit less than they expected to:
- 5% answered to waste lots less than they expected to.

When the **Group A** was asked the same question, the following answers were provided:

- The 41.6% declared to waste the same amount they expected to;
- The 25% answered to waste a little bit more;
- The 25% answered to waste a little bit less than they expected to.
- The 8.3% answered to waste lots less than they expected to

On the contrary, by comparing data of the overall sample (sum of the EPEFW gr/hh/week and the quantity declared in the interview expressed in gr/hh/week), data are the following:

- 80% declares to waste an amount of food inferior to the effective sum of the edible food waste self-reported in the diary
- 20% declares a superior amount of food waste

As a general conclusion on the first comparison of answers, it emerges that both the groups are not aware of their weekly food waste, except for the 25% that realized to waste a little bit more than expected. Though, data has shown that the quantity of weekly food waste declared and the diaries'/audits' are still far from each other.

Details about the quantitative difference among interviews, diaries and audits are provided in the next paragraphs. The statistical significance of the measurements is tested through a paired sample hypothesis testing between:

1. the questionnaire and the diary,

2. the questionnaire and the sorting and
3. The sorting and the diary results.

5.4.3 Respondents self-estimation of HFW expressed in euros

As from literature (Tversky & Kahneman , 1973) (1974), it is possible that a double computation might not be the most reliable method to gather data on frequency and behavior. If considered that the behavior inquired into the present work might be affected by social desirability bias (Grimm, 2010), it can be assumed that such a data might reflect too many biases instead of an effective and reliable computation. This is actually what happened with the question:

"*How much do you waste, monthly (in euros)*?" (questionnaire 1) and (questionnaire 2). The question was an open-answer one.

For instance, **four units** declare they realized to waste a little bit more than thought before the experiment. Then, the economic value declared in all the mentioned cases is incoherent with their statement. All of them, in fact, lowered the value of economic FW in the second questionnaire, sometimes in a meaningful way. For example, in the second questionnaire unit 5 declared she realized to waste a little bit more than thought, then answered to waste 40/50 euros a month for food waste. In the first questionnaire, she answered to waste 100 euros/month. The same tendency has been recorded for the units 6,9,22, even though with lower differences.

Among the **nine units** who answered B (I realized to waste about the same amount I thought before the experiment) four units confirmed the same (or similar[46]) answer in the quantitative question. Five of them gave different values, some of them a higher one (for example, one unit declared 50 euros in the second questionnaire while 30 in the first), while others a reduced value (unit 15 declared to waste 10 euros a month in the first questionnaire, while 1 euro in the second).

Among those **(five units**) answering to waste a little bit less than imagined before the experiment, only 1 gave an incoherent value (before: 10 euros/month; after: 50 euros/month).

One unit (unit 2) answered to waste meaningfully less than thought before the experiment; then, the economic value of monthly waste provided in the second questionnaire was 30 euros a month, while the first was 20.

One unit did not answer the question in the second questionnaire.

If considered the total value, 11 answers over 19 are incoherent.

[46] We considered as "similar" a value +/- 5 euros.

5.4.4 Does questionnaire methodology underestimate the diary estimation?

As shown, preliminary data suggest that families are not aware of their weekly food waste, so they tend to underestimate their food waste when asked about it, due to many reasons.

Yet, how much do they underestimate?

Overall sample (20 U)

On the overall sample (20 units), the average amount of EPEFW reported in the questionnaire is 488.45 gr per week per family, with a mode of 500 grams and a median value of 300 grams. Instead, the average amount resulting from the **diary** is 1034.5 grams per week per family, with a median value of 644.0 grams. Considering the Fusions definition, self-declared food waste through diary method is around 2600 gr/hh/week.

Overall sample (20U)	Questionnaire	Diary	Audits (waste sorting)
EPEFW *(gr)*	488.45	1034.5	NA
Fusions' definition *(gr)*	NA	2600	NA

Table 3- Overall sample, Questionnaire and Diary values (average/hh/week)

The Wilcoxon matched-pairs signed-ranks test gives back the following results:

$H_0: \mu_1 = \mu_2;$

$H_1: \mu_1 > \mu_2$

Where
$H_1: \mu_1 > \mu_2$ is confirmed at 5%.

Group A (U 1-14)

Unfortunately, auditing data are related to 12 units on 20, hence the comparison among the three data is made on the group A only.

Group's A weekly *EPEFW* average, declared in the questionnaire, is **334.16 grams** per family while the diary average is 818.25 gr per family per week. Hence, the questionnaire underestimates the self-reported diary value of the 59.16%. Comparing the self-perceived amount of food waste with the one declared in the diary, a (statistical significant) difference has been recorded. The

hypothesis that the questionnaire underestimates the value of self-recorded weight of 52-59% seems to be confirmed.

If considered the Fusions definition, diary average is 2426 gr/hh/week on 12 units.

Group A (12 U)	Questionnaire	Diary	Audits (waste sorting)
EPEFW *(gr)*	334.1	818.25	NA
Fusions' definition *(gr)*	NA	2426.1	NA

Table 4- Sub-sample A, Questionnaire and Diary (average/hh/week)

5.4.5 Respondents' under- estimation of HFW in diaries if compared with auditing

The theoretical assumption is that the diary method underestimates food waste due to self-correction and under-reporting for the over mentioned reasons. Over 28, 16 units answered that they had reduced their food waste due to an increased attention to the issue during the week of the experiment (questionnaire 2, question 2).

As a matter of facts, there is a way to estimate the difference between diaries and sorting waste. The comparison between diary data and auditing in the garbage bin has been performed, even though the limits of the sample need to be considered carefully and many assumptions have been made to auditing data (data from auditing have not been collected for the entire week but just for some days).

In order to show the quantitative difference, the most reliable comparison is between the exact EPEFW data emerged by auditing and the one recorded in the diary along the same amount of time, which is not weekly but it varies unit by unit.

While the audit gives a sum of 3973.5 gr and an average of 331.2 gr, the diary gives an amount of 3225 grams as sum and 268.7 as average in the same period of time. **Standing to this data, diary underestimates auditing data of 19%,** including drinks and food given to pets**.**

EPEFW, group A	Questionnaire	Diary	Audits (waste sorting)
Sum *(gr)*	4010	3225	3973.5
Average *(gr)*	334,1	268.7	331.2

Table 5- Overall sample, Questionnaire and Diary values (average/hh/t5)

Next data have been built by estimating an audited daily average and its correspondent weekly one, on the basis of available data.

Considering data emerged by auditing and the attempt to have a weekly set built on them, we know that weekly food waste as for Fusions' is 32 717 gr/hh/week (sum) and its average is 2 726.34 gr/hh/week, while the same data in the diary is 29114 (sum) and 2426.16 (average). In this case, diary shows an underestimation around 11% in comparison with auditing data. In case of weekly auditing EPEFW, sum is 12700.8 and the average is **1058.4 grams**. Diary shows data as following: average **818.25** gr and sum 9819 grams. Hence, considering only EPEFW, underestimation of the diary if compared to audits is 22%.

Group A (12 U)	Questionnaire	Diary	Audits (waste sorting)
EPEFW *(gr)*	334.1	818.25	1058.4
Fusions' definition *(gr)*	NA	2426.1	2726.3

Table 6- Sub-sample A, Questionnaire, Diary and Waste sorting values (average/hh/week)

5.4.6 Respondents' under- estimation of HFW in questionnaires if compared with auditing

Since we know that the declared value of HFW is 334.1gr/hh/week (average on 12 units), while 1058.4 gr is the audit weekly average of **EPEFW,** the under-estimation of the questionnaire is 68.5% on average. A synthesis of mentioned data is available in the following tables.

EPEFW, group A	Questionnaire	Diary	Audits (waste sorting)
Sum *(gr)*	4010	3225	3973.5
Average *(gr)*	334.1	268.7	331.2

Table 7- Sum and average of main data (Q/D/WS) on sub-sample A

In this case, value are expressed in gr/hh/per t= 0.5 <x<5

Data auditing for one week is 2726.34 gr (average on 12 units, Fusions def.).

5.4.7 Statistical tests and synthesis of data

Data suggest that EPEFW underestimation between questionnaires and diaries/audits varies as following:

- *Underestimation between Q and D = 52.7%<x<59.2% (where the sample varies between 12 and 20 units)*
- *Underestimation between Q and A= 68.5%<x<NA (overall sample)*

Group A (gr)	Questionnaire to diary	Diary to auditing	Questionnaire to auditing
EPEFW	59.2	19<X<22.69	68.5
Fusions definition	NA	11	NA

Table 8- Underestimation among HFW estimated with different methodologies (in percentage): synthesis

In this case, values (average) are expressed in percentage and only for the group A. X is included between 19% (descriptive value) and 22.69% (assumptions value).

On the other hand, diary underestimates auditing value as follows:

- *Underestimation between D and A= 19% <x<22.69% (depending on the assumption made on available data)*

Also, standing on Fusions definition of food waste, data varies at a higher value, but those will not be considered as reliable since the questionnaire just asked about edible food waste ("spreco alimentare").

On the basis of the above mentioned differences recorded among HFW data estimated through three different methodologies, a Paired T-test of equality of means and a Wilcoxon matched pair test have been performed. The hypothesis $H_0 = 0$ (the means are equal) has been refused in all the three cases.

Pairs	**Paired T-test of equality of means**				**Wilcoxon matched-pairs signed-ranks test**			
	H_0	**H_1**	**p-value**	**decision**	**H_0**	**Z**	**p-value**	**decision**
questionnaire-dairy	$\mu_q = \mu_d$	$\mu_q < \mu_d$	0.0220	refuse (5%)	q=d	-2.576	0.0100	refuse (5%)

questionnaire-sorting	$\mu_q = \mu_s$	$\mu_q < \mu_s$	0.0037	refuse (1%)	q=s	-2.746	0.0060	refuse (1%)
diary-sorting	$\mu_d = \mu_s$	$\mu_d < \mu_s$	0.0358	refuse (5%)	d=s	-1.726	0.0844	refuse (10%)

Table 9- Synthesis of the statistical tests (t paired and Wilcoxon matched pair test)

6 Discussion

6.1 Data comments

6.1.1 Does questionnaire underestimate food waste quantities?

Evidences from the present study suggest they do.

