



Food waste: causes, impacts and proposals



**Fondazione
Barilla**

il tuo cibo, la tua terra
people, environment, science, economy

THE BCFN CONTRIBUTION TO THE MAJOR ISSUES IN FOOD AND NUTRITION

The multidisciplinary analysis concerning the people, environment, economy and society has led to the definition of 4 specific lines of interconnected studies on the issues related to food and nutrition.



▶ FOOD FOR ALL

In the area Food for All, the Barilla Center for Food & Nutrition addresses the issues of access to food and of malnutrition, with the aim of reflecting on how to promote better governance of the global food system in order to make a more equitable distribution of food possible and to encourage a better impact on social welfare, health and the environment.



▶ FOOD FOR SUSTAINABLE GROWTH

With reference to the area Food for Sustainable Growth, the Barilla Center for Food & Nutrition aims to examine the issue of a better utilization of natural resources within the food chain. More specifically, the analyzes performed have allowed us to point out the weaknesses, to assess the environmental impact of the production and consumption of food and to formulate (a set of) proposals and recommendations concerning personal and collective lifestyles that can have a positive affect on the environment and natural resources.



▶ FOOD FOR HEALTH

In the Food for Health area, the Barilla Center for Food & Nutrition decided to start its research work by analyzing the relationship that exists between nutrition and health. It thoroughly analyzed the various recommendations made by the most authoritative scientific institutions in the world, in addition to the themes that emerged at different stages of discussion with the most qualified experts, thus providing civil society with a concise and effective overview of concrete proposals aimed at facilitating the adoption of a correct lifestyle and a healthy diet.



▶ FOOD FOR CULTURE

In the Food for Culture area, the Barilla Center for Food & Nutrition described man's relationship with food. In particular, the BCFN wanted to retrace the most important steps along the path that have accompanied the development of the man-food relationship, bringing (through moments of comparison) the fundamental role of the "Mediterranean-ness" and its relevant dimensions to the center of attention.



THE VISION OF BARILLA CENTER FOR FOOD & NUTRITION

The Barilla Center for Food & Nutrition (BCFN) is a center of multidisciplinary analysis and proposals which aims to explore the major issues related to food and nutrition on a global scale. Created in 2009, BCFN intends to listen to the demands emerging from society today by gathering experience and qualified expertise on a worldwide level and promoting a continuous and open dialogue. The complexity of the phenomena under investigation has made it necessary to adopt a methodology that goes beyond the boundaries of different disciplines.

These topics under study are broken down into four areas: Food for Sustainable Growth, Food for Health, Food for All and Food for Culture. The areas of analysis involve science, the environment, culture and the economy; within these areas, BCFN explores topics of interest, suggesting proposals to meet the food challenges of the future.



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Dear Reader,
Huge food losses and waste are constantly occurring in our fields, in our factories, in our restaurants, and in our homes. This phenomenon, which we analyze in-depth in this document, casts a worrisome shadow over the development model that has governed the world's economy for the past fifty years. The kind of economy which now – in light of the knowledge we have available – we believe is entirely unsustainable.

An economy that is measured solely by the growth in Gross Domestic Product and puts its foundations on increases in consumption, without taking into account the fact that natural resources are limited and that our planet has physical borders that represent an insurmountable limitation on uncontrolled development. An economy that has never seen wasting resources especially food resources, as a negative factor, but has, instead tolerated waste, considering it an inevitable by-product of its production model.

This is not the economy that we aspire to for our children's future. The cultural, social, and economic environment that we wish to live in does not accept waste, either that of rich countries, which occurs mainly in homes or in retail distribution, or that of developing countries, which originates, above all in the fields, due to the difficulty in harvesting, storing, and transporting crops.

This does not merely involve reporting an unsustainable phenomenon and structure, but displaying possible solutions and paths. Therefore, in this document, along with the presentation of rather surprising data on the dimensions of the food loss and waste phenomenon and the explanation of its main causes, possible solutions are highlighted, thanks to an in-depth analysis of good practices gathered from different parts of the world. Combating food waste is a battle that is won only by joining all forces together: the people who cultivate the fields, those who produce and distribute food, and the people who purchase and consume it.

We're ready to do our part.
Enjoy reading!

Guido Barilla
Guido Barilla
BCFN President

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

Food waste is defined in different ways by institutions and within the specialized literature. There is not, in fact, any standardized definition of the phenomenon, or any homogeneous and comparable data.

Taking account of all of the phases of the food supply chain, the BCFN proposes to distinguish between:

- Food losses, meaning the losses that occur upstream of the food supply chain, mainly during the sowing, cultivation, harvesting, processing, preserving, and first agricultural transformation stages;
- Food Waste, meaning the waste that takes place during industrial processing, distribution, and final consumption.

In an analysis carried out in 2011 by FAO, annual global food waste is estimated to be about 1.3 billion tons, equivalent to about a third of the total food production intended for human consumption.

According to another piece of research (Smil, 2010), if, along the food supply chain, we take account not only of losses and waste, but also the conversion of food production into animal feed, we find that only 43% of the caloric equivalent of the products cultivated for food purposes worldwide is directly consumed by humans.

According to the USDA (2007), in the United States a total of 30% of the food intended for human consumption is wasted each year, primarily in the home and in restaurants and food service establishments.

According to Eurostat data (2006), the quantity of food wasted annually in Europe is 89 million tons, equivalent to 180 kg per capita, but this figure does not take account of the losses during the production and harvesting stages.

Looking only at waste in the home, and using various national data sources (which are not always entirely comparable), we find that the amount wasted per person per year is: 110 kg in Great Britain, 109 in the United States, 108 in Italy, 99 in France, 82 in Germany and 72 in Sweden.

There are numerous causes of losses and waste, and they are differentiated according to the various stages of the food supply chain.

In developing countries, the most significant losses are concentrated at the first part of the food supply chain, primarily due to limits in the cultivation, harvesting, and preserving techniques, or due to a lack of adequate transportation and storage infrastructures.

In industrialized countries, the largest proportion of waste occurs at the final stages of the food supply chain (household consumption and restaurants and food service establishments, in particular). However, even in these countries, the losses recorded at the

agricultural stage are not negligible (due to sizing and esthetic standards, product quality regulations, production surpluses, or economic factors). For example, in Italy in 2009, 17.7 million tons of agricultural produce was left in the fields, representing 3.25% of total production (Segrè and Falasconi, 2011).

In agriculture, it appears on a first analysis that the food losses are attributable to climatic and environmental factors, and disease and parasites. The significant differences found within this stage between developing and developed countries may be attributed to the available technology and infrastructures, agricultural expertise and the techniques used for land preparation, sowing, cultivation, harvesting, processing, and storage.

In developed countries, and sometimes also in developing countries, regulatory and economic factors play a part. However, there is undoubtedly still a long way to go in understanding the causes of the losses at the initial part of the food supply chains.

During the stages of first processing of the agricultural product and semi-finished goods, the main causes of waste that can be identified are technical malfunctions and inefficiencies in the production processes - generally referred to as "production waste."

During distribution and sales (both wholesale and retail), there are many causes of waste, including inappropriate ordering and incorrect forecasting of demand.

Waste in the home arises due to the difficulties consumers have with correctly interpreting food labeling; the preparation of over-generous portions (both in restaurants and in the home); mistakes made at the purchase planning stage (often induced by special offers); and foods not being preserved appropriately.

Food losses and waste have negative environmental and economic impacts and their existence raises questions for society.

In order to estimate the environmental impact of a wasted food, it is necessary to consider its entire "life cycle" (or in other words, work through all the stages of the food supply chain), calculating the indicators commonly used, such as the carbon footprint (CO₂ equivalent), the ecological footprint (m² equivalent), and the water footprint (m³ of virtual water).

The data gathered in Italy has demonstrated that the fruits and vegetables thrown away at sales outlets alone account for the consumption of more than 73 million m³ of water (water footprint) in a year, as well as the use of environmental resources equal to almost 400 million square meters equivalent (ecological footprint) and the emission into the atmosphere of more than 8 million kg of carbon dioxide equivalent (carbon footprint).

In Great Britain, food waste is responsible for the emission of 25.7 million tons of CO₂ equivalent per year: 78% of this emission is attributable to waste that could be "always avoidable," while 22% relates to waste that is "sometimes avoidable;" the water footprint of the food wasted in the home amounts to 284 liters per person per day.

In the United States, it is estimated that the emissions during the production, processing, packaging, distribution, and disposal stages of the food not consumed amount to approximately 112.9 million tons of CO₂ equivalent per year (Venkat, 2011).

In Italy, the estimated values of food waste are €10 billion per year for the losses occurring in agriculture, €1.2 billion for industrial waste, and €1.5 billion for losses concentrated in the distribution stage, for a total of around €12.7 billion (Segrè and Falasconi, 2011). In Great Britain, food wasted each year at the household level amounts to £18 billion, whereas in the United States, the waste at the consumption stage alone is equivalent to \$124.1 billion (around 63% of the total), costing a family of four about \$1,600 per year, on average (WRAP, 2008).

Food waste is a phenomenon that raises serious questions from a social point of view. In fact, given the problem of malnutrition that is afflicting around one billion people

THERE ARE MANY CAUSES FOR FOOD LOSSES AND WASTE AND TODAY WE MUST BETTER UNDERSTAND, IN PARTICULAR, THE FACTORS AT PLAY UPSTREAM IN THE FOOD SUPPLY CHAIN

FOOD WASTE HAS ENVIRONMENTAL, ECONOMIC, AND SOCIAL IMPACTS

THE BCFN WOULD
LIKE TO PROPOSE
THAT GOVERNMENTS
AND INSTITUTIONS
GIVE PRIORITY TO 7
RECOMMENDATIONS

worldwide, the increase in food waste, even in the form of excessive nutrition (contributing to the increase in the obesity epidemic in Western countries), appears extremely unacceptable.

The FAO points out that the quantity of food that ends up in the garbage in industrialized countries (222 million tons) matches the food production available in Sub-Saharan Africa (230 million tons).

The lack of awareness of the scale of the waste that each person produces, its environmental impact, and its economic value certainly do not assist with tackling this problem.

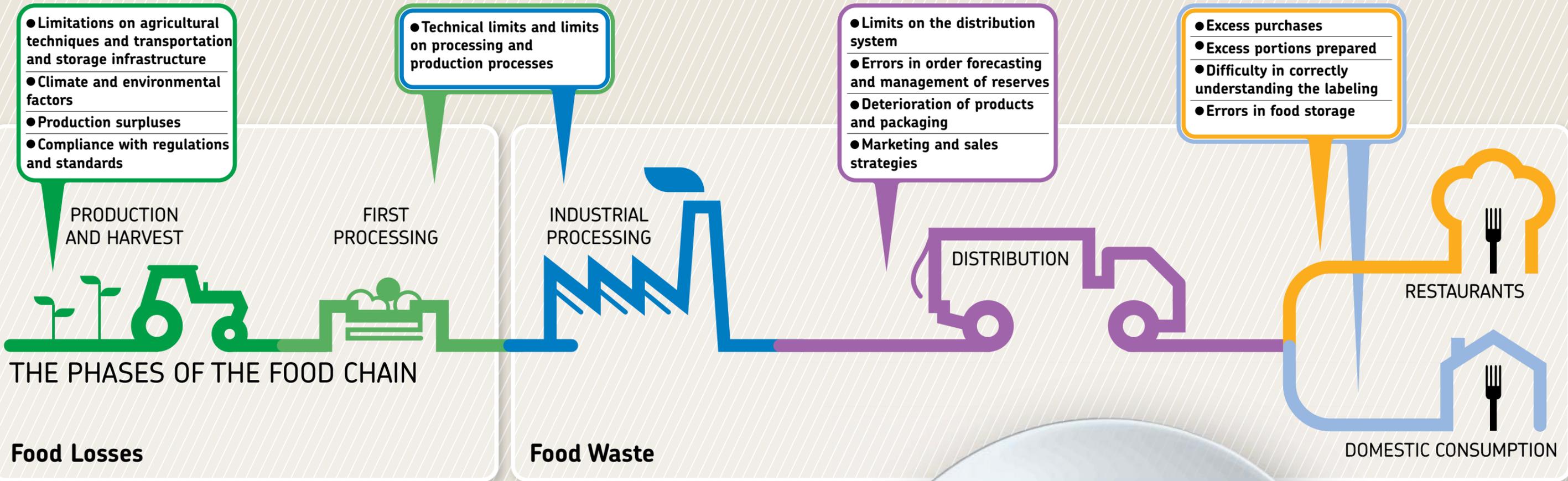
Given the scale reached by the food waste phenomenon, and above all the scope of its impacts, the BCFN has identified seven recommendations that it wishes to bring to the attention of governments and political institutions:

- 1) Common definitions and metrics. Assigning a standardized meaning to the terms “food losses” and “food waste,” and harmonizing the collection of statistical data at an international level.
- 2) Understanding the causes. Understanding in greater detail why food waste occurs in the various food supply chains and better assessing its impacts.
- 3) Reducing in order to recover less. Investing first in reducing food losses and waste and then in their recovery.
- 4) (Re)use. Launching initiatives to recover the waste still not eliminated, by distribution to disadvantaged persons, use as animal feed or, as a last resort, for producing bioenergy.
- 5) A political priority. Managing the reduction of waste at an institutional level, and also ensuring that the adoption of standards does not introduce unjustified losses and waste along the food supply chain.
- 6) Cooperating to save. Developing supply chain agreements between farmers, producers, and distributors for more appropriate planning of food supply.
- 7) Information for education. Raising consumer awareness of the waste and teaching consumers how to purchase, preserve, prepare, and ultimately dispose of food on a more sustainable basis.



FOOD LOSSES AND FOOD WASTE: CAUSES AND IMPACTS

• CAUSES



• IMPACTS

ENVIRONMENTAL

- Greenhouse gas emissions
- Soil degradation
- Waste of water resources
- Energy consumption

In Italy, fruits and vegetables thrown away at points of sale involve the consumption of over 73 million cubic meters of water:

36.5 billion two liter bottles

ECONOMIC

- Cost/Value of the food wasted
- Value of the negative externalities produced
- Opportunity-cost of farmland

On average, in the U.S. the food wasted by a family of four equals the sum of US \$ 1,600 per year

4.4 US \$ a day

ETHICAL/SOCIAL

- Food waste ↔ Difficult food access
- Overeating ↔ Malnutrition
- Waste of nutrients ↔ Nutritional deficiencies

“Sufficient to feed a family in a developing country”



1/3 of the world's food production ends up in the trash

1.3 billion tons

1. WHAT FOOD
LOSSES AND FOOD
WASTE MEAN



1.1 WHAT DO WE MEAN BY FOOD WASTE?

The term *food waste* most commonly means food that was purchased but not consumed and ends up in the garbage.

This is by no means, however, the only valid meaning because, along the whole food supply chain, there are various reasons why edible food products are discarded.

There is no single definition of food waste, whether as an institutional definition or one in specialized scientific literature.

A first definition of *food waste* was given by the UN Food and Agriculture Organization (FAO) and includes any healthy or edible substance that – instead of being destined for human consumption – is wasted, lost, degraded, or consumed by parasites at every stage of the food supply chain (*Food Supply Chain, FSC*).¹

In a recent study conducted by the Swedish Institute for Food and Biotechnology (SIK), which was commissioned by FAO,² a distinction between *food losses* and *food waste* was also proposed. *Food losses* “take place during agricultural production, post-harvest, and processing stages in the food supply chain,”³ while *food waste* occurs “at the end of the food chain (distribution, sale and final consumption):”⁴ the former is due to logistical and infrastructural limitations, while the latter is because of behavioral factors.⁵

Some scholars, including Professor Jan Lundqvist of the Stockholm International Water Institute (SIWI), speak of *field losses* and *spoilage*, referring to the loss that takes place in the fields and during transportation and storage.⁶ The SIK also points out that food loss and waste only refer to products intended for human consumption, therefore excluding animal feed and non-edible parts of plants and animal products.⁷ Therefore, food that was originally meant for human consumption, but which is no longer part of the human food chain, is considered as food loss, even if it is then re-utilized for non-food use (animal feed, bioenergy, etc.).

We must therefore distinguish between *planned* and *unplanned* non-food use, counting the latter as food loss⁸ (despite it being recuperated later).

Food waste expert and activist Tristram Stuart agrees: according to him, food waste is any product that, rather than being meant for human consumption, is deliberately given to animals, or is a sub-product resulting from the post-production of food for human use.⁹

The definition of *food waste* varies by country. In Europe, there is no single definition of food waste, but recently, within the Agricultural and Rural Convention, it was defined as the “whole of the discarded products of the food supply chain which, for economic or esthetic reasons, or for closeness to the expiry date, despite still being edible and therefore potentially intended for human consumption, in the absence of a possible alternative use, are eliminated and disposed of, producing negative effects from the environmental point of view, economic costs and missed revenue for companies.”¹⁰

Other definitions were proposed in some European countries. A complete work on the topic was carried out in Italy by food waste researchers Andrea Segrè and Luca Falasconi, who define food waste as “food products that were discarded from the food supply chain, which have lost commercial value, but can still be intended for human consumption.”¹¹

In Great Britain, the Waste Resources Action Programme (WRAP) offers a definition¹² of food waste, distinguishing between:

- *Avoidable*: food and drinks that are thrown away despite still being edible (for example, slices of bread, apples, meat, etc.);
- *Possibly Avoidable*: food and drinks that some people consume and some do not (for example, bread crusts), or food that can be edible, if cooked one way instead of another (such as potato skins, etc.);
- *Unavoidable*: waste deriving from the preparation of food or drinks that are not, and could not, be edible (for example, meat bones, egg shells, pineapple skins, etc.).

In the United States, the Environmental Protection Agency (EPA) defines *food waste* as “uneaten food and food preparation waste from residences and commercial establishments such as grocery stores, restaurants, bars, and company cafeterias.” This is a general definition that allows the various American states to arbitrarily establish what food waste is, according to their own purposes and objectives.

For the California Department of Resources Recycling and Recovery (CalRecycle), the definition of food waste is equal to that of *food scraps*. Therefore, by food waste they mean “any discarded food, including excess food, leftovers, or unsold food (for example, due to the poor quality of some vegetables, or leftovers such as onion skins or carrot tips), as well as any leftovers in dishes.”

Starting in the mid-Nineties, the United States Department of Agriculture (USDA) pinpointed three different types of losses recorded along the food supply chain:

- losses from the fields to point of sales (*losses from primary to retail*);
- losses at point of sales (*losses at the retail level*);
- losses by the consumer at home and out of the home (*losses at the consumer level*).

This last stage specifically includes the edible food that becomes refuse because it is not used by the final consumer (*avoidable waste from eaten food*), and the inedible scraps (*unavoidable waste from eaten food*).¹³

A broader definition is the one offered by Professor Vaclav Smil of the University of Manitoba, who considers food waste as an individual’s excessive nutrition as well, or the difference between the quantity of food that each person consumes and what he or she really needs (energetic value).¹⁴

THERE IS NO INTERNATIONALLY-ACCEPTED DEFINITION OF FOOD WASTE



FOOD LOSSES AND FOOD WASTE



FOOD PRODUCTS DISCARDED ALONG THE ENTIRE FOOD SUPPLY CHAIN

ALWAYS AVOIDABLE, SOMETIMES AVOIDABLE, AND UNAVOIDABLE WASTE



1.2 ONE POSSIBLE DEFINITION OF FOOD WASTE AND LOSSES OFFERED BY THE BCFN

FOOD LOSSES AND WASTE REGISTERED ALONG THE ENTIRE FOOD SUPPLY CHAIN

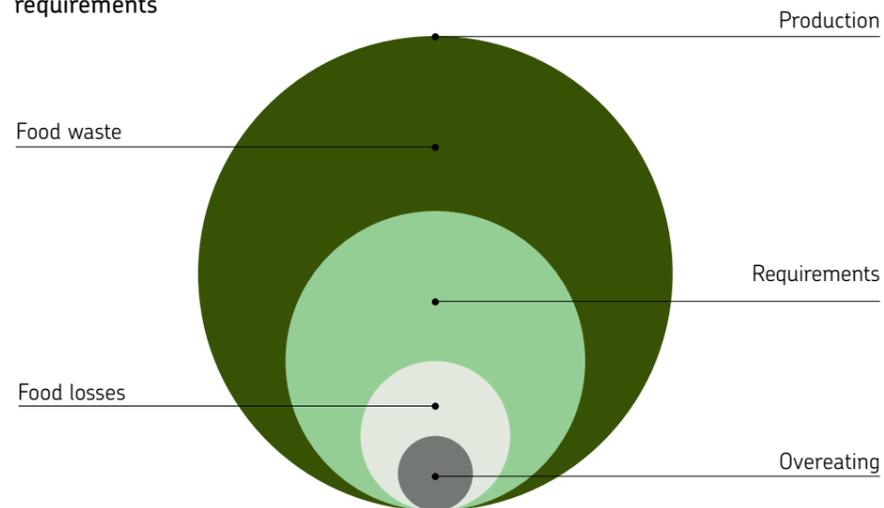
A distinction is offered here between food “losses” and “waste,” which might take place along the whole food supply chain, so that:

- *Food Losses* are the losses that take place upstream of the food supply chain, mainly during the harvesting, processing, and primary agricultural transformation stages. These are due to climatic and environmental factors (which are difficult to summarize) and accidental causes that can be traced back to the limitations of agricultural technology and infrastructure used in the area. This category also includes the losses caused by economic reasons, such as the quality and esthetic standards imposed by the market, food regulations, and the greater or lesser convenience of harvesting operations.
- *Food Waste* is the waste that takes place during industrial processing, distribution, and final consumption. Also included in this are intentional choices, based on which perfectly edible food is discarded and “thrown away.”

EXCESSIVE NUTRITION AS A FORM OF FOOD WASTE

Losses and waste lead to a very significant reduction of the food that is actually available for human consumption. On the other hand, consumption in developed countries far outweighs the caloric requirements recommended by international organizations, placing excess weight and obesity (and their related pathologies) at the center of the debate. For this reason, it is considered necessary to follow the suggestions of Professor Smil, who would like us to also take the overeating phenomenon into consideration when we talk about food waste (Figure 1.1).

Figure 1.1. Losses, waste, and overeating between food production and nutritional requirements



Source: BCFN elaboration, 2012.



1.3 LOSSES AND WASTE ALONG THE FOOD SUPPLY CHAIN

Every stage of the food supply chain is made up of different operations, both agricultural and industrial, within which different types of losses and waste occur. On a global level, the food chain is becoming longer and more complex. Elements such as the expectations by consumers for variety and convenience of choice, the growing portion of the population moving from the rural areas to cities, and the resulting increase in distance dividing production areas from consumption ones, have made the distribution structure and the food offered increasingly complex. At the same time, the increase in demand for meat, fruits, vegetables, and other easily perishable products increases the risk of losses and waste.