Findings from literature suggest that most of the respondents at questionnaires believe not to waste at all or just a few (all the examined questionnaire show the same tendency). When openly asked a quantitative, respondent answer less than 1 kg (Waste Watcher estimates IHFW to be about 630gr/hh/week in 2015, for instance). Instead, diary studies and waste sorting analysis in literature both confirm that HFW is a value between 1kg and 1.8 kg/hh/per week, with some peak values such as UK (3.5 kg/hh/week). Data from the present study confirm the trend, with a questionnaire average being 334.1 gr/hh/week, a diary average being 818 gr/hh/week and a waste sorting being 1058 gr/hh/week (on 12 U), assuming that the waste sorting data is heavily underestimated due to the methodological constraints described in paragraph 4.3.2. Yet, since those data make reference to a very little sample, they need to be explored further. Currently, they just show that, as from literature, there are consistent differences between what respondents believe to waste and what they actually waste.

6.1.2 Does diary method underestimate food waste?

As WRAP highlight, dairy actually underestimate HFW. While they suggest this value to be around 40%, findings from the present work reveal this value to be around 20%, including food waste given to pets and disposed through sink.

6.1.3 The influence of cognitive biases

First of all, a clear evidence of *anchoring effect* has been demonstrated through the Waste Watcher survey. The answer varies clearly standing to the way the question is made, with an average of 213 gr/hh/week of HFW declared in 2013 and a value of 570gr/hh/week in 2014 and 630 gr/hh/week in 2015.

Another hypothesis of anchoring has been formulated during a comparison of methodologies performed in 2015 at Guelph University. While Italian respondents tend to underestimate their food waste in questionnaires if compared to waste sorting, this is not the case of Guelph's respondents (Parizeau et al., 2015).

A synthesis of findings follows.

The role of the anchoring effect in the self-estimation of HFW

The hypothesis of an influence of anchoring has been formulated during a field visit at Guelph University, made in 2015. Kate Parizeau, of the Geography Department, was conducting two waste sorting plus questionnaire experiments and we had the opportunity to compare our preliminary results.

The comparison between the cognitive bias[47] emerging from our study and the cognitive bias of Guelph's respondents was impressive (see chapter "discussion on results"): apparently, while Guelph respondents were almost completely aware of the quantity of food they wasted, Bologna respondents were not at all.

After cleaning the field from the role of the variables (sampling and collection method), we focused our attention to a simple detail in waste collection that could have helped the Guelph respondents being aware of the exact quantity of food waste. The collection method is a separate, weekly, door to door. The humid garbage fraction of the entire week is put in a bin of around 7 kg, usually located into the garage of the house. It means that once a week, a member of the family has to move the bin from the garage to the road (the collection is scheduled in the early morning). Hence, if a bin is almost full, the respondent will answer that HFW it's around 7 kg per week (a very close data to the average). This is an anchoring (of course, the respondents cannot really know the average of their weekly HFW, yet making reference to the last time they threw the garbage away they get very close to what happens.

With reference to the same question, the respondents of Bologna experiment showed a mode of 500 gr per week, which is between a half and one third of the effective quantity (result of the waste sorting analysis). If the respondents to the Italian experiments follow the same anchoring, they might make reference to the last time they threw away the humid fraction, which is a separate collection that can be thrown anytime in disposal bins located in the street.

This hypothesis will be tested in a national experiment. If confirmed, asking how much food you waste weekly would give back a quantity related to a single garbage bin and not

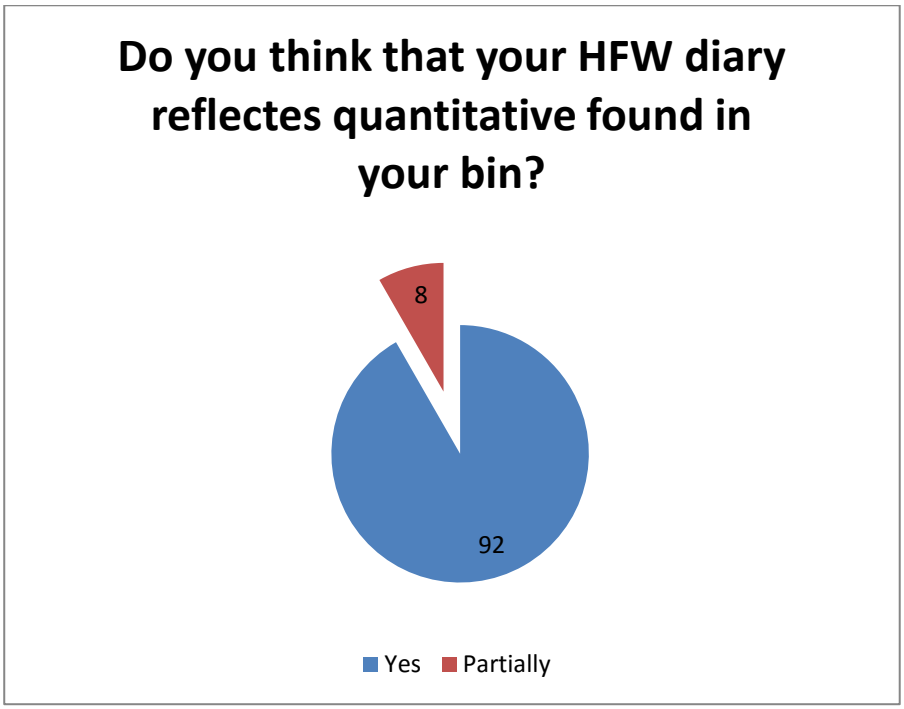
[47] The answers to the questionnaire made by university of Bologna on June 2015. Further details will be shown in the next chapter.

to the sum of all the bins thrown in one week. Data could be easily corrected by asking how many times you usually throw away the humid fraction.

Table 10 – The anchoring effect due to the waste collection method: a comparison with Guelph's experiment

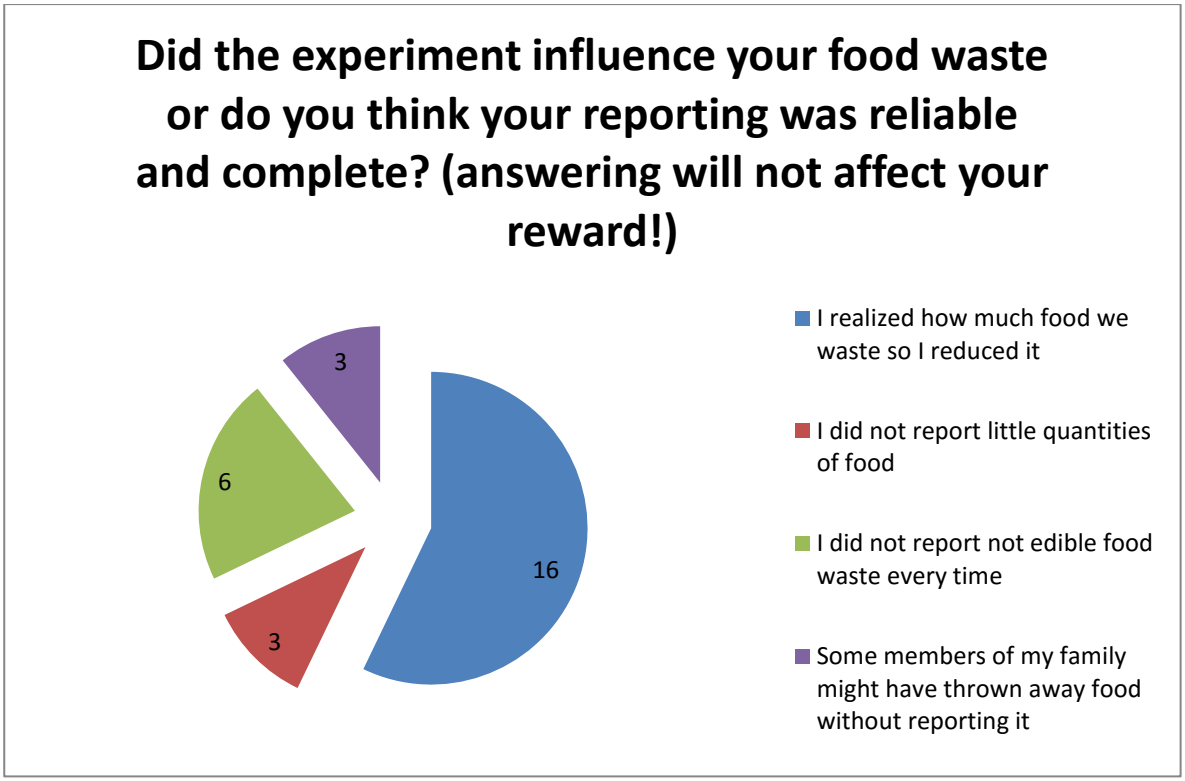
An *availability bias* is possibly affecting all the questionnaires that ask an estimation of weekly HFW without providing a set of answers ((Camillo & Adorno, 2013)), leading to a very low quantitative declared (213 gr/hh/week is the lowest value given in literature). Availability bias is a hypothesis that could possibly explain the difference in self-awareness on HFW between respondents to the present study and to Guelph study.

A *positive illusion bias* is confirmed with reference to the issue, since just few respondents, in all mentioned questionnaires (Abeliotis et al., 2014) (WRAP, 2007), (The Gallup Organization, 2011) (WRAP, 2014) answer to waste a significant amount of food waste, independently from the final data of HFW emerging from the single study. This data means that most of the respondents think not to waste or to waste a just a little as a sort of prejudice of the self that causes a projection of a personal value more than a real quantity (as (Tversky & Kahneman , 1973) describes the heuristics). In other words, they are aware of their HFW quantities neither before nor after the experiment and either they are aware of their HFW after a diary study.



Results indicate that the 80% of the panel provided an amount of food waste in questionnaire which was inferior to the diary's HFW value.

A *social desirability bias* has not been demonstrated in literature on HFW, yet it was just stated to exist, in other terms. Though, it is clearly demonstrated in the present study. Respondents involved in the auditing phase wasted less than the average of the overall sample and less (on average) of the group not included in the waste sorting phase, declaring to have modified their behavior because they were aware of the aim of the experiment (they were more involved) and performed the experiment better, with a relevant lower rate of invalidated diaries (group A: 2 invalidated diaries due to misreading of instructions or deception; group B: 4 invalidate diaries due to misreading of instructions or deception).