We will focus on all the stages of the food chain in this document to highlight the various actors contributing to food losses and food waste. We identified six main areas (Figure 1.2.):

- Cultivation, agricultural production, and harvest;
- First processing;
- Industrial processing;
- Distribution;
- Restaurants and food service;
- Household consumption.

Figure 1.2. Stages of the food chain and food losses and waste



Source: BCFN elaboration 2012.

CULTIVATION,
AGRICULTURAL
PRODUCTION, AND
HARVESTING

The first stage of the chain includes those activities that are closely connected to agricultural cultivation and production, during which losses can be recorded. In addition to poor weather conditions, crop losses can occur because of diseases and infestations. Later, during, and after the harvest, more losses can occur because of processing, storage, and transportation techniques. Given the extreme variety of factors involved in their occurrence – including reasons of economical convenience – losses are particularly difficult to estimate.

The next two stages concern the first processing operations of agricultural products and

industrial processing, which include treatment and harvest procedures and their subsequent conversion into edible food products. At these stages, waste is due to scraps derived from food processing, partly physiological and partly owing to the limitations of techniques and technologies, and the processing techniques used. Packaging processes and choice of food packaging materials also play a role in the prevention of waste.

The fourth stage concerns the wholesale and retail distribution processes, where a large part of the waste is made up of the food that has remained unsold through compliance with food safety legislation and quality and esthetic standards, marketing strategies, and logistical aspects.

The final stages coincide with final consumption, which generally takes place in food service locations and in private homes. Waste that is recorded at this stage is mainly due to the excessive portions served or the quantity of food that is prepared, the overabundance of purchased foods, the inability to consume food before its expiration date, and the difficulty in correctly interpreting instructions on labels.

We will come back to the causes of losses and waste (see Chapter 3), but first we would like to illustrate the general framework in which this phenomenon belongs.

FIRST PROCESSING
AND INDUSTRIAL
TRANSFORMATION

DISTRIBUTION

RESTAURANT INDUSTRY
AND DOMESTIC
CONSUMPTION



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2. AMOUNT OF FOOD LOSSES AND WASTE



2.1 GLOBAL SCENARIO

THE AVAILABLE DATA IS LIMITED AND HETEROGENEOUS, ABOVE ALL REGARDING FOOD LOSSES



The limited availability and heterogeneity of data hinder establishing a global estimate of total food losses and waste. The data that is available has been gathered from studies and research carried out by institutions and international organizations, mostly at a national level.

The analyses relating to the losses that occur at the first stages of the food supply chain are scarce and insufficient. There is more detailed information available, however, regarding the final consumption analysis of food waste. Specific monitoring techniques, including *waste sorting analysis*,¹ enable researchers to gather reliable data on the composition of home refuse.

One of the few global analyses available is a study carried out in 2011 by FAO,² which estimates annual global waste at approximately 1.3 billion tons, equivalent to roughly one-third of total food production.

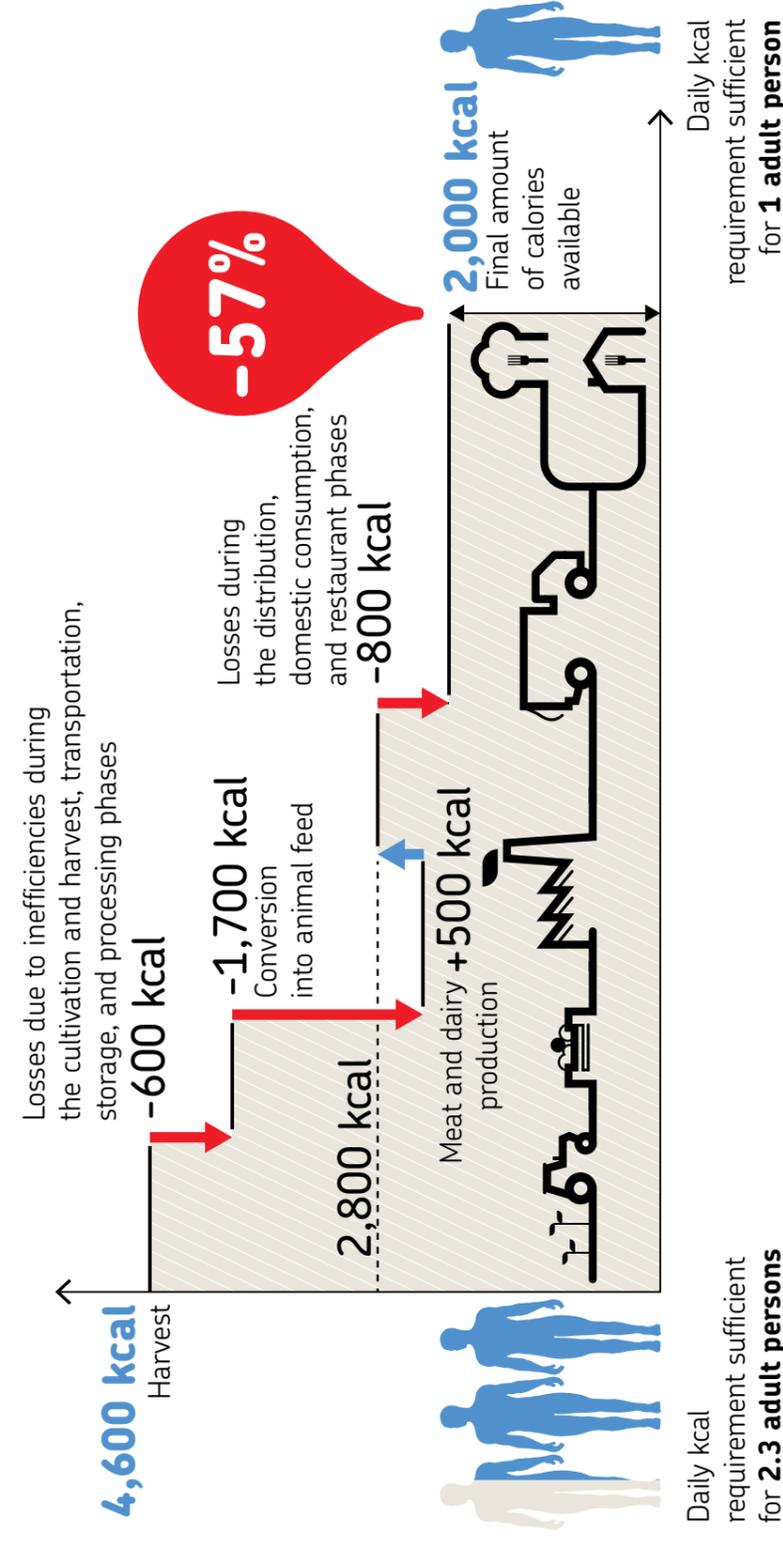
Furthermore, research carried out by Smil³ provides a global overview of losses and waste that take place along the entire food chain, or “from the field to the fork:”

Figure 2.1. An estimate of global food production and food loss along the entire food chain (daily kcal per capita)

DISPERSION OF AVAILABLE CALORIES FROM THE FIELD TO THE TABLE

BCFN interpretation of the SMIL diagram

Estimate of food losses along the entire chain (daily Kcal per capita)





© Corbis

on average, only 43% of the products cultivated for food is actually consumed. Farmers are able to produce the equivalent of 4,600 kcal/capita/day. In addition to the losses because of inefficiencies in the harvesting, transportation, storage, and processing stages, which cause an initial reduction (600 kcal), the conversion of food production (mainly grains) into food intended for livestock has the most significant impact on the amount of daily kilocalories actually available for human consumption. This conversion causes a further net decrease of 1,200 kcal/capita. While not really food waste per se, allocating food to animals raises many questions among those studying food security.

Finally, food retail distribution causes additional waste (equal to 800 kcal), leading to a usable caloric content of just 2,000 kcal (Figure 2.1.).

Figure 2.2. sums up the most important studies in the available literature that provide data concerning food losses and waste per country, with reference to the different stages of the FSC (food supply chain).

Figure 2.2. Stages of FSC that were taken into consideration in the various studies available



Source: BCFN elaboration, 2012.

2.2 FOOD WASTE IN THE EUROPEAN UNION

A recent DG Environment study from the European Commission⁴ analyzes food waste in the European Union, which falls into four stages of the food supply chain:

- *Manufacturing*: treatment and processing of food products allocated for distribution;
- *Retail/Wholesale*: distribution and sale to individuals or organizations;
- *Food Service Sector*: ready-to-eat food preparation, catering, and restaurants;
- *Households*: household consumption.

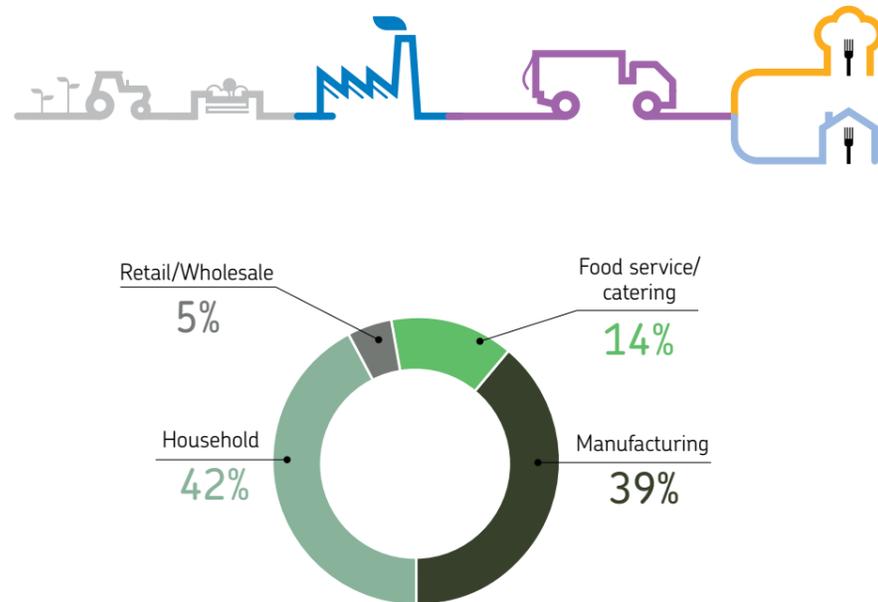
EUROPEANS WASTE
180 KG OF FOOD PER
YEAR, PER CAPITA

Estimates indicate that the quantity of food wasted in Europe every year amounts to 89 million tons, or 180 kg per capita. Figure 2.3. divides this waste between the four stages described.

Figure 2.3. shows that waste at home contributes the most significant percentage of food waste: it is equal to 42% of the total (25% of the food expense per weight) and amounts to about 76 kg/year/person (60% of which could be avoided).

The portion attributed to food processing (39%) and the portion from catering and restaurant services (14%) are also quite substantial.

Figure 2.3. Estimates of European food waste by sector



Source: BCFN elaboration from DG Environment, European Commission, 2010.

However, waste during distribution (8 kg/capita/year) is more contained, although, in some cases, distribution is indirectly responsible for a part of the waste that takes place higher up or further down the FSC.

The EU average level of per capita waste (180 kg per year) is the result of a highly varied and different situation in each member state⁵ (Figure 2.4.).

Figure 2.4. Per capita food waste (kg/year)



Source: BCFN elaboration of Eurostat data, 2010.

2.2.1 Food losses and waste in Italy

IN ITALY, 20 MILLION TONS OF FOOD ARE WASTED, FROM THE FIELD TO THE SALE POINT

Until recently, the food waste phenomenon was neglected in Italy. Specialized literature and official statistics on the subject are, in fact, almost non-existent. Segrè and Falasconi's study in 2011⁶ was the first to provide a quantification of the waste along the whole food supply chain: 20 million tons from the field to the point of sale.

An estimate of the waste was obtained by comparing the amount of food available to every Italian by product type, as reported by FAO (food balance sheets), with the consumption of food per capita per day, as claimed by INRAN (National Research Institute for Food and Nutrition). The percentage of food surplus is obtained by the difference between how much food is potentially available and what is actually consumed (Figure 2.5.). A significant portion of this figure is definitively classifiable as waste.

Only grains and fish have surplus percentages that do not exceed 50%: in the case of grains,

Figure 2.5. Quantity of food waste in Italy (2005-2006)

FOOD CATEGORIES	QUANTITY AVAILABLE g/PERSON/DAY (A)	ESTIMATED CONSUMPTION g/PERSON/DAY (B)	SURPLUS% (A) - (B)
 Grains, grain products and substitutes	433	258	40%
 Vegetables, fresh and processed	463	211	54%
 Fruit, fresh and processed	418	208	50%
 Alcoholic beverages and substitutes	205	91	55%
 Meat, meat products and substitutes	242	110	54%
 Fish and fish products	67	44	33%

Source: Segrè and Falasconi, 2011.

Figure 2.6. Tons of agricultural production remaining in the fields (2009)

	TOTAL PRODUCTION (000 t)	HARVESTED PRODUCTION (000 t)	REMNANTS IN THE FIELD (000 t)	%
 Fruit	62,178	61,069	1,108	1.78%
 Citrus Fruits	37,849	37,095	753	1.99%
 Olives*	34,541	32,866	1,675	4.85%
 Grapes**	83,131	80,378	2,752	3.31%
 Open field vegetables***	127,936	124,416	3,519	2.75%
 Greenhouse vegetables	15,712	13,744	1,968	12.53%
 Legumes and potatoes	20,009	18,966	1,043	5.21%
Total fruit	217,699	211,408	6,288	2.89%
Total vegetables	163,657	157,126	6,530	3.99%
Total fruits and vegetables	381,356	368,534	12,818	3.36%
Total grains	163,795	158,915	4,879	2.98%
Total	545,151	527,449	17,697	3.25%

* Including table olives and olives used for olive oil.

** Including table grapes and grapes used for wine.

*** Industrial tomatoes are also included.

Source: Segrè and Falasconi, 2011.

this happens because the products are less perishable, while in the fish sector it is because of the increased technological efficiency of the supply chain.

According to SINU (Italian Nutrition Society), the daily caloric availability for every Italian is about 3,700 kcal, equal to over one and a half times the daily energy requirement, generating a surplus of 1,700 kcal, which can cause overeating or is wasted.

If we look further into the food supply chain, five stages were identified for Italy:

- Manufacturers;
- Primary cooperatives (specifically, in the fruit and vegetable sector);
- Processing industries;
- Wholesale and retail distributors;
- Consumers.

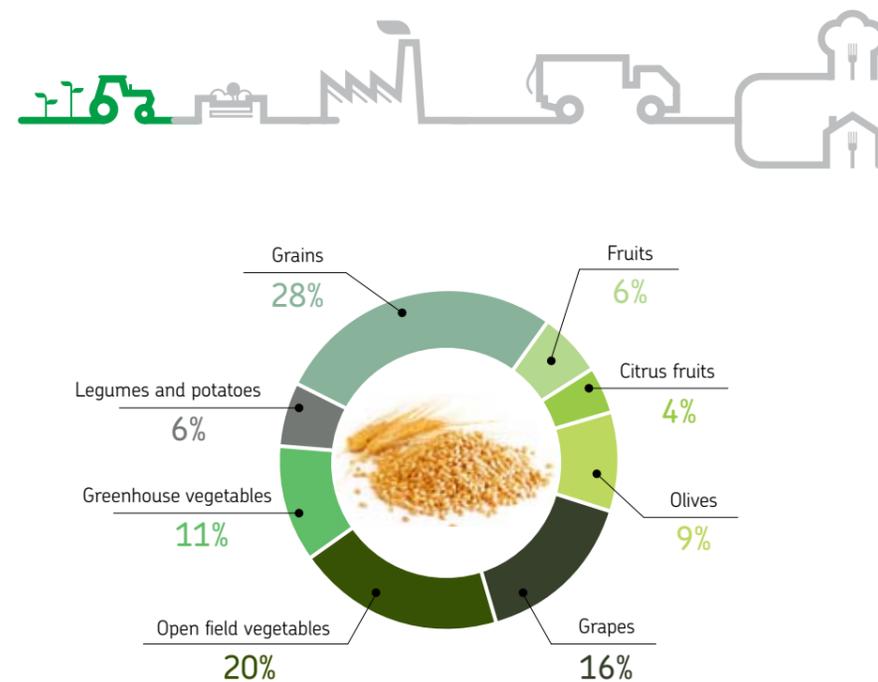
17.7 MILLION TONS OF FOOD REMAIN IN THE FIELDS

Based on data collected by ISTAT (National Statistics Institute), it was possible to quantify the percentage of agricultural production that remained in the fields, amounting to 3.25% of the total (17,700,586 tons).

The highest percentage of unharvested crops is grain (Figure 2.7). According to a time series analysis from 2006 to 2009, 2009 was the year with the most produce wasted in the field because of very low market prices for grain (especially corn).

In the fruit and vegetable sector, waste is also affected by primary cooperatives, which must implement the Common Market Organisation (CMO) rules. These rules may include the withdrawal of part of the production to avoid the collapse of prices. The recalled product is, in fact, intended only in part for free distribution (for vulnerable populations, schools, and prisons), while most of it is used for distilling alcohol (36%), composting (55%), and animal feed (4%). These uses are considered waste because the product is used differently than the human consumption for which it was originally cul-

Figure 2.7. Percentage distribution of agricultural production remaining in fields (2009)



Source: Segrè and Falasconi, 2011.

Figure 2.8. Amount of recalled product and its destination (2005-2006)

QUANTITY (000t)	
Free distribution	3,2
Animal feed	3,2
Distillation	26,4
Composting and biodegradation	39,7
Total	72,5
PERCENTAGE OF TOTAL WITHDRAWALS	
Free distribution	4.5%
Animal feed	4.5%
Distillation	36.4%
Composting and biodegradation	54.6%
Total	100%

Source: Segrè and Falasconi, 2011.

tivated. During 2005-2006, only 4.43% of the recalled product was not wasted, a total of nearly 73,000 tons (Figure 2.8.). Waste amounted to an average of 2.6% of the total, equal to almost 1.9 million tons of food (excluding the beverage sector) in the food industry. The discarded products are usually managed as refuse or used to produce animal feed, rather than for redistribution to vulnerable populations, as shown in Figure 2.9. Most food waste can be found in the dairy industry and in the production and preserving of fruits and vegetables (Figure 2.10.).

1.9 MILLION TONS OF FOOD ARE WASTED BY INDUSTRY

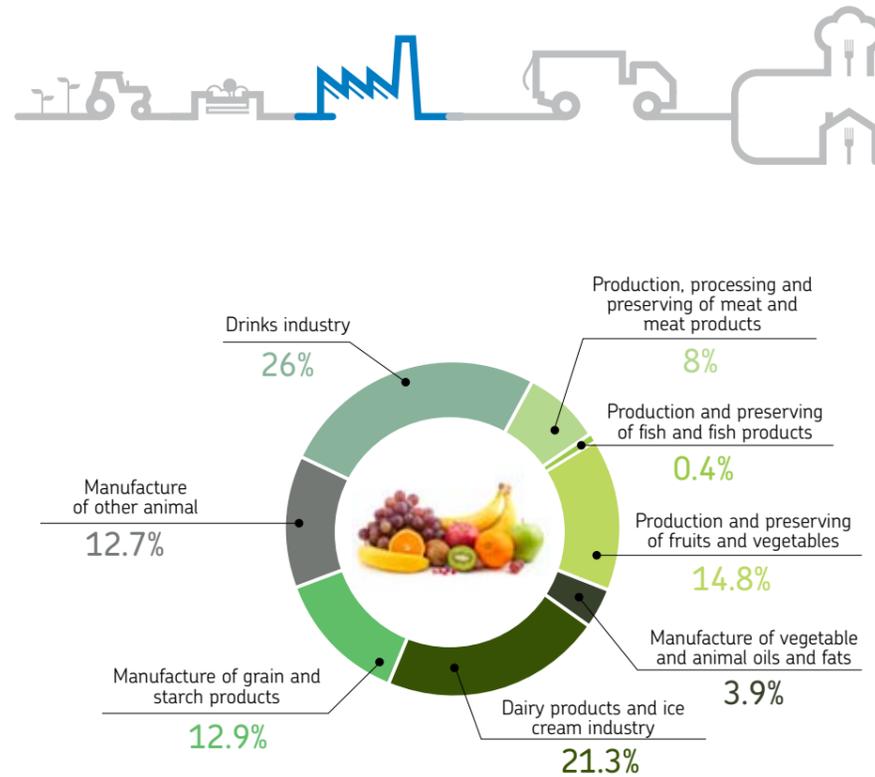
The research conducted by Last Minute Market⁷ provides estimates on the amount of food “thrown away” by wholesale markets (farmers markets and food centers) and modern distribution. It appears that 263,645 tons of food products were wasted (for a total of €900 million) in Italy in 2009, 40% of which consisted of fruits and vegetables.

Figure 2.9. Estimates of waste in the food industry

INDUSTRIAL SECTOR	QUANTITY PRODUCED (000 t)	QUANTITY WASTED (000 t)	QUANTITY WASTED (%)
Production, processing, and preserving of meat and meat products	6011	150	2.5%
Production and preserving of fish and fish products	232	8	3.5%
Production and preserving of fruits and vegetables	6215	279	4.5%
Manufacture of vegetable and animal oils and fats	4894	73	1.5%
Dairy products and ice cream industry	13,484	404	3%
Production of grain and starch products	16,390	245	1.5%
Manufacture of other food products	11,977	239	2%
Drinks industry	24,641	492	2%
Total	83,844	1,890	2.6%

Source: Segrè and Falasconi, 2011.

Figure 2.10. Percentage breakdown of waste in the food industry (2009)



Source: Segrè and Falasconi, 2011.

ON AVERAGE, EVERY FAMILY WASTES 454 EUROS-WORTH OF FOOD PER YEAR

At the consumer level, waste reaches even more alarming levels (Figure 2.11.). Data released by the ADOC (Association for the Defence and Orientation of Consumers) show that the average household waste is:

- 35% of fresh produce;
- 19% of bread;
- 16% of fruits and vegetables.

More waste comes from restaurants, bars, and cafeterias.

Figure 2.11. Estimates for household waste

	2008	2009	2010
Annual waste per family in €	561	515	454
Fresh produce (milk, eggs, meat, etc.)	39%	37%	35%
Bread	19%	19%	19%
Fruits and vegetables	17%	17%	16%
Cold cut meats	10%	9%	10%
Bagged products	6%	8%	10%
Pasta	4%	4%	4%
Canned goods	3%	3%	3%
Frozen foods	2%	3%	3%

Source: Segrè and Falasconi, 2011.

2.2.2 Economic crisis and food waste in Italy

According to a survey conducted in October 2011 by Coldiretti-SWG, Italians have reduced food waste by 57% because of the economic crisis.

To combat waste and thus save more food, as many as three out of four Italians spend more carefully than before.