When asked to answer to the question "how much food do you waste monthly (euros)", some confusion emerges. 11 units over 19 give incoherent answers- if they realized to waste less than previously thought, they declare a higher value in euros in the second questionnaire than in the first, and so on. Difficulty in computation might affect such a question, probably enhanced by the unit of measure that requires a double computation (such as euros, yet the same could happen with percentage). While the qualitative question might highlight the self-perception of the respondent with reference to its own FW after the experiment (as well as a prejudice), the economic value is totally incoherent for more than half of the respondents.

6.1.3.1 The influence on behavior due to the interaction with the researcher –pilot test

As shown from the proper compilation of the data, one of the first problems to be put under control is the influence that the researcher can make on the respondent by the following passages:

1. The first phone call, aimed at checking the interest in attending the experiment: as the experiment is longer than usual (it takes one week and more efforts than a simple questionnaire), units are supposed to accept because:
    - interest on the food waste theme- which had been specified by the first call yet; or
    - b) interest in the reward or
    - c) other reasons.

In order to check which one of the reasons was the core one, the first questionnaire made 10 questions on the value given to climate change, hunger and food waste (questions 17-27). By cross-checking the results, it emerges that a more sensitiveness for environment and world hunger are directly proportional to a more proper compilation for both groups, yet there is no evident connection with a reduced production of food waste. On the other side, most of the respondents that show to attribute a great value to food declared not to waste food at all, even though food waste, environment or world hunger were declared not to be personal concerns for them. Hence, there is a third and not prevented order of reasons that leads the respondent to believe that she/he does not waste food, which is not related to a "food waste problem" but seems to be part of a value given to food that needs to be explored further. The cross-checking between the questionnaires (in particular the question on "how much food do you think to waste weekly in grams and euros"), the diary and the audits show that the answer resides in a respondent's belief which is not influenced by the experiment at all, nor when the question is repeated after it. Hence, the belief does not vary after the experiment for those who strongly believe not to waste food. At this time, a depth interview to enquire into the deep belief of the unit is required- perhaps, an ethnographic approach and a focus group would be more efficient.

2. Another influence can be produced by the phone contact: as the food waste problem is shown and the unit gives its availability for the auditing, it can be more aware of the problem itself and wasting less as a consequence- both because its awareness rises or to

show a minor quantity of food waste to the researcher. In literature, this kind of self-correction is defined *social desirability bias***.** In the pilot experiment, the difference was meaningful.

3. Another influence factor can be the use of "spreco alimentare" instead of "rifiuto alimentare". Since the word "spreco" contains a negative judgment itself, it can have a correction influence on the respondent. For the next experiment, it is highly recommended to substitute the world "spreco" with a synonym.

4. The last factor of influence depends on the "in person" interaction between the researcher and the unit, which could increase its feeling to be judged by somebody that will be able to associate its name to a face. Although many solutions have been explored, there is no possibility to avoid this distortion except if the waste collection is a door to door, so the garbage is collected without any contact with the respondent. Nevertheless, another recommendation is comparing both type of collection in order to test possible differences in the food waste quantity due to the mandatory, separate door to door collection.

6.2 The diary study: pros and cons in our experiment

6.2.1 *General conclusions on the completion rate*

There is a strong evidence that a phone contact, or the fear to be "checked" by the sorting waste analysis, have positively influenced the participants of the group A by encouraging them in reading/following the instructions carefully.

As from results, only 2 units were invalidated in the first group while 7 were invalidated in the non-audited group, for a lack of sensitive information or mistakes in the fill out.

Among the unexpected phenomena, the first was the clear deception of one unit, whose garbage was sorted out (unit 7). It was a coincidence, though other units might have filled out the diary in the same way (once a week or similar, recalling what they threw away during the week). Actually, there is no other way to estimate the percentage of deception, out of the cross- checking through sorting waste. It has to be planned an uncountable amount of "cheating", physiological to the self-reporting method of diary that can be only checked trough auditing. Yet, this phenomenon led us to insert a specific question in the second questionnaire:

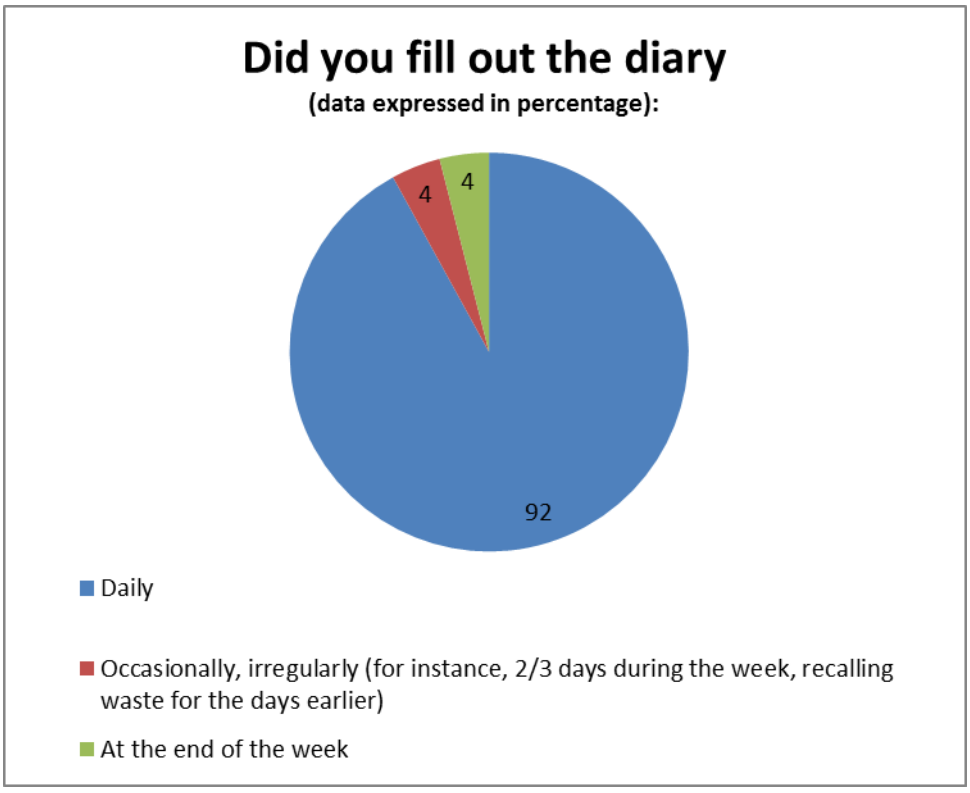


Figure 10 - Frequency of diary compilation

Other recommendations for a future experiment are:

- An initial clause related to a proper compilation of the diary in order to receive the reward is warmly recommended.
- The personal information page will be inserted inside the diary as first page instead of being on a different page.
- A proper strategy needs to be for non-Italian speakers - it can be an English translation of the material in some cases, or a higher attention from the researchers.

6.2.2 Considerations on data collection

We realized that the visits to the families possibly influenced the experiment results (the units involved in the face by face collection gave back the best diaries in terms of accuracy- with a satisfying filling of all the slots); it also emerged that the audited families (sub-group A) wasted less than the non-audited - perhaps confirming a tendency to change behavior if deeply involved in the experiment, confirmed in literature. Some respondents answered that they had been more careful to their food waste during the week of the experiment, perhaps wasting a few less than usual, just because they were paying attention to the issue.

It is important to underline that a strong need to show "a positive behavior" in relation to the issue emerged during the visits and the chatting with the respondents, a phenomenon that could be explained both in terms of positive illusion bias and in social desirability. Most of participants were "sure" not to waste at all or almost at all and some of them proudly showed their food stores to the researcher, commenting that they were "*good* at buying/ using/ storing". Although a considerable difference among the participants' kitchen storage, most of them declared the same (*I / we* (as a family) *do not waste so much because we care about food/ food is important for us/ etc.*). For this reason, some of the visits lasted more than half an hour. The concept was underlined also through the recurrent usage of words with a positive judgment as "good", "frugal", "careful and accurate", with reference to the shopping behavior or storage. The hypotheses that this belief was part of the cognitive dissonance we are trying to enquire into have been eventually validated by the difference among the declared waste, the diary record and garbage analysis of those units. Although we did not deepen the analysis with recorded interviews at this time, the indication emerged clearly to the researcher, suggesting the need for a discourse analysis to be inserted it in the next experiment.

7 Conclusions

Wasting food seems to be covered by a normative behavior. Not only has it seemed related to environment- actually, almost not at all, if analyzing questionnaires- yet it seems closer to a moral judgment (wasting food is wrong) or to an economic concern (most of respondents answer they would reduce their HFW to reduce the economic loss). Those results emerge clearly from literature. Eventually, they have been confirmed through the present analysis.

In some cases (see Waste Watcher 2015) the way a question is formulated determines a meaningful difference in the answer, even in the same survey. Standing to the formulation of the question, there is the opportunity to reduce *the availability bias*, determining more accurateness in answering (for a review of this specific issue, see paragraph 3.5). At the same time, it emerged clearly that providing answer to be selected (close question), lead the majority of respondents to choose the lower value of FW (see paragraph 3.2), perhaps expressing a *positive illusion bias* rather than an answer computed on the basis of actual experience. Also, it emerged (as serendipity!) that Guelph respondents to the questionnaire look more aware of their HFW quantity, possibly due to some logistical differences in the garbage collection system that creates a positive anchoring (see box in paragraph 6.1.3).

For all these reasons, we built a questionnaire that tried to test and, in some cases, overcome the cognitive biases- for instance, we asked *how much do you waste weekly (in gr)* which is supposed to provide a biased answer (positive illusion, social desirability) yet we asked it only after the entire experiment (second questionnaire), to test the reliability of such a question after a diary and a waste sorting analysis. The result is closer to the real waste than in other questionnaires- such as in Waste Watcher 2015, where the average answer to the same question was around 170 gr per week while in our case it is a value between 300 and 450gr/hh/week. Though, it is still far from the real data (about1 kg/hh/week). Such a difference can be due to the experiment (raising awareness on the HFW or reducing the availability bias through diary experiments) or, also, to the size of the sample (1500 against 20 families). Hence, results are actually not comparable, yet they can be seen as indications for a future analysis.

Also, it clearly emerges that there is no point in asking the value of food waste in euros, since there were no accordance between answers to the same questions made before and after the experiment. For instance, while a unit answers he/she realized to waste less than imagined before the experiment, it gives back an economic value three times higher than the value given before the experiment. This is not an isolated case, since only 8 units (on 19) were able to provide coherent answers. If analyzed this data through the lens of behavioral economics, once again, we could assume that estimating the own food waste in euros (as well as in percentages) asks for a double computation (1. how much do I waste in one week? 2. To how much money/percentage of

purchased food it corresponds?). Double computation might be able to provide answers very far from reality. This is actually what happens when testing this answer in the present experiment: the economic value was a random answer more likely to reflect the feeling of the respondent at the end of the experiment, yet it was incoherent with the value provided in the first questionnaire (for more details, see 5.4.3). Once again, even considering the huge limit of our sample size, we can assume this finding as a clear indication on the fallacy of HFW self-estimation especially if computed through a double estimation, likely to be affected by an availability bias.

If compared to diaries studies existing in literature, the value of about 1kg/hh/week of edible FW seem to be coherent. Yet, as it emerged quite clearly from literature, also diary suffers of under-estimation that has been estimated to be around 20% in our experiment (yet the same data corresponded to 40% in WRAP's). The under-reporting can be due to social desirability bias (feelings of shame, for instance) or to carelessness (this is what emerged more clearly from the present experiment, especially with reference to the sample which was not involved in the waste sorting analysis).

The waste sorting analysis showed that both methods (questionnaire and sorting) are not reliable with reference to data, hence only waste sorting or weighting would be the recommended method to overcome any possible cognitive dissonance or underreporting. Nevertheless, through this method it is quite impossible to understand the reason why food has been thrown away, either because it can be a subjective choice ("I did not like it") or because of the length of time between the food is thrown and the analysis is done. This might affect the state of food, raising its degradation- then, it is hard to say whether a fruit has been thrown because of mold or not. This is why it is still suggested to conduct a diary study along with the other two methods.

All the considerations on the limits of the methodology had been well documented in literature and were confirmed in the present study.

The use of three methods on the same sample also showed some important differences between who was involved in the auditing and who was not. In first instance, the sub-sample involved had a higher redemption rate of the diary (2 diaries invalidate over 14). Moreover, the same sub-sample wasted less than the other sample, declaring (when asked, in the second questionnaire, question 2) that perhaps food waste had been slightly reduced due to the awareness to be "studied" and because a higher attention to the wasted food during the week of the experiment.

In conclusion, there is strong evidence that questionnaire is not a reliable method to gather quantitative data on Food Waste, nor it is diary *per se*- a control group put under observation (audited through waste sorting) is recommended.

Questions may be built trying to reduce the bias listed in the present work, as it had been done in the pilot experiment.

Moreover, in a national experiment the two questionnaires might be reduced to only one, since the reason for two was part of the scope of the present experiment, namely to detect changing in self-perception due to the experiment itself.

There are no doubts that such an experiment requires exceptional economic and human resources, yet it is the more effective way to conduct an analysis over a large sample in the shortest amount of time. Nevertheless, such a methodology is the most complete to detect self-perception, drivers and real quantity of food waste, so that practical measures and awareness raising campaigns can be set up on the basis of findings.

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9 Appendix

9.1 Instructions: pre-test phase (9th -15th February, 2015)

Il diario dello spreco alimentare

Pilot test

9-15 febbraio 2015

Benvenuto nel tuo diario dello spreco alimentare

Le indicazioni e i suggerimenti che seguono ti aiuteranno a capire come compilare il tuo diario.

Leggile attentamente!

Caro volontario,

innanzitutto ti ringraziamo per aver preso parte a questo studio pilota dell'Università di Bologna, condotto in collaborazione con Waste Watcher (un progetto Last Minute Market e SWG per il monitoraggio degli sprechi alimentari in Italia)**.** Per maggiori informazioni su chi siamo e sui nostri progetti, visita le pagine http://www.lastminutemarket.it/ e http://www.andreasegre.it/.

Questo studio ci consentirà di capire quali prodotti alimentari sono maggiore oggetto di spreco all'interno dei nuclei domestici italiani e perché.

Potrai davvero aiutarci se compilerai il diario con maggior attenzione possibile ai dettagli. Per ricordare a tutti i componenti del nucleo domestico di segnalare il loro spreco alimentare, tieni il diario in un posto ben visibile in cucina (nei pressi del frigorifero o sul piano cottura) oppure attacca dei promemoria adesivi sui bidoni della spazzatura (raccolta organico, se presente, e/o indifferenziato) e sul frigorifero. Ogni altra idea è benvenuta se vi aiuterà a compilare il diario opportunamente!

E’ fondamentale che tutti i componenti del tuo nucleo familiare compilino il diario con le informazioni relative a cibo e bevande gettate via.

Il diario deve essere compilato:

- Da tutti i componenti del nucleo domestico
- A prescindere dal prodotto
- A prescindere dal motivo per il quale hai deciso di gettar via l’alimento
- Prodotti presenti solo all’interno della tua abitazione (non registrare spreco avvenuto al ristorante, in mensa o a scuola, salvo che non si tratti di alimenti provenienti da casa tua)
- A prescindere se il prodotto è stato gettato via nel contenitore dell’indifferenziato, dell’organico, nel lavandino o in altri scarichi, o se è stato dato al tuo animale domestico!

Troverai ulteriori elementi utili alla compilazione nella pagina successiva.

Ricorda, è fondamentale che tu rispedisca il presente plico all’indirizzo che segue:

SWG

VIA SAN FRANCESCO 24

34133 TRIESTE

Il termine entro cui spedire il materiale è **mercoledì 18 febbraio 2015**.

Per qualsiasi dubbio sulla compilazione, scrivi a claudia.giordano4@unibo.it oppure chiama il numero *051 2096142.*

I risultati dell'esperimento pilota ti saranno inviati via mail non appena saranno stati elaborati in via definitiva.

Privacy e trattamento dei dati personali

Per garantire il rispetto delle norme, ai sensi e per gli effetti dell'art. 29 del D.lgs. 30 giugno 2003 n.196 e s.m.i. e del **D.lgs. n. 81/2008 e s.m.i.** SWG S.p.A. assicura il rispetto pieno delle vigenti disposizioni in materia di trattamento di dati personali. La medesima società sarà designata da Last Minute Market e dal Dipartimento di Scienze e Tecnologie Agro-Alimentari dell'Università di Bologna come responsabile del trattamento dei dati personali raccolti, elaborati e trattati per la realizzazione dell'indagine.

Il trattamento dei dati effettuato da SWG S.p.A si limiterà alle operazioni strettamente necessarie per l'esecuzione delle prestazioni aventi ad oggetto la realizzazione della rilevazione delle informazioni. Pertanto SWG S.p.A prende atto ed accetta che i nominativi verranno utilizzati esclusivamente ai fini dell'indagine in questione. La materia relativa al trattamento dei dati personali è compiutamente documentata nell'ambito della Procedura PR17 – Gestione della privacy e della data security, del Sistema Qualità certificato,. Oltre a quanto sopra esposto, SWG S.p.A in materia di Gestione della privacy e della data security, ottempera a quanto previsto dai codici etici e di autodisciplina dell'ASSIRM, Associazione nazionale che riunisce i principali istituti di ricerca di mercato e d'opinione e dell'ESOMAR, Associazione internazionale nello stesso ambito, organizzazioni alle quali SWG S.p.A. è iscritta.

Le informazioni fornite nel corso della compilazione del "diario" sono classificabili come "dati personali" solo per il breve lasso di tempo in cui sono state collegate all'inserimento delle risposte nel data base. Tale collegamento permette infatti di associare le informazioni medesime al titolare dell'utenza.

Per il breve lasso di tempo in cui i "dati personali" sono stati disponibili, essi sono stati trattati da operatori specificatamente incaricati, ovvero da Organizzazioni con nomina a responsabile del trattamento, sotto stretto vincolo di riservatezza ed assoluto divieto espresso di comunicazione a terzi.

Al fine di ottemperare nel modo più scrupoloso non solo al dettato formale, bensì anche allo spirito del Codice Privacy, SWG provvede a dissociare, quanto prima possibile, le informazioni personali dai dati raccolti nella compilazione. Tale operazione viene denominata "blindizzazione" ed i dati depurati del riferimento al rispondente assumono la denominazione di dati "blindati". La

blindizzazione viene effettuata al termine della rilevazione ed è irreversibile. Successivamente quindi i dati della rilevazione diventano assolutamente anonimi e perdono conseguentemente la loro connotazione di "dati personali". D'altronde il fine per il quale i dati sono raccolti è esclusivamente di tipo statistico ed i risultati dell'indagine effettuata, che si svolge su un campione estratto casualmente dall'universo da indagare, vengono presentati sotto forma di percentuali, senza alcuna possibilità di riferimento alle singole fonti.

Schema del campionamento

La sperimentazione della compilazione di un "diario" settimanale degli sprechi alimentari domestici avverrà in collaborazione con la trasmissione radio Decanter.

Questa fase dell'esperimento è detta *fase 0* e ci aiuterà a raccogliere feedback, da parte dei volontari, sulla metodologia più opportuna da applicare nella fase successiva. Alle persone che si dichiareranno disponibili a partecipare alla compilazione del diario verrà altresì richiesta la definizione del loro profilo socio demografico.

Ai fini della realizzazione della prima fase dell'esperimento, invece, SWG contatterà altri nuclei familiari che andranno a confluire in un campione rappresentativo della popolazione italiana. Qui avrà inizio la *fase 1* dell'esperimento, con l'auspicio che il modello creato possa costituire la base per una proficua reiterazione dell'esperimento in futuro e che sia utile alla predisposizione delle soluzioni più opportune per ridurre gli sprechi alimentari domestici.

Come si misura lo spreco?

È molto importante registrare con accuratezza il cibo che non si consuma.

Anche se ti sembrerà ininfluente, anche il fondo del vasetto di uno yogurt ha la sua importanza! Moltiplica quel fondo di vasetto per tutti i consumatori di yogurt in Italia; scoprirai che anch'esso ha un impatto ambientale da considerare.