Among the measures taken to reduce food waste are to shop more wisely (47% of respondents), reduce the quantity of food purchased (31%), increase use of leftover products in meals (24%), and pay more attention to expiration dates (18%).

According to the survey, Italians are spending more time in grocery stores: 61% compare prices more carefully, 59% watch 3X2 offers, without sacrificing quality.

Forty-three percent of respondents indicated that they always check the quality of the products and a similar proportion always checks where the food was produced.

But during the Christmas season of

2011, the data was not as encouraging. According to figures supplied by the CIA (Italian Confederation of Farmers), from December 24th to the 31st, Italians threw 440,000 tons of food in the garbage, worth a total of €1.32 billion (20% of total expenditure). These figures are not just negative in terms of environmental impact (consider that a single ton of organic waste generates 4.2 tons of carbon dioxide), but also represent a financial loss that directly affects the family budget, equal to €50 per household.

According to this data, consumers threw away dairy products, eggs, and meat (43%), followed by bread (22%), fruits and vegetables (19%), pasta (4%), and sweets (3%).

However, compared to the previous year, there has been a decline of 12% in food waste, but it is still too small when compared with the Coldiretti figure, which estimates the reduction of food waste by 57%.

2.2.3 Food losses and waste in Great Britain

1/3 OF THE FOOD PURCHASED IN GREAT BRITAIN IS WASTED

According to analyses by WRAP, British families wasted as much as 7.2 million tons of food in 2010,⁸ or about a third of over 21 million tons of food purchased. Of this waste, more than half (4.4 million tons) is made up of food or drinks that are still edible (what is referred to as “avoidable food waste”). Compared to the years 2006-2007, however, total food waste decreased by 13%, from 8.3 to 7.2 million tons.

As for the *avoidable food waste*, the percentage is still high, although there has been a decrease of 18% (Figure 2.12.).

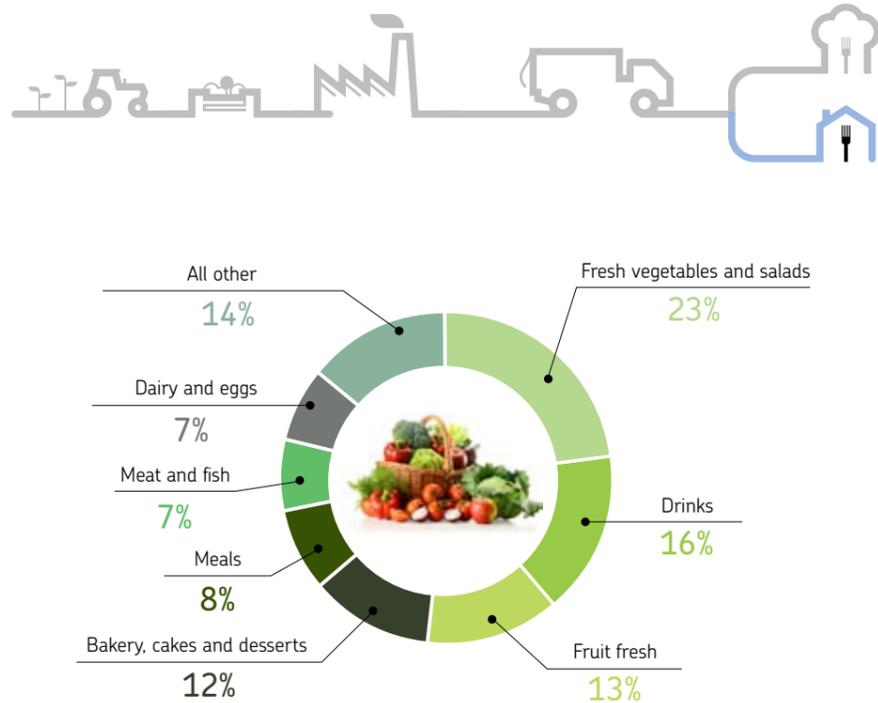
Figure 2.12. Household food waste in Great Britain

	AVOIDABLE	POSSIBLY AVOIDABLE	UNAVOIDABLE	TOTAL
Previous estimate	5.3 mt	1.5 mt	1.5 mt	8.3 mt
New estimate	4.4 mt	1.4 mt	1.4 mt	7.2 mt
Difference %	-18%	-5%	-5%	-13%

Source: 2010 data (new estimates of 2010 vs. old 2006-2007 estimates).

The majority of food bought and thrown away without being consumed is, in particular, salad and fresh vegetables (23%).

Figure 2.13. Food and drinks wasted by families in Great Britain



Source: WRAP, 2009.

Families with children tend to waste more food: over a quarter of the food bought, in fact, is thrown away, while single people throw away “only” 11% of the food they buy⁹.

2.2.4 Food waste in France

France produces about 9 million tons of food products, of which 7 kg are still food waste every year: of this, over 6 million tons can be attributed to the final consumer stage; 626,000 tons to the industry; while the remaining 2 million tons, more or less, can be attributed to the distribution and restaurant and food service sectors.¹⁰ Every year, a French citizen wastes, on average, the equivalent of 20 kg of

food products, of which 7 kg are still in their original packaging and 13 kg of meal leftovers, damaged fruits and vegetables.¹¹ In terms of catering,¹² it is estimated that every meal, including the preparation and consumption stages, generates about 150 g of organic waste consisting of 50 g of skins and preparation scraps.



2.2.5 Food waste in Sweden

According to SMED (Swedish Methodology for Environmental Data), Sweden generated over a million tons of food waste in 2010, along the whole food supply chain. Sixty-seven percent of this waste is derived from household consumption (of which 35% is represented by avoidable food waste). On average, that comes to about 72 kg wasted per person per year. Only 17% of food waste, on the other hand, can be attributed to the industry.

Figure 2.14. Food waste in Sweden

SECTOR	GENERATED AMOUNTS (tonnes)	PERCENTAGE OF TOTAL GENERATED AMOUNT (%)
Farming	unknown	unknown
Food Industry	171,000	17
Grocery stores	39,000	4
Restaurants	99,000	10
School canteens	26,000	3
Household	674,000	67
<i>included unavoidable food waste</i>	435,000 (65%)	--
<i>included avoidable food waste</i>	259,000 (35%)	--
Total	1010,000	--

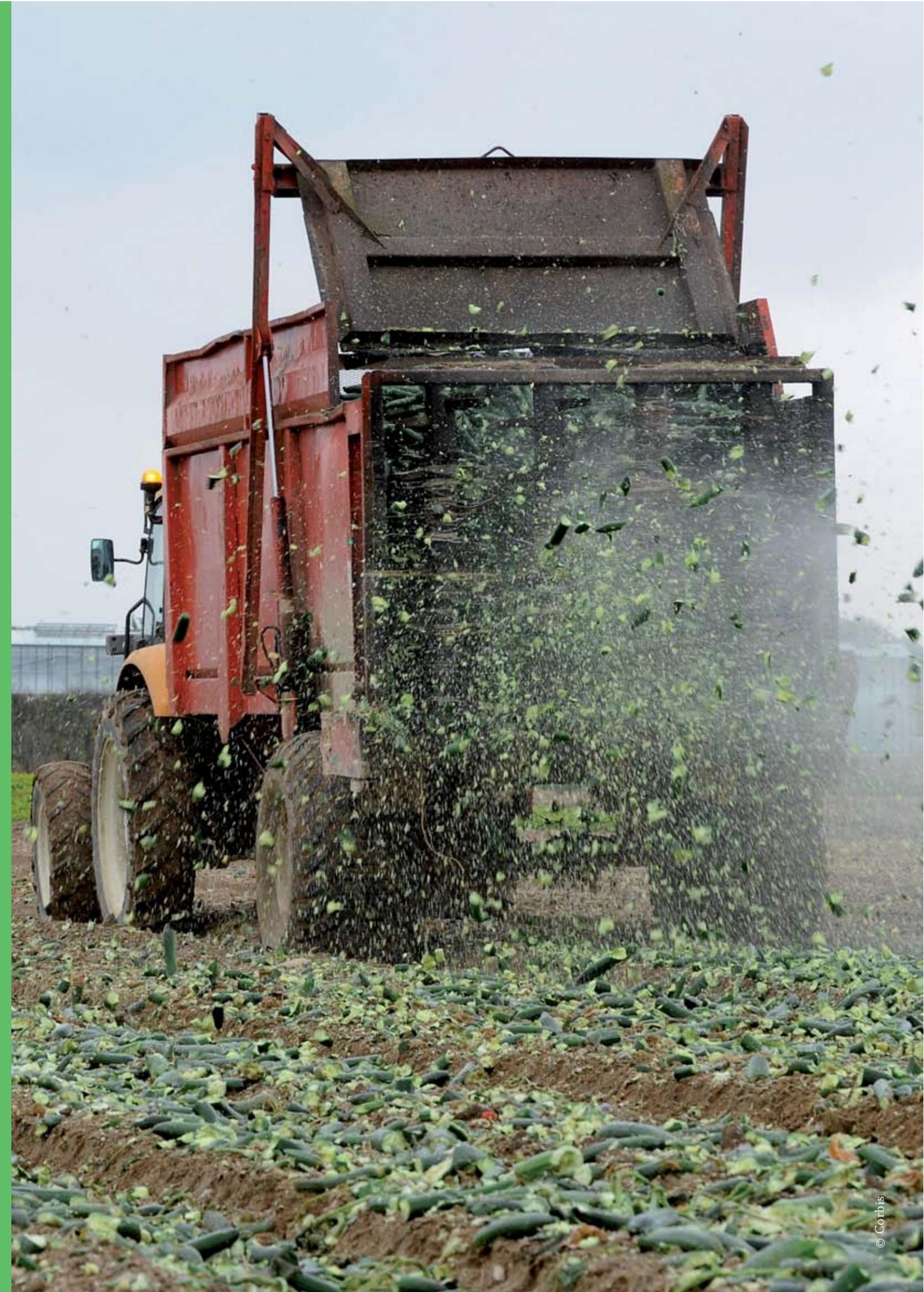
Source: SMED, 2011

2.2.6 Food waste in Germany

A study conducted by the University of Stuttgart in 2012¹³ reports that about 11 million tons of food are wasted every year in Germany during industrial processing, distribution, and final consumption stages (home and catering). The waste is due to:

- industrial processing procedures, 17%;
- household consumption, 61%;
- consumption in restaurants and food services, outside the home, 17%.

Therefore, most of the food waste takes place in homes (about 6.7 million tons of food per year): every German discards 81.6 kg of food each year, an amount that, in 65% of the cases, could be partially or completely avoided.