Non includere mai la confezione quando misuri/pesi il cibo che getti via.

- *Come misurare i liquidi (litri)*:

usa una CARAFFA GRADUATA 

oppure, se non ne possiedi una, usa:

- UN CUCCHIAIO,
  - un cucchiaino da dessert

- *Come misurare il peso (grammi)*: usa una BILANCIA DA ALIMENTI

  oppure, se non ne possiedi una, usa:

  - UNA TAZZA
  - *una manciata*(circa un pugno),
    - ✓ mezza manciata (circa mezzo pugno),

- *Come misurare i prodotti interi*: limitati a specificare il numero di prodotti che hai gettato via (UNA SCATOLA di cereali da 300 gr, una mela, *5* carote, ecc).

Grazie per il tuo aiuto!

Inizia da qui!

Informazioni personali *(compilare la casella a destra)*	
Nome	
Cognome	
Indirizzo	
Numero di telefono	
Cellulare	
Email	

Informazioni sul nucleo domestico *(fornire indicazione numerica nel riquadro a destra!)*	
Nr. di adulti nel nucleo domestico (+18 anni di età)	
Nr. di bambini (sotto i 10 anni di età)	
Nr. di ragazzi (11-17 anni di età)	

Quanti dei componenti adulti (+18 anni di età) del nucleo domestico ricadono nelle seguenti categorie? *(fornire indicazione numerica nel riquadro a destra!)*	
Impiegati a tempo pieno	
Impiegati part-time	
Libero professionisti	
Non retribuiti/volontari	
Studenti	
Casalinga/ o	
In pensione	
Disoccupati (in cerca di occupazione)	
Disabili	
Altro (specificare)	

9.2 Pre-test Diary sample

Esempio di diario compilato

LUNEDÌ- PRANZO

Se non hai sprecato nulla, specifica la ragione (barrare):

abbiamo consumato tutto il cibo del pasto ☐ non

abbiamo consumato il pasto in casa ☐ altro(specificare)

Cosa hai gettato?	Motivazione	Tipologia di prodotto						Quanto ne è stato gettato via?	Dove è stato smaltito?				
Fornisci una descrizione più completa possibile (prodotto, marca)		Surgelato	Confezionato *	Fresco	Da asporto	Fatto in casa	altro	Peso, volume o numero di pezzi	Indifferenziato	Organico	Scarichi	Animali domestici	Altro
Pasta e lenticchie	*Ne ho cucinato troppo*						x	*30 grammi*		x			
Pollo grigliato con limone	*Avanzo di mio figlio*			x				*60 grammi*				x	
Insalata in busta Bonduelle	*Mio figlio ha rovesciato il piatto pur di non mangiarla!*			x				*30 grammi*		x			
Mela	*Era marcia (in frigo da più di una settimana)*			x				*Intera*		x			

*Confezionato= in scatola, cartone, bottiglia, tetrapack.

Esempio di diario compilato

Lunedì- altri pasti

Se non hai sprecato nulla, specifica la ragione (barrare):

abbiamo consumato tutto il cibo del pasto ☐ non abbiamo

consumato il pasto in casa ☐ altro(specificare)

Cosa hai gettato?	**Motivazione**	**Tipologia di prodotto**						**Quanto ne è stato gettato via?**	**Dove è stato smaltito?**				
Fornisci una descrizione più completa possibile (prodotto, marca)		**Surgelato**	**Confezionato ***	**Fresco**	**Da asporto**	**Fatto in casa**	**altro**	**Peso, volume o numero di pezzi**	**Indifferenziato**	**Organico**	**Scarichi**	**Animali domestici**	**Altro**
Yogurt Mila lampone	*Non mi va mai tutto!*			*x*				*Un cucchiaino da dessert*			*x*		
Patatine San Carlo gusto Paprika	*Pacco comprato e aperto più di un mese fa*		*x*					*Mezzo pacco (circa 50 gr)*	*x*				
Carote	*Marcite nel frigo (non riesco mai a finirle tutte)*		*x*					*3*		*x*			

Commenti e considerazioni sulla giornata		**Hai acquistato del cibo, oggi?** Scrivi l'ammontare della spesa approssimativo!
Specifica se ci siano state circostanze inusuali rispetto alle vostre abitudini alimentari o allo spreco prodotto oggi	• *Non compriamo mai patatine, quelle gettate via oggi sono avanzi della festa di compleanno di mio figlio!* • *Solitamente non andiamo a cena dai nonni il lunedì sera ma oggi abbiamo tardato al lavoro*	*Circa 3 euro per pane fresco e latte (steligarda, ½ lt)*

9.3 Pre-food waste diary survey

Nel rispondere al questionario faccia riferimento al suo nucleo familiare.

1. **Quanto è personalmente responsabile della spesa alimentare all'interno del suo nucleo familiare?** Single code
   - Quasi del tutto responsabile
   - Circa a metà
   - Meno della metà/ in minima parte
   - Non ne sono affatto responsabile (non me ne occupo personalmente)

2. **Con riferimento alle abitudini nella preparazione del pasto del suo nucleo familiare, quale delle seguenti affermazioni rappresenta meglio le vostre abitudini :** single code
   - Una persona prepara i pasti per tutto il nucleo familiare
   - Ogni membro del nucleo familiare prepara il proprio pasto
   - Gruppi all'interno del nucleo familiare preparano il loro pasto
   - Altro (specificare)

3. **Con riferimento alle abitudini d'acquisto di beni alimentari all'interno del suo nucleo familiare, da quale delle seguenti affermazioni si sente più rappresentato?** Single code
   - Solitamente l'acquisto è effettuato da un solo componente per tutti
   - Ognuno dei singoli componenti acquista i beni alimentari per sé
   - Differenti gruppi all'interno del nucleo famigliare acquistano i beni alimentari per sé

4. **Quale delle seguenti affermazioni descrive meglio le abitudini d'acquisto di beni alimentari (luogo) del suo nucleo familiare?** Single code
   - Acquistiamo quasi tutto in un unico punto vendita (supermercato/ipermercato)
   - Acquistiamo quasi tutto in un unico punto vendita (supermercato/ipermercato) e alcuni prodotti in negozi di prossimità
   - Acquistiamo quasi tutto in punti vendita dedicati (panificio, fruttivendolo, salumeria, ecc)

5. **Quale delle seguenti affermazioni descrive meglio le abitudini d'acquisto del suo nucleo familiare (in termini di frequenza)** Single code
   - Facciamo la spesa più di una volta a settimana
   - Facciamo la spesa circa una volta a settimana
   - Facciamo la spesa circa una volta ogni due settimane
   - Facciamo la spesa circa una volta al mese
   - Non facciamo quasi mai un'unica spesa (ci rivolgiamo a negozi di prossimità secondo necessità)

6. **Come sono organizzati i pasti principali nell'arco di una settimana?** Single code
   - Si decide con anticipo quasi tutti i pasti che verranno consumati durante la settimana
   - Si decide con anticipo buona parte dei pasti che verranno consumati durante la settimana
   - Si decide con anticipo una piccola parte dei pasti che verranno consumati durante la settimana

- Si decide giorno per giorno o sul momento

7. **Risponda alla seguente domanda con riferimento all'ultima volta che ha fatto la spesa di beni alimentari, che sia avvenuto in super/iper mercato, negozio di prossimità o online. Aveva precedentemente controllato di avere già ognuno dei seguenti alimenti prima di acquistarne altri?** Single code each item

	Si	No	Non so/non ricordo	Non acquisto questa tipologia di prodotto
a. Frutta				
b. Verdura				
c. Pane				
d. Carne (fresca)				
e. Pesce (fresco)				
f. Latte				
g. Piatti pronti				
h. Prodotti in barattolo, scatola, ecc..				
i. Surgelati				
l. Insalata				

8. **Sempre con riferimento all'ultima volta che ha fatto la spesa: quale delle seguenti azioni la rappresenta più da vicino?** single code
   - Ho precedentemente scritto una lista di alimenti da comprare, man mano che finivano nell'arco della settimana
   - Prima di recarmi a far la spesa ho scritto un elenco da portare con me
   - Avevo una elenco ben preciso in mente
   - Avevo un idea generica del tipo di alimenti che avrei comprato
   - Nessuna delle precedenti
   - Non so/non ricordo

9. **Sempre pensando all'ultima spesa che ha fatto, quale delle seguenti situazioni rappresenta meglio quel che è effettivamente avvenuto una volta nel negozio?** Allow multicoding
   - Ho comprato tutto ciò che era sulla mia lista
   - Ho comprato buona parte di quel che avevo nell'elenco
   - Ho comprato qualcosa tra gli alimenti segnati nell'elenco
   - Ho comprato alcuni alimenti extra rispetto alla lista
   - Ho comprato molti alimenti extra rispetto alla lista
   - Ho comprato principalmente prodotti sulla base dell'ispirazione del momento
   - Non so/non ricordo
   - Non applicabile (*ha risposto "nessuna delle precedenti " nella domanda 8*)

10. **Acquista cibo extra rispetto all'elenco quando vede un'offerta speciale?**
    - Si (vai alla domanda 11)

- No (vai alla domanda 12)

11. **Quale delle seguenti situazioni descrive meglio ciò che accade dopo l'acquisto di prodotti in offerta speciale?** Single code
    - Una buona parte di essi viene consumata
    - Una minima parte di essi viene consumata
    - Non so/ non ricordo

12. **Quale delle seguenti situazioni descrive meglio ciò che accade durante e dopo l'acquisto di prodotti in offerta speciale?** Allow multicoding
    - (*all'interno della stessa spesa*) Di solito, compro quantità inferiori di altri prodotti
    - (*successivamente alla spesa in oggetto*) Attendo più tempo prima di acquistare nuovamente lo stesso tipo di prodotto
    - Non so

13. **Con riferimento all'ultima volta che sono rimasti avanzi di un pasto (per esempio ha cucinato troppo), cosa è accaduto agli avanzi:** Single code
    - Utilizzati come parte del pasto successivo
    - Utilizzati come pasto successivo
    - Non utilizzati e gettati via
    - Ancora conservati
    - Altro (specificare)
    - Non so/non ricordo

14. **Nell'ultima settimana, ha gettato via uno dei seguenti prodotti perché era stata superata la data di scadenza (*da consumare preferibilmente entro il /da consumare entro il*) impressa sulla confezione?** Single code each item