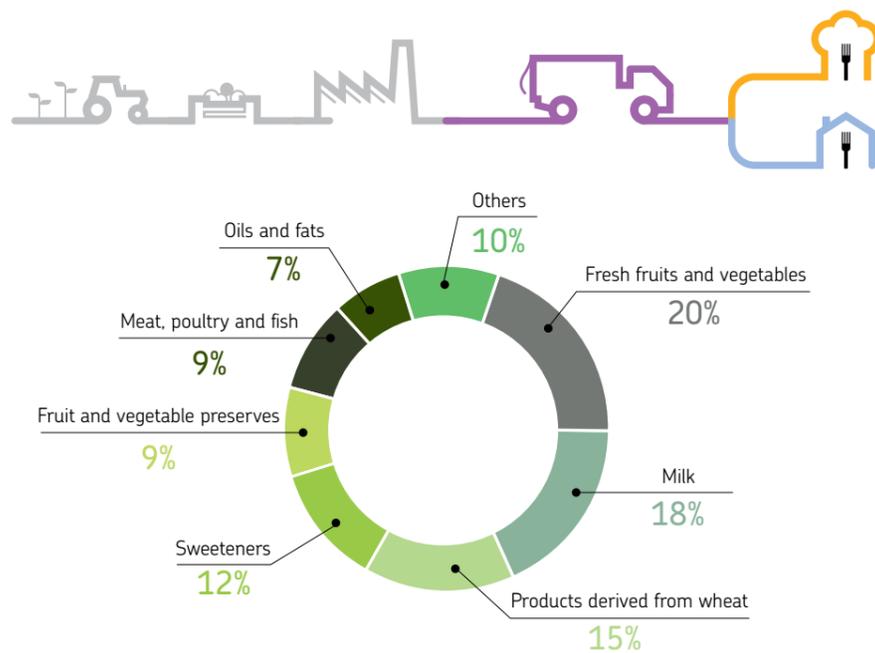
2.3 FOOD LOSSES AND WASTE IN THE UNITED STATES

IN THE UNITED STATES, 30% OF THE FOOD IS THROWN AWAY

The United States Department of Agriculture (USDA) estimates that every year Americans throw away 30% of the total food intended for human consumption, the equivalent of \$48.3 billion (€36.8 billion),¹⁴ or a fourth of the total food expenditure. In the United States, waste happens mostly in homes and in restaurants or food services. In fact, during food distribution, 2.5 million tons (equivalent to 2% of the overall supply) is wasted and approximately 41.3 million tons are wasted by consumers in their own homes or in restaurants. This quantity, which corresponds to 26% of food available for human consumption every year, is mainly from wasted fruits and vegetables, milk, grains (especially wheat), and meat.¹⁵

The graph in Figure 2.15. illustrates the types of food wasted during distribution and consumption each year in the United States.

Figure 2.15. Composition of food waste during distribution and in restaurants, food services, and homes.

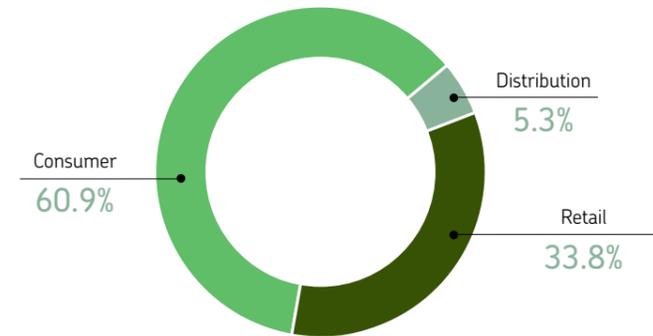


Source: BCFN elaboration of USDA data, 1995.

Another recent study¹⁶ shows how total waste in the United States amounts to 55.4 million tons, 60.9% of which is due to household waste.

CONSUMERS ARE RESPONSIBLE FOR 60.9% OF FOOD WASTE

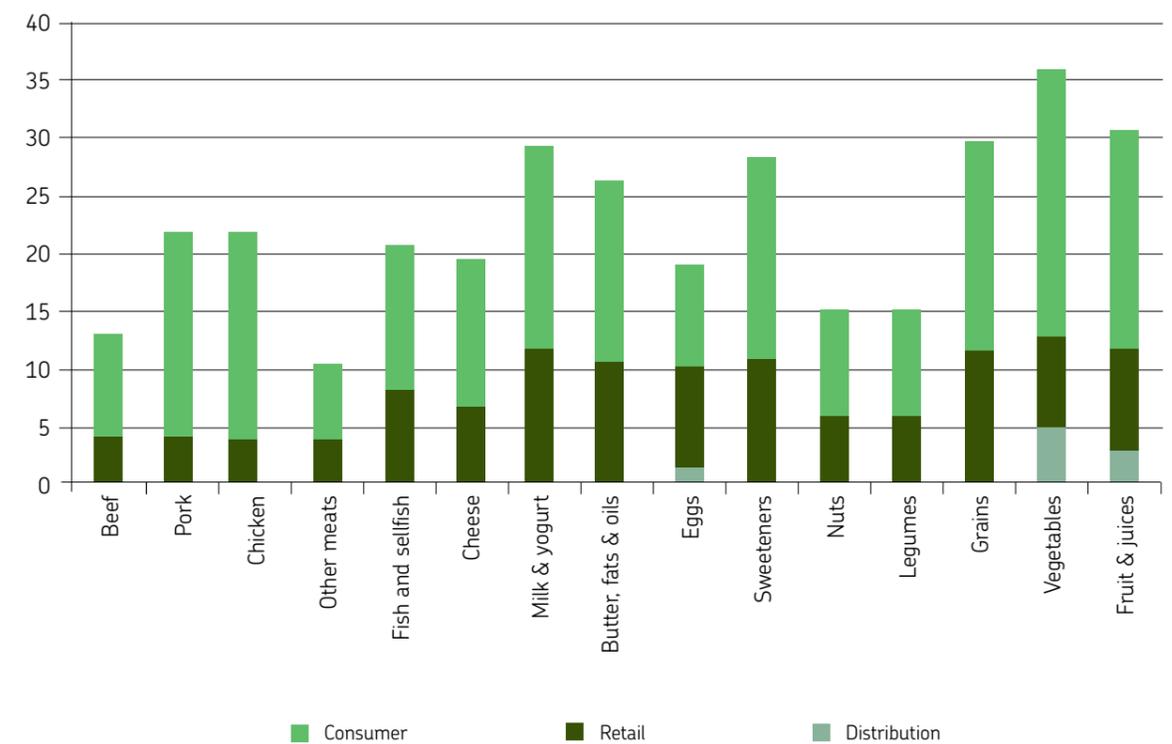
Figure 2.16. Origin of food waste in the distribution and final consumption stages



Source: BCFN elaboration of USDA data, 1995.

Figure 2.17. shows the relationship between waste and the production of food for each of the main food categories in the United States.

Figure 2.17. Percentage of food waste for each category of food products in the United States (2009)



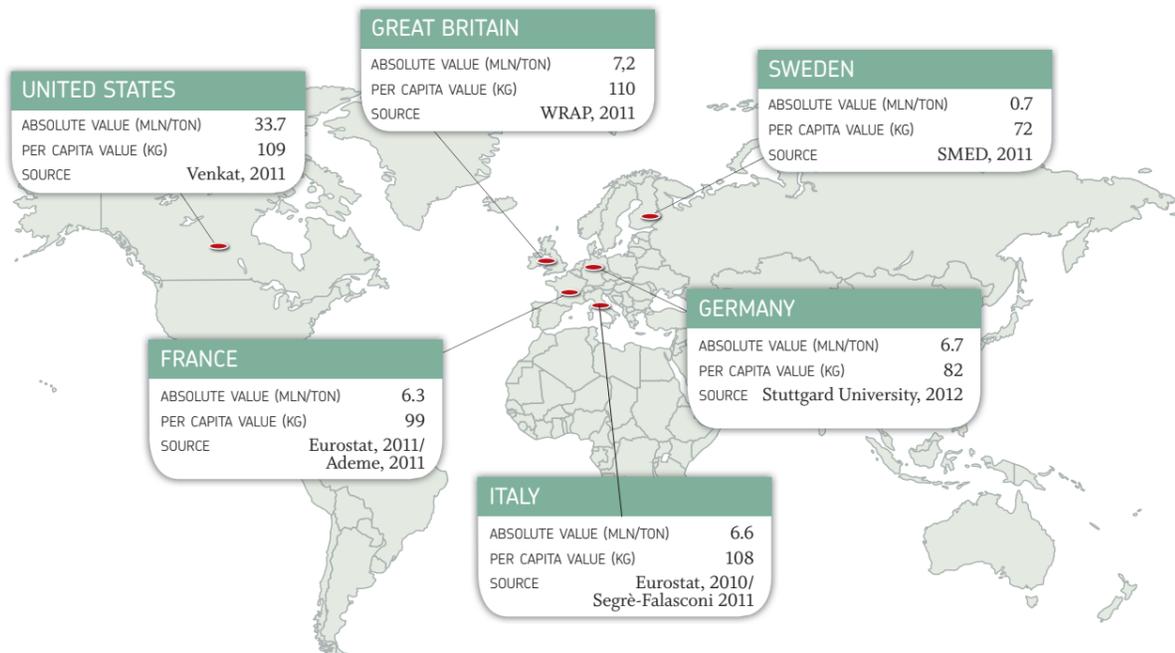
Source: BCFN elaboration of USDA data, 1995.



FRESH PRODUCTS CONSTITUTE THE MAJORITY OF DISCARDED FOOD

Fresh products with a shorter *shelf life*, such as fruits and vegetables, make up the majority of waste. Other products such as meat or condiments, which have already undergone processing and can be preserved for longer periods, generate a smaller amount of waste. Approximately 15-35%¹⁷ of waste occurs during the early stages of the FSC, but the amount varies greatly depending on the type of crops.

Figure 2.18. The level of food waste in household consumption



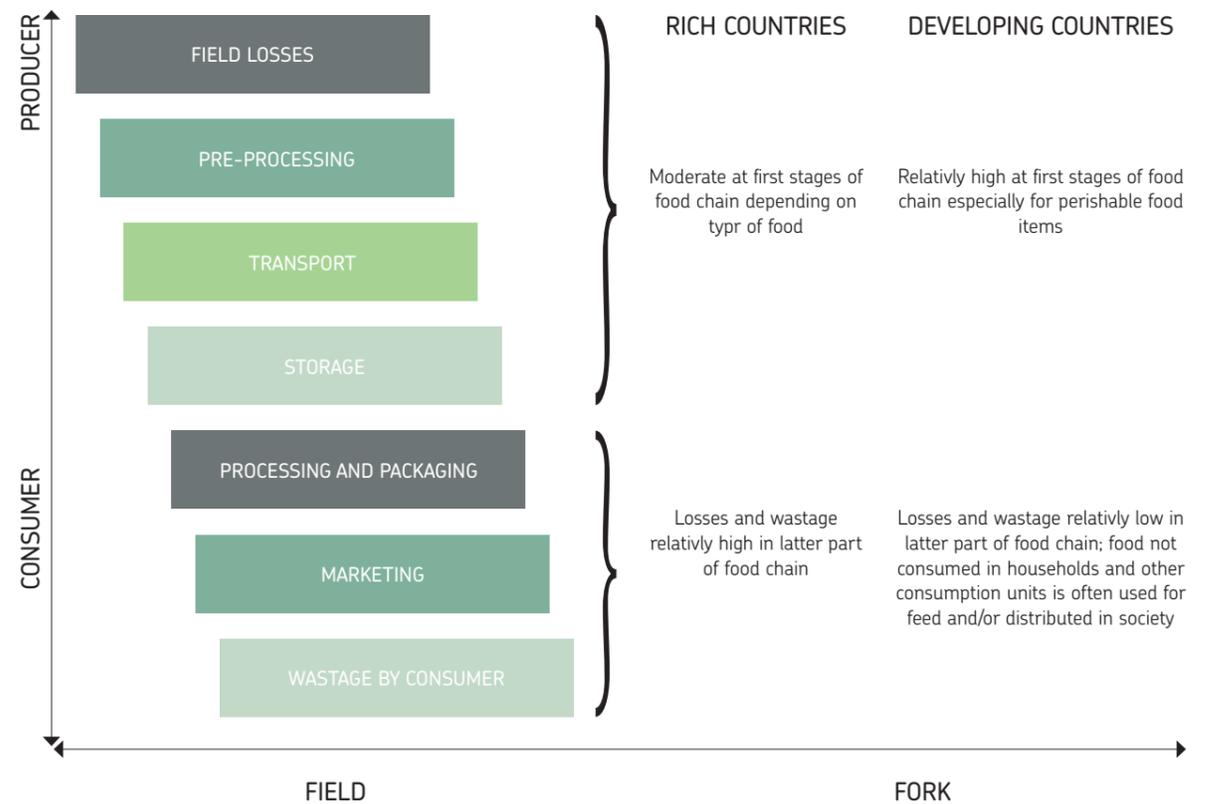
2.4 THE DIFFERENCES BETWEEN DEVELOPED AND DEVELOPING COUNTRIES

There are significant differences between developed and developing countries in the type of losses and waste within the FSC (Figure 2.19.).

In developing countries, inefficient cultivation and harvest techniques, lack of infrastructures (which hinders transport and distribution operations), inadequate storage and maintenance systems, and adverse weather conditions often lead to losses, mainly in the first part of the food chain.

In developed and rich countries, however, waste tends to occur further down the chain.

Figure 2.19. Type of losses and waste along the food chain, differences between developed and developing countries



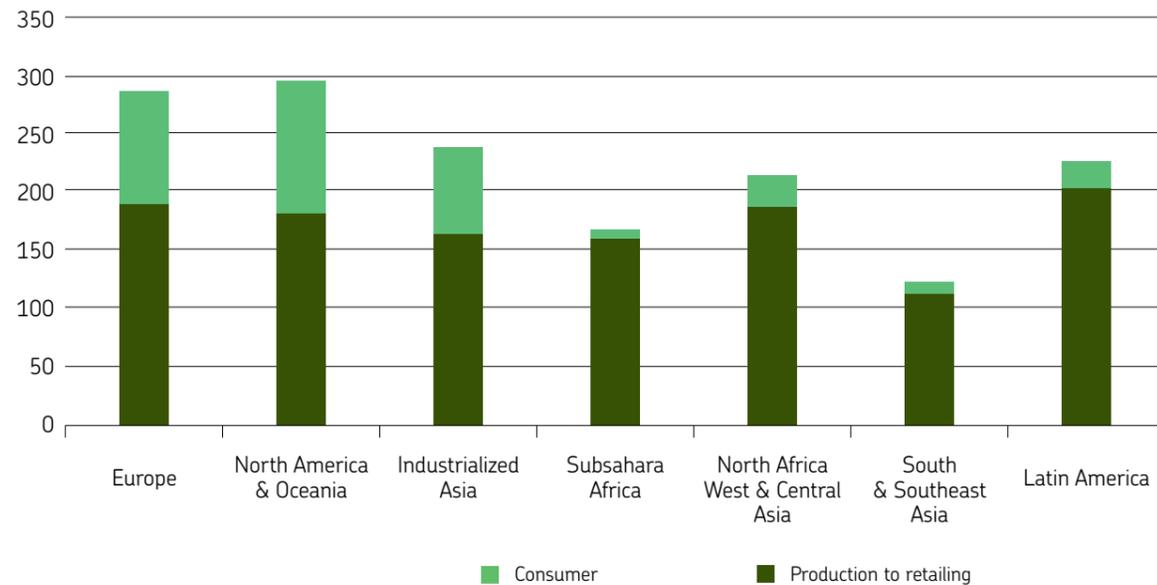
Source: BCFN elaboration from Lundqvist, 2008.

THE ECONOMIC FACTORS BEHIND FOOD LOSSES IN INDUSTRIALIZED COUNTRIES

However, even in industrialized countries, there is a high percentage of losses during the higher stages of the chain, which varies depending on the type of crop and also depends on various economic factors. In fact, because of the quality standards regarding aspect and size set by regulations and/or requested by consumers (especially for fruits and vegetables), it is not always economically viable to collect and market certain products; moreover, the excessive mechanization of harvesting procedures, which are often unable to recognize ripe products from less ripe ones, also contributes to food losses.

FAO data shows that, with the single exception of Southeast Asian countries, the levels of waste and losses per capita that occur in the higher stages of the final consumption differ only slightly between industrialized and developing countries (Figure 2.20.).

Figure 2.20. Food losses and food waste per capita in different regions of the world (kg/year)



Source: BCFN elaboration of FAO data, 2011.

The main difference between developed and developing countries is the amount of waste at the end of the food supply chain. In Europe and North America, this waste amounts to 95-115 kg per capita per year, while in Southeast Asia and Sub-Saharan Africa, only 6-11 kg per person of food is wasted by consumers.

2.4.1 Food losses and waste for the main food commodities

LOSSES AND WASTE OF CEREALS

In the last stage of the FSC, high amounts of waste were recorded, mainly in developed countries, especially for wheat. In the earliest stages in the chain (cultivation and post-harvest agricultural activities), however, there are significant losses in less developed countries, especially for rice.

LOSSES AND WASTE OF FRUITS AND VEGETABLES

Analyzing the data on fruits and vegetables (Figure 2.22.), the food wasted directly by final consumers in developed countries amounts to 15-30% of the total, but quality standards set by distributors also cause high amounts of waste during distribution.

In developing countries, waste during the stages of treatment, processing, and distribu-

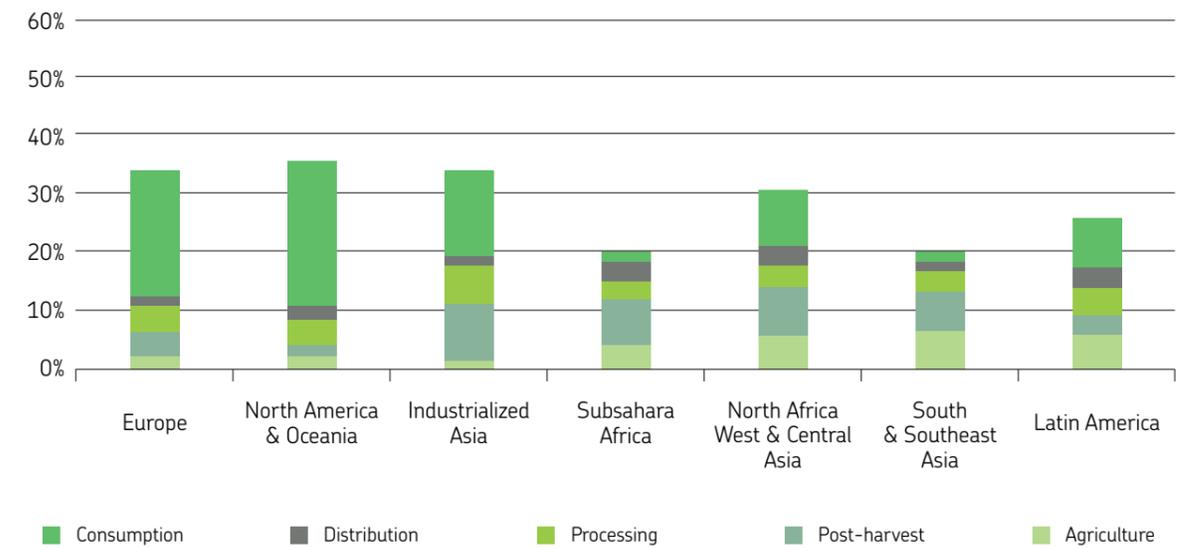
tion of fruits and vegetables is significant. This is due to humid climates that affect the preservation of stored food, as well as the seasonality of products, which often results in excess production and unsold goods.

The percentage of meat waste is low and the differences between countries are less marked. However, it is interesting to observe that (Figure 2.23.):

LOSSES AND WASTE OF MEAT

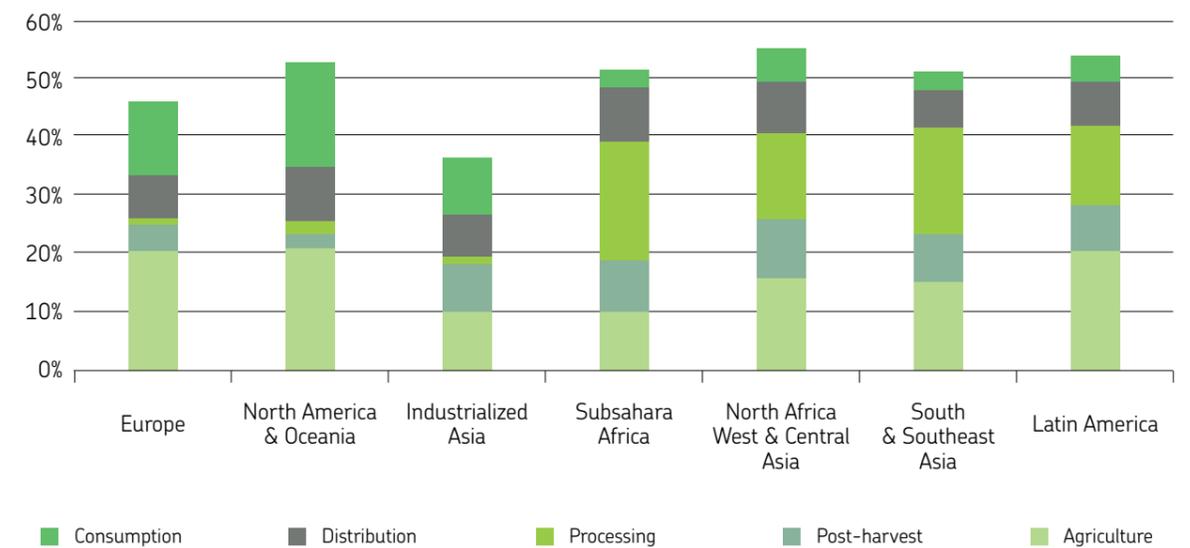
- developed countries' waste at the last level of the FSC alone account for 50% of the total, while waste during other stages is lower;

Figure 2.21. Food losses and food waste at the different levels of the food supply chain in different regions of the world: the case of grains



Source: BCFN elaboration of FAO data, 2011.

Figure 2.22. Food losses and food waste at the different levels of the food supply chain in different regions of the world: the case of fruits and vegetables



Source: BCFN elaboration of FAO data, 2011.



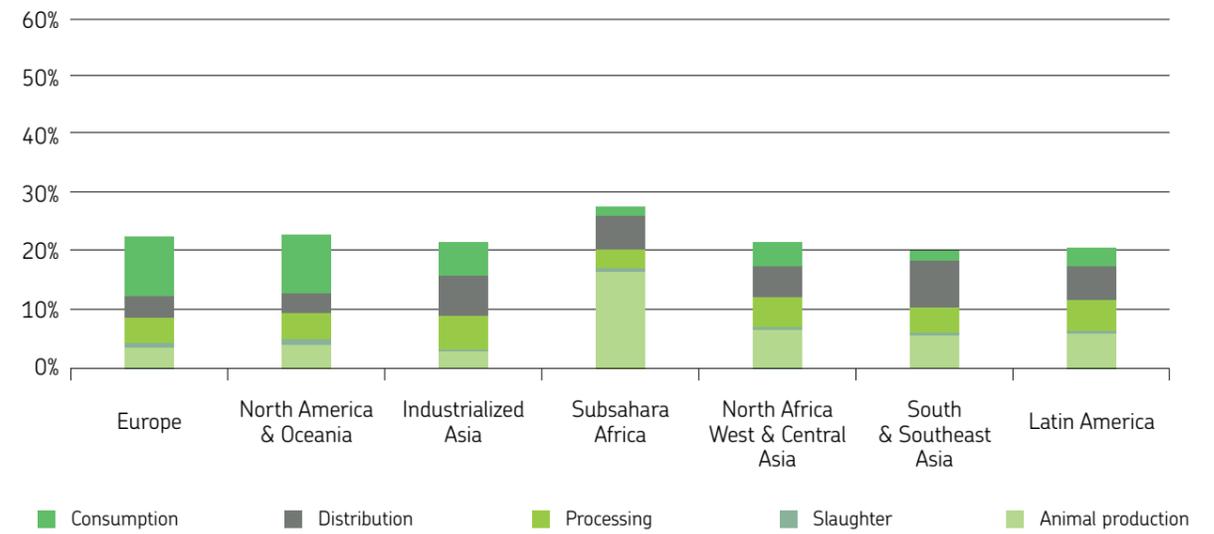
- losses in developing countries occur in nearly consistent amounts along the chain. In Sub-Saharan Africa, losses occur due to high animal mortality rates caused by livestock diseases.