	Si	No	Non so / non ricordo
A. Carne fresca	01	02	03
B. Salumi	01	02	03
C. Latte	01	02	03
D. Yogurt	01	02	03
E. Alimenti precotti	01	02	03
F. Succhi di frutta	01	02	03
G. Pane o prodotti da forno	01	02	03
H. Frutta fresca	01	02	03
I. Verdura	01	02	03
L. Prodotti surgelati	01	02	03
M. Altri prodotti	01	02	03

15. **Durante l'ultima settimana, quanto ha gettato via dei seguenti prodotti alimentari (sia che siano stati smaltiti nei rifiuti organici, nell' indifferenziato, negli scarichi domestici o utilizzati per alimentare animali domestici):** Rotate statement, single code for each statement

	Parecchio	Una piccola quantità	Una minima quantità	Niente	Non consumo questo alimento
Frutta					
Verdura e insalate					
Pane e prodotti da forno					
Pesce e carne crudi o cotti in casa					
Formaggi e yogurt					
Latte e succhi di frutta					
Pasti pronti o precotti					
Cibo preparato in eccesso e non consumato (non servito)					
Cibo avanzato nel piatto					
Cibo acquistato ma mai consumato (confezione mai aperta, frutto intero)					
Cibo proveniente da confezioni aperte ma mai terminate					
Cibo scaduto/con muffa					
Cibo la cui data di scadenza “da consumare preferibilmente entro” è passata					
Cibo la cui data di scadenza “da consumare entro il” è passata					
Parti di cibo non commestibile (bucce, lische, ecc)					

16. **In generale, quanto ritiene di gettar via dei seguenti prodotti alimentari (sia che siano stati smaltiti nei rifiuti organici, nell' indifferenziato, negli scarichi domestici o utilizzati per alimentare animali domestici):** Rotate statement, single code for each statement

	Parecchio	Una piccola quantità	Una minima quantità	Niente	Non consumo questo alimento
Frutta					
Verdura e insalate					
Pane e prodotti da forno					
Pesce e carne crudi o cotti in casa					
Formaggi e yogurt					
Latte e succhi di frutta					
Pasti pronti o precotti					
Cibo preparato in eccesso e non consumato (non servito)					
Cibo avanzato nel piatto					
Cibo acquistato ma mai consumato (confezione mai aperta, frutto intero)					
Cibo proveniente da confezioni aperte ma mai terminate					
Cibo scaduto/con muffa					
Cibo la cui data di scadenza “da consumare preferibilmente entro” è passata					

Cibo la cui data di scadenza "da consumare entro il" è passata					
Parti di cibo non commestibile (bucce, lische, ecc)					

17. **In che misura ognuna delle seguenti motivazioni può incoraggiarla a ridurre il lo spreco alimentare?** Rotate, single code each statement

	Molto	Abbastanza	Un po'	Per niente	Non so
Ridurre l'impatto ambientale negativo del mio stile di vita	01	02	03	04	05
La diseguaglianza di accesso al cibo nel mondo					
La possibilità di risparmiare					
La necessità/voglia di gestire la mia casa in maniera efficiente					
Senso di colpa quando getto via il cibo che avrebbe potuto essere consumato					
Mangiare in modo sano					
Insegnare ai miei figli a mangiare in modo sano					

18. **Quali tra le seguenti affermazioni la rappresenta meglio (con riferimento anche al suo nucleo domestico) rispetto allo spreco alimentare?** Rotate, allow multicode (massimo 3)

- Non ho tempo
- Ci sono cose più importanti di cui occuparsi
- Non credo che il cibo che getto via mi costi così tanto in termini economici
- Non credo che gettar via cibo abbia un impatto negativo sull'ambiente
- Ho necessità di comprare molto cibo per garantire che ce ne sia a sufficienza e sempre a disposizione per la mia famiglia
- I bambini non sempre finiscono il loro cibo
- Non so come posso ridurre il mio spreco alimentare

- Altro (specificare)
- Nessuna delle risposte precedenti

19. **Nell'ultimo anno, hai sentito o visto qualcosa rispetto al tema dello spreco alimentare o a come ridurlo?** Single code
    - Si
    - No
    - Non so / non ricordo

20. **Approssimativamente, quanti soldi ipotizza potrebbe risparmiare in media ogni mese, se non gettasse via cibo?**
    - Aperta (*valore numerico*)
    - Non so

21. **Dove fa la spesa abitualmente? (elenco supermercati da indagine WW)** Allow Multicoding
22. **Quanto spesso (giorni per settimana) svolge le seguenti azioni?** Write in frequency code for each

    Domande 24/25/26 se applicabili

23. **Quanto spesso altri adulti nel suo nucleo domestico svolgono le seguenti azioni?**

24. **Quante volte i bambini (12-17 anni) svolgono le seguenti azioni?**

25. **Quante volte i bambini (< 12 anni) svolgono le seguenti azioni?**

Frequency code:
1,2,3,4,5,6,7 : giorni della settimana
8: una volta ogni due settimane
9: una volta al mese
10. meno di una volta al mese
11. mai
12. non so

	Io	Altri adulti	Bambini 12-17 anni	Bambini <12 anni
Cibo da asporto a casa				
Cena fuori				
Pranzo fuori				
(riceviamo) Ospiti a pranzo/cena				
Siamo invitati a pranzo/cena a				

casa di amici				
Pasto precotto				
Pasto composto di ingredienti in buona parte precotti/preconfezionati (salse pronte, legumi precotti in barattolo, pane confezionato)				

26. **In generale, a suo avviso, direbbe che ciò che è abitualmente consumato nel suo nucleo domestico è** … single code
    - Molto sano
    - Abbastanza sano
    - Né sano né insano
    - Abbastanza insano
    - Molto insano
    - Non so

27. **Le leggerò delle affermazioni che mi sono state fatte in merito al cibo. Può dirmi in che misura è o non è d'accordo?** single code

	Completamente d'accordo	Tendenzialmente d'accordo	Né accordo né disaccordo	Tendenzialmente in disaccordo	Del tutto in disaccordo	Non so
Per me, il cibo è necessario solo per sopravvivere	01	02	03	04	05	06
Mi piace leggere articoli sul cibo in giornali e riviste	01	02	03	04	05	06
Per me, il cibo dovrebbe essere innanzitutto rapido da preparare	01	02	03	04	05	06
Spesso non compro il cibo che vorrei a causa del prezzo eccessivo	01	02	03	04	05	06
Cucinare è un hobby per me	01	02	03	04	05	06
Il prezzo del cibo non è così importante se proporzionale alla certezza della qualità	01	02	03	04	05	06
Ho una vita	01	02	03	04	05	06

frenetica che mi lascia il tempo di mangiare al volo tra un impegno e l'altro						
Mi piace cucinare cose nuove	01	02	03	04	05	06
Mi piace cucinare e preparare	01	02	03	04	05	06

9.4 Instructions: pilot test (17th - 23rd June, 2015)

Il diario dello spreco alimentare

II Pilot test

17/06/2015- 23/06/2015

DISTAL (UniBo)

Coordinatore scientifico: Andrea Segrè

Referenti progetto: Claudia Giordano, Luca Falasconi

Benvenuto nel tuo diario dello spreco alimentare

Le indicazioni e i suggerimenti che seguono ti aiuteranno a capire come compilare il tuo diario.

Leggile attentamente!

Gentile volontaria/o,

innanzitutto ti ringraziamo per aver preso parte a questo studio pilota dell'Università di Bologna, condotto in collaborazione con Waste Watcher (un progetto Last Minute Market e SWG per il monitoraggio degli sprechi alimentari in Italia)**.** Per maggiori informazioni su chi siamo e sui nostri progetti, visita le pagine http://www.lastminutemarket.it/ e http://www.unannocontrolospreco.org/it/.

Questo studio ci consentirà di capire quali prodotti alimentari sono maggiore oggetto di spreco all'interno dei nuclei familiari italiani e perché.

Potrai davvero aiutarci se compilerai il diario con maggior attenzione possibile ai dettagli. Per ricordare a tutti i componenti del nucleo familiare di segnare tutti i prodotti gettati via, ***tieni il diario in un posto ben visibile*** in cucina (nei pressi del frigorifero o sul tavolo) oppure attacca dei ***promemoria adesivi sui bidoni della spazzatura*** (raccolta organico, se presente, e/o indifferenziato) e sul frigorifero. Ogni altra idea è benvenuta se ti aiuterà a compilare il diario opportunamente!

E’ fondamentale che le informazioni relative a cibo e bevande siano riferite a tutto il nucleo familiare.

Il diario deve essere compilato:

- Da un referente per tutti i componenti del nucleo familiare
- Per prodotti presenti solo all'interno della tua abitazione (non registrare spreco avvenuto al ristorante, in mensa o a scuola, salvo che non si tratti di alimenti provenienti da casa tua)
- A prescindere se il prodotto è stato gettato via nel contenitore dell'indifferenziato, dell'organico, nel lavandino o in altri scarichi, o se è stato dato al tuo animale domestico!

Troverai ulteriori elementi utili alla compilazione nella pagina successiva.

Ricorda, è fondamentale che tu rispedisca il presente plico inserendolo all'interno della busta preaffrancata che ti è data in dotazione, destinata a:

CLAUDIA GIORDANO

DISTAL- DIPARTIMENTO DI SCIENZE E TECNOLOGIE AGRO- ALIMENTARI

UNIVERSITÀ DI BOLOGNA

VIA FANIN 50, 40127 BOLOGNA

Il termine entro cui spedire il materiale è **venerdì 26 giugno 2015**.

Per qualsiasi dubbio sulla compilazione, scrivi a claudia.giordano4@unibo.it oppure chiama il numero *051 2096142.*

I risultati dell'esperimento pilota ti saranno inviati via mail non appena saranno stati elaborati in via definitiva.

Privacy e trattamento dei dati personali

Per garantire il rispetto delle norme, ai sensi e per gli effetti dell'art. 29 del D.lgs. 30 giugno 2003 n.196 e s.m.i. e del **D.lgs. n. 81/2008 e s.m.i.** SWG S.p.A. assicura il rispetto pieno delle vigenti disposizioni in materia di trattamento di dati personali. La medesima società sarà designata da Last Minute Market e dal Dipartimento di Scienze e Tecnologie Agro-Alimentari dell'Università di Bologna come responsabile del trattamento dei dati personali raccolti, elaborati e trattati per la realizzazione dell'indagine.

Il trattamento dei dati effettuato da SWG S.p.A si limiterà alle operazioni strettamente necessarie per l'esecuzione delle prestazioni aventi ad oggetto la realizzazione della rilevazione delle informazioni. Pertanto SWG S.p.A prende atto ed accetta che i nominativi verranno utilizzati esclusivamente ai fini dell'indagine in questione. La materia relativa al trattamento dei dati personali è compiutamente documentata nell'ambito della Procedura PR17 – Gestione della privacy e della data security, del Sistema Qualità certificato,. Oltre a quanto sopra esposto, SWG S.p.A in materia di Gestione della privacy e della data security, ottempera a quanto previsto dai codici etici e di autodisciplina dell'ASSIRM, Associazione nazionale che riunisce i principali istituti di ricerca di mercato e d'opinione e dell'ESOMAR, Associazione internazionale nello stesso ambito, organizzazioni alle quali SWG S.p.A. è iscritta.

Le informazioni fornite nel corso della compilazione del "diario" sono classificabili come "dati personali" solo per il breve lasso di tempo in cui sono state collegate all'inserimento delle risposte nel data base. Tale collegamento permette infatti di associare le informazioni medesime al titolare dell'utenza.

Per il breve lasso di tempo in cui i "dati personali" sono stati disponibili, essi sono stati trattati da operatori specificatamente incaricati, ovvero da Organizzazioni con nomina a responsabile del trattamento, sotto stretto vincolo di riservatezza ed assoluto divieto espresso di comunicazione a terzi.

Al fine di ottemperare nel modo più scrupoloso non solo al dettato formale, bensì anche allo spirito del Codice Privacy, SWG provvede a dissociare, quanto prima possibile, le informazioni personali dai dati raccolti nella compilazione. Tale operazione viene denominata "blindizzazione" ed i dati depurati del riferimento al rispondente assumono la denominazione di dati "blindati". La

blindizzazione viene effettuata al termine della rilevazione ed è irreversibile. Successivamente quindi i dati della rilevazione diventano assolutamente anonimi e perdono conseguentemente la loro connotazione di "dati personali". D'altronde il fine per il quale i dati sono raccolti è esclusivamente di tipo statistico ed i risultati dell'indagine effettuata, che si svolge su un campione estratto casualmente dall'universo da indagare, vengono presentati sotto forma di percentuali, senza alcuna possibilità di riferimento alle singole fonti.

Come si compila il diario?

- *Inizia il tuo diario il mercoledì* ***17 giugno 2015*** *e termina il* ***martedì 23 giugno 2015.***
- ***Svuota il frigo e la dispensa l'ultimo giorno di esperimento****, o il giorno successivo al termine dello stesso, appuntando nella sezione* ***"pulizia frigo/dispensa"*** *tutti i prodotti che hai acquistato durante la settimana e non intendi più consumare (perché scaduti, avariati, o perché acquisti sbagliati, eccetera).*
- ***Il primo giorno di esperimento inaugura dei nuovi sacchetti per la pattumiera****. Potresti essere selezionato per il ritiro dei rifiuti nel turno del mercoledì sera; in tal caso, è importante che i dati relativi ai prodotti alimentari rinvenuti siano riferiti al giorno stesso e non ai giorni precedenti.*
- *Ogni foglio contiene due tabelle (fronte/retro): nella prima tabella trascrivi tutto ciò che hai gettato via ma ritieni* ***commestibile/potenzialmente commestibile****. Per "potenzialmente commestibile" si intende un alimento non più commestibile perché avariato, scaduto, o che non si intende consumare per altre ragioni (acquisto sbagliato, avanzo di porzione troppo abbondante,eccetera). Rientrano in questo gruppo, ad esempio, l'avanzo di pasta che getti via, lo yogurt scaduto dimenticato sul fondo del frigorifero, il succo di frutta avanzato che non si è terminato perché la confezione era troppo grande.*
- *Fornisci il maggior numero di dettagli che puoi sullo stato di conservazione del prodotto che hai deciso di gettar via (ad esempio, se annoti "formaggio con muffa", scrivi anche come la identifichi- patina verde sulla superficie/ cattivo odore/ eccetera). Gli esempi riportati nelle prime pagine della tabella potranno aiutarti nella compilazione.*
- *Nella tabella sul retro della pagina annota se hai gettato via degli scarti o del cibo che* ***non*** *ritieni nemmeno* ***potenzialmente commestibili (osso di pollo, lische di pesce, buccia di frutta , ecc)****.*

Se hai dei dubbi su dove trascrivere un certo prodotto, non preoccuparti e trascrivilo dove ritieni che sia più opportuno! Ci occuperemo noi di classificare il dato correttamente.

- *Se accade qualcosa di inusuale (ad esempio, hai organizzato una festa a casa tua oppure ti sei ammalato) annota l'avvenimento nella sezione "**Commenti e considerazioni sulla giornata**".*
- *Non segnare alimenti che hai gettato via al di fuori delle mura domestiche (al ristorante, al bar), salvo che non provengano dal tuo frigo (ad esempio, segna se hai gettato via una parte del pranzo al sacco che avevi preparato a casa).*
- *Annota l'importo totale della tua spesa alimentare nella pagine "**cena**", nella casella "**Hai acquistato del cibo, oggi?**" Non includere alimenti che hai consumato fuori da casa. Escludi, quindi, la colazione al bar o l'aperitivo! Se qualche altro membro del tuo nucleo familiare ha fatto la spesa durante la settimana, ricordati di annotare l'importo. In alternativa, puoi anche scegliere di allegare lo scontrino fiscale.*
- *Ricorda, **i tuoi risultati non saranno giudicati né ricondotti in alcun modo a te o al tuo nucleo familiare**, quindi non preoccuparti se ti sembra di gettar via troppo!*
- *Non lasciare alcuna pagina vuota! Se non hai sprecato nulla, compila la sezione delle motivazioni all'inizio della pagina.*
- *Non includere nel diario eventuali prodotti alimentari acquistati con il preciso intento di nutrire i tuoi animali domestici. Segna, invece, se hai dato loro del cibo avanzato dal tuo pasto.*
- *Usa le pagine bianche finali se hai terminato lo spazio.*

Come si misura lo spreco?

È molto importante registrare con accuratezza il cibo che non si consuma.

Anche se ti sembrerà ininfluente, anche il fondo del vasetto di uno yogurt ha la sua importanza! Moltiplica quel fondo di vasetto per tutti i consumatori di yogurt in Italia; scoprirai che anch'esso ha un impatto ambientale da considerare.

Non includere mai la confezione quando misuri/pesi il cibo che getti via.

- *Come misurare i liquidi (litri)*:

  usa una CARAFFA GRADUATA 

  oppure, se non ne possiedi una, usa:

  - UN BICCHIERE
    - un cucchiaio

- *Come misurare il peso (grammi)*: usa una BILANCIA DA ALIMENTI

  oppure, se non ne possiedi una, usa:

  - UNA TAZZA
  - *una manciata*(circa un pugno),
    - ✓ mezza manciata (circa mezzo pugno),

- *Come misurare i prodotti interi*: limitati a specificare il numero di prodotti che hai gettato via (UNA SCATOLA di cereali da 300 gr, una mela, *5* carote, ecc).

Inizia da qui!

Informazioni personali *(compilare la casella a destra)*	
Nome	
Cognome	
Indirizzo	
Numero di telefono	
Cellulare	
Email	

Informazioni sul nucleo familiare *(fornire indicazione numerica nel riquadro a destra!)*	
Nr. di adulti nel nucleo familiare (+18 anni di età)	
Nr. di bambini (sotto i 10 anni di età)	
Nr. di ragazzi (11-17 anni di età)	

Quanti dei componenti adulti (+18 anni di età) del nucleo familiare ricadono nelle seguenti categorie? *(fornire indicazione numerica nel riquadro a destra!)*	
Impiegati a tempo pieno	
Impiegati part-time	
Libero professionisti	
Non retribuiti/volontari	
Studenti	
Casalinga/ o	

In pensione	
Disoccupati (in cerca di occupazione)	
Disabili	
Altro (specificare)	

Grazie per il tuo aiuto!

9.5 Pilot diary sample

Esempio di diario compilato

LUNEDÌ- COLAZIONE

Se non hai sprecato nulla, specifica la ragione (barrare):

abbiamo consumato tutto il cibo del pasto ☐ non abbiamo

consumato il pasto in casa ☐ altro(specificare)

Commestibile													
Cosa hai gettato?	**Motivazione**	**Tipologia di prodotto**						**Quanto ne è stato gettato via?**	**Dove è stato smaltito?**				
Fornisci una descrizione più completa possibile (prodotto, marca)		**Surgelato**	**Confezionato ***	**Fresco**	**Da asporto**	**Fatto in casa**	**altro**	**Peso, volume o numero di pezzi**	**Indifferenziato**	**Organico**	**Scarichi**	**Animali**	**Altro**
Biscotti Plasmon	*I miei figli non li hanno mangiati ma li avevano già masticati, quindi li ho dovuti gettare via*		x					*1,5 pezzi*		x			
Cereali Fitness	*Fondo della tazza*		x					*Mezza mancia ta*		x			
Pane in busta Mulino Bianco	*In ritardo per il lavoro, non sono riuscito a finirla*							*Mezza fetta*		x			
Latte Granarolo alta qualità intero	*Scaduto in frigo (cattivo odore)*		x					*2 bicchieri pieni*			x		
Torta di mele	*Avanzo di una fetta lasciata da mio figlio*						x	*50 gr*				x	

*Confezionato= esempio: scatola, busta, latta/lattina, barattolo, tetrapak/tetra brik..

LUNEDÌ- COLAZIONE

Non commestibile													
Cosa hai gettato?	**Motivazione**	**Tipologia di prodotto**						**Quanto ne è stato gettato via?**	**Dove è stato smaltito?**				
Fornisci una descrizione più completa possibile (prodotto, marca)		**Surgelato**	**Confezionato ***	**Fresco**	**Da asporto**	**Fatto in casa**	**altro**	**Peso, volume o numero di pezzi**	**Indifferenziato**	**Organico**	**Scarichi**	**Animali domestici**	**Altro**
Bustine di tè usate	usate		x					2	x				
Caffè Lavazza	Fondo caffettiera		x					Un cucchiaino		x			

*Confezionato= esempio: scatola, busta, latta/lattina, barattolo, tetrapak/tetra brik..

9.6 Post food waste diary survey

Post food waste diary survey

Gentile partecipante,
La ringraziamo per esser giunto sino alla fine del nostro esperimento.
Quando avrà rispedito il questionario le verranno accreditati i punti come da accordi.
Nelle domande che seguono, le verrà chiesto se è cambiato qualcosa nella sua percezione dello spreco alimentare domestico e in che modalità è stato coinvolto nell'esperimento. L'obiettivo finale, per noi, è di conoscere a fondo la validità del modello: nessuna delle risposte da lei fornite verrà valutata per giudicare il suo coinvolgimento soggettivo, quindi la invitiamo a rispondere del tutto liberamente.
A nome dei nostri ricercatori e di SWG, La ringraziamo per la pazienza e la disponibilità accordateci sino ad ora.

1. ***Dopo aver compilato il diario per una settimana, come è cambiata la sua percezione dello spreco domestico relativo al suo nucleo familiare?*** SINGLE CODE

a. *Gettiamo via **molto più** di quanto non credessi*
b. *Gettiamo via **un po' di più** di quanto non credessi*
c. *Gettiamo via un ammontare **simile** a quello che mi aspettavo*
d. *Gettiamo via **un po' meno** di quanto non credessi*
e. *Gettiamo via **molto meno** di quanto non credessi*

2. ***Alcuni dei soggetti intervistati hanno dichiarato di non aver compilato il diario TUTTE le volte che gettavano via qualcosa. Altri, invece, ritengono di aver cambiato il loro comportamento abituale perché sensibilizzati al tema a causa dell'esperimento. Quale delle seguenti affermazioni sentirebbe più vicina al suo caso (la risposta non avrà alcuna ripercussione sui punti che le verranno accreditati alla fine dell'esperimento!)*** MULTICODE

a. *Mi sono reso conto di quanto cibo gettiamo via e quindi ho iniziato a gettar via meno possibile*
b. *Non ho segnato quello che gettavo via se i quantitativi erano esigui*
c. *Non ho sempre segnato quello che gettavo via se si trattava di rifiuti non commestibili*
d. *Alcuni membri del mio nucleo familiare potrebbero aver gettato via del cibo senza segnarlo*
e. *Non ho segnato quello che gettavo via se avevo fretta*

3. ***C' e stato qualche cambiamento nelle abitudini alimentari della settimana di sperimentazione rispetto al solito ? se si indicare quali (compilare)_____***

4. ***Facendo riferimento a tutta la settimana di diario e tenendo presente tutti gli eventi poco usuali che sono accaduti (ospiti a cena, più pasti del solito consumati fuori casa, fine settimana trascorso in villeggiatura, eccetera) quanto cibo/bevande ha gettato rispetto alle sue normali abitudini?*** SINGLE CODE

a. *Il quantitativo di cibo e bevande gettati via durante la settimana di sperimentazione è **molto inferiore** di quanto gettato via normalmente*
b. *Il quantitativo di cibo e bevande gettati via durante la settimana di sperimentazione è **un po' inferiore** di quanto gettato via normalmente*
c. *Il quantitativo di cibo e bevande gettati via durante la settimana di sperimentazione è **circa uguale** a quanto gettato via normalmente*
d. *Il quantitativo di cibo e bevande gettati via durante la settimana di sperimentazione è **poco superiore** di quanto gettato via normalmente*
e. *Il quantitativo di cibo e bevande gettati via durante la settimana di sperimentazione è **molto superiore** di quanto gettato via normalmente*
f. *Non saprei*

5. ***Considerando i seguenti alimenti, quanto è stato gettato <u>via durante la settimana di esperimento</u> rispetto alle sue aspettative precedenti?*** SINGLE CODE EACH

Rispetto a ciò che credevo, abbiamo gettato …	Significativamente di più	Un po' di più	Né più, né meno	Un po' meno	Significativamente di meno	Non consumo questo alimento/non so
Frutta						
Verdura e insalata						
Pomodori						
Carne/pesce						
Formaggio						
Yogurt						
Latte						
Succhi di frutta						
Pasta cotta						
Parti non commestibili (buccia di frutta, lische di pesce, ecc..)						
Pane, biscotti, prodotti da forno						
Legumi freschi						
Prodotti in scatola/barattolo						
Prodotti surgelati						

6. ***Con riferimento alle due <u>settimane successive all'esperimento</u>, sono stati gettati via alimenti acquistati durante la settimana di diario?*** SINGLE CODE EACH
   a. *Sì (vai alla 6)*
   b. *No (vai alla 7)*

7. ***Se sì, cosa è stato gettato dei seguenti alimenti?***

Prodotti acquistati dal 17 al 23 giugno e gettati nelle due settimane successive	
Frutta	
Verdura e insalata	
Pomodori	
Carne/pesce	
Formaggio	
Yogurt	
Latte	
Succhi di frutta	
Pasta cotta	
Parti non commestibili (buccia di frutta, lische di pesce, ecc..)	
Pane, biscotti, prodotti da forno	
Legumi freschi	
Prodotti in scatola/barattolo	
Prodotti surgelati	

8. ***A seguito della sua partecipazione all'esperimento, ritiene di poter valutare il quantitativo di rifiuti alimentari generati normalmente dal suo nucleo familiare come segue:*** SINGLE CODE EACH

Normalmente, gettiamo via …	Parecchio	Una quantità minima	Niente	Non consumo questo alimento/ non so
Frutta				
Verdura e insalata				
Pomodori				
Carne/pesce				
Formaggio				
Yogurt				
Latte				
Succhi di frutta				

Parti non commestibili (buccia di frutta, lische di pesce, ecc..)				
Pasta cotta				
Pane, biscotti, prodotti da forno				
Legumi freschi				
Prodotti in scatola/barattolo				
Prodotti surgelati				

9. ***Con riferimento agli <u>scorsi tre mesi</u>, quanto spesso le è capitata una situazione come quella descritta nella colonna 1?*** SINGLE CODE EACH

	1	più di 6 volte al mese	4-5 volte al mese	2-3 volte al mese	Una volta al mese	1-2 volte nelle ultime tre settimane	Mai nelle ultime tre settimane	Non ricordo	Non so
A	Acquisto di prodotti alimentari insoliti che poi non ho utilizzato affatto/ ho usato solo in parte								
B	Acquisto di una confezione troppo grande che non siamo riusciti a terminare								
C	Acquisto di prodotti alimentari in offerta speciale che non siamo riusciti a terminare								
D	Acquisto di prodotti non utilizzati a causa di impegni imprevisti fuori (quali, ad esempio, cene fuori casa, straordinari al lavoro, ecc)								
E	Avanzi di pasto **non** consumato e **non** conservato								
F	Avanzi di pasto conservati in frigo ma **non** più consumati								
G	Avanzi di pasto conservati in freezer ma **non** più consumati								

10. ***Alla luce dell'esperimento, approssimativamente quanto cibo ritiene di gettar via <u>ogni settimana (grammi)?</u>***
    a. *INSERIRE VALORE NUMERICO*
    b. *Non so*

11. ***Alla luce dell'esperimento, approssimativamente quanto cibo ritiene di gettar via <u>ogni mese (euro)?</u>***
    c. *INSERIRE VALORE NUMERICO*
    d. *Non so*

12. ***La compilazione del diario è avvenuta****: SINGLE CODE*
    a. *Di giorno in giorno*
    b. *Saltuariamente, irregolarmente (ad esempio 2/3 giorni a settimana, cercando di ricordare le informazioni dei giorni precedenti)*
    c. *Alla fine della settimana (fornendo i dati dei giorni precedenti)*

13. ***Il suo nucleo familiare è stato inserito nel gruppo di controllo per il ritiro dei rifiuti da parte di un nostro ricercatore?*** *SINGLE CODE*
a. *Sì (vai alla 14)*
b. *No (vai alla 19)*

14. ***Se sì, ha effettivamente ricevuto la visita di un nostro ricercatore?*** *SINGLE CODE*
    a. *Si (vai alla 15)*
    b. *No (vai alla 19)*

15. ***Se ha ricevuto la visita di un nostro ricercatore, aveva pattuito esattamente il giorno della visita o aveva dato disponibilità di più giorni?*** *SINGLE CODE*
    a. *Un giorno*
    b. *Più giorni*

16. ***Ha ricevuto la visita di un nostro ricercatore per la seconda volta?*** *SINGLE CODE*
    a. *Si*
    b. *No*

17. ***Ritiene di esser stato influenzato dalla visita del ricercatore:*** *MULTICODE*
    a. *Nella produzione di rifiuti alimentari (ho gettato via meno, sono stato più attento)*
    b. *Nella compilazione del diario (ho riportato le informazioni accuratamente)*
    c. *In nulla*

18. ***Ritiene che le informazioni riportate nel diario coincidessero esattamente con quanto rinvenuto nei rifiuti?*** *SINGLE CODE*
    a. *Si*
    b. *In parte*
    c. *Non saprei*

19. ***Generalmente, differenzia i rifiuti tra organico (umido) e indifferenziato?*** *SINGLE CODE*
    a. *Si*
    b. *No*

20. ***Se sì, ritiene di gettar via rifiuti alimentari nell'indifferenziato****: SINGLE CODE*
    a. *Mai*
    b. *Ogni tanto (per errore)*
    c. *Spesso (per errore o altri motivi- fretta, eccetera)*

21. ***Ora che il diario è stato completato, ritiene che lei e il suo nucleo familiare farete degli sforzi per ridurre lo spreco alimentare domestico?*** *SINGLE CODE*
    a. *Sì, faremo il possibile per ridurre il nostro spreco domestico*
    b. *Faremo qualche sforzo per ridurre il nostro spreco domestico*
    c. *Non faremo sforzi per ridurre il nostro spreco domestico*
    d. *Facciamo già tutto quello che possiamo per non sprecare/per sprecare il meno possibile*

Il questionario termina qui.

Grazie per aver partecipato al nostro esperimento.