Finally, for milk and dairy products (Figure 2.24.), losses and waste in developed countries are concentrated mainly in the first and last stages of the chain. The average waste by final consumers amounts to 40-65% of the total.

In developing countries, the losses of milk and dairy products are quantitatively higher in all levels of the chain preceding final consumption, where waste is rather low.

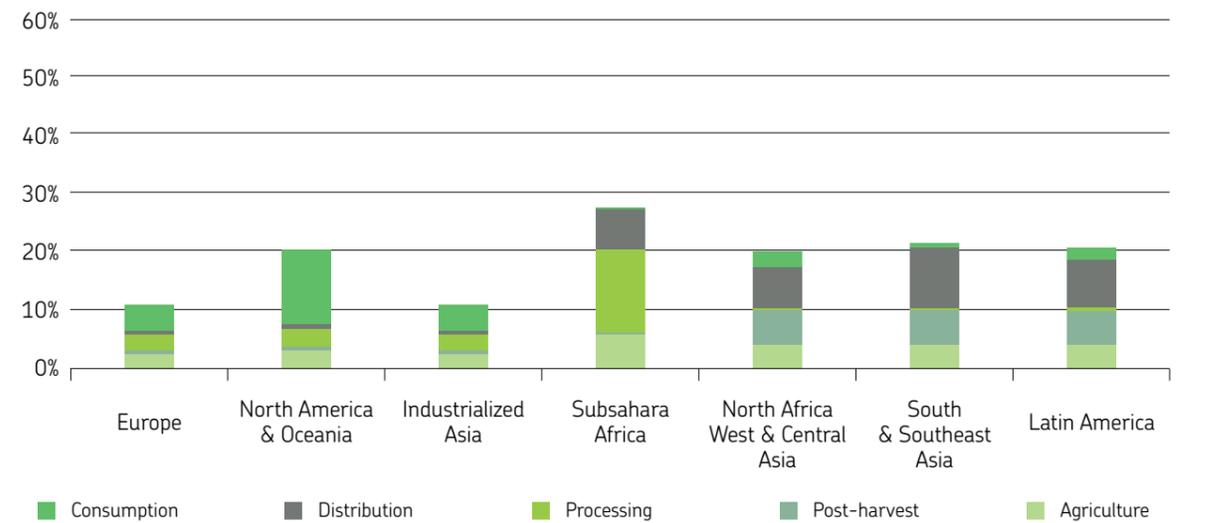
LOSSES AND WASTE OF MILK AND MILK PRODUCTS

Figure 2.23. Food losses and food waste at the different levels of the food supply chain in different regions of the world: the case of meat



Source: BCFN elaboration of FAO data, 2011.

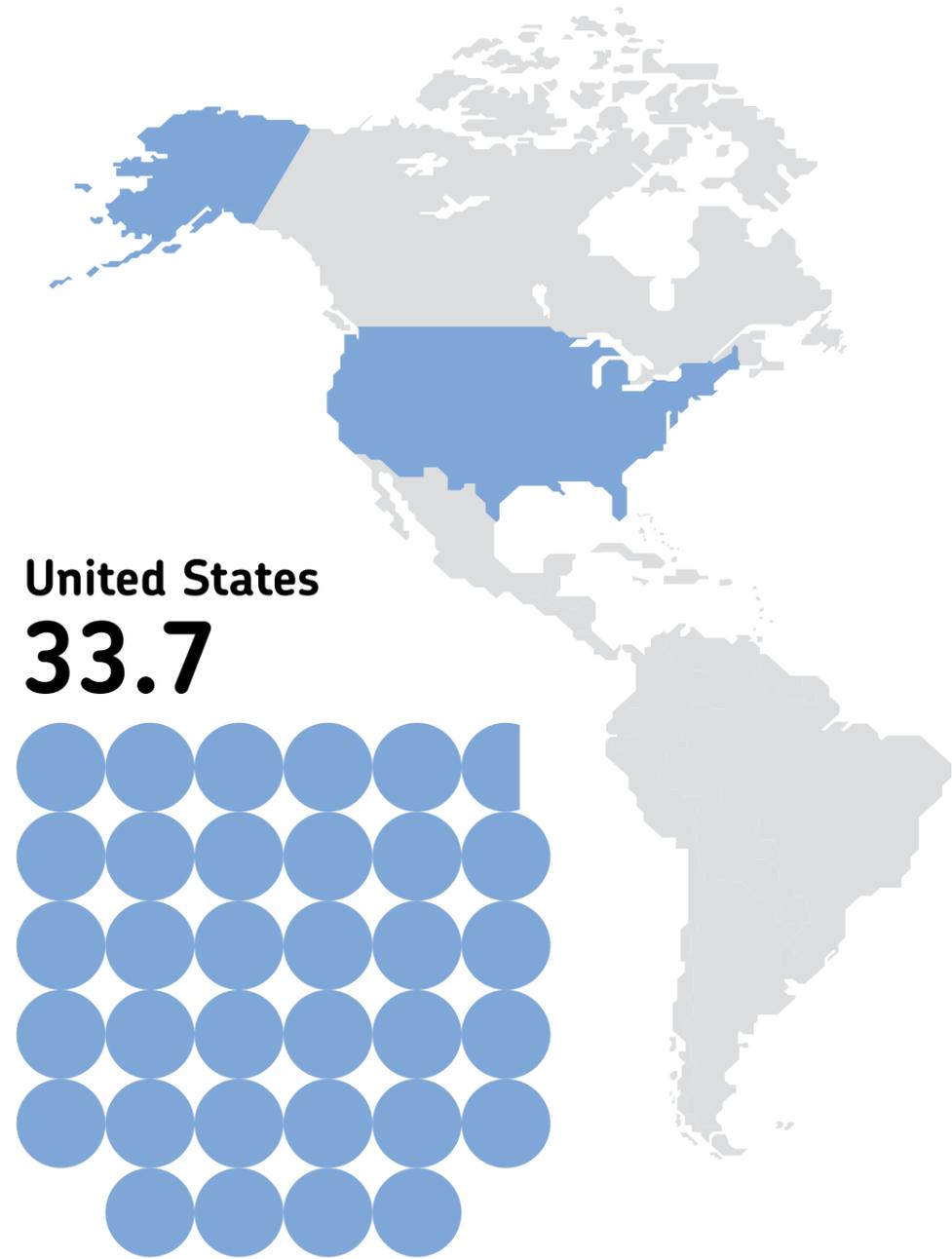
Figure 2.24. Food losses and food waste at the different levels of the food supply chain in different region of the world: the case of milk and dairy products



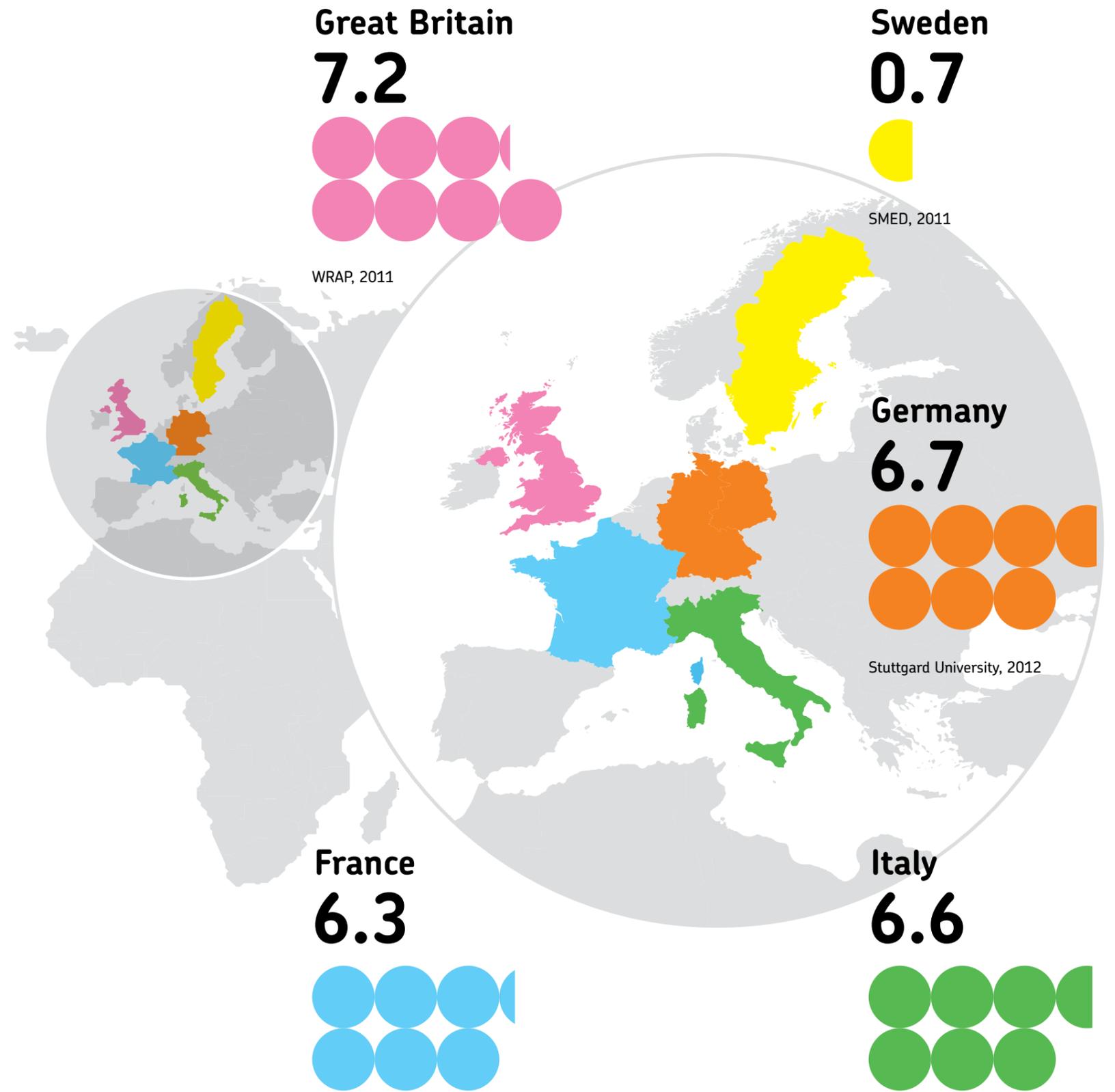
Source: BCFN elaboration of FAO data, 2011.

FOOD LOSS AND WASTE: GENERAL COMPARISON

Absolute value (million tons)



Venkat, 2011



WRAP, 2011

SMED, 2011

Stuttgard University, 2012

Eurostat, 2010/Ademe, 2011

Eurostat, 2010/Segrè-Falascini 2011

3. THE ORIGINS AND CAUSES OF WASTE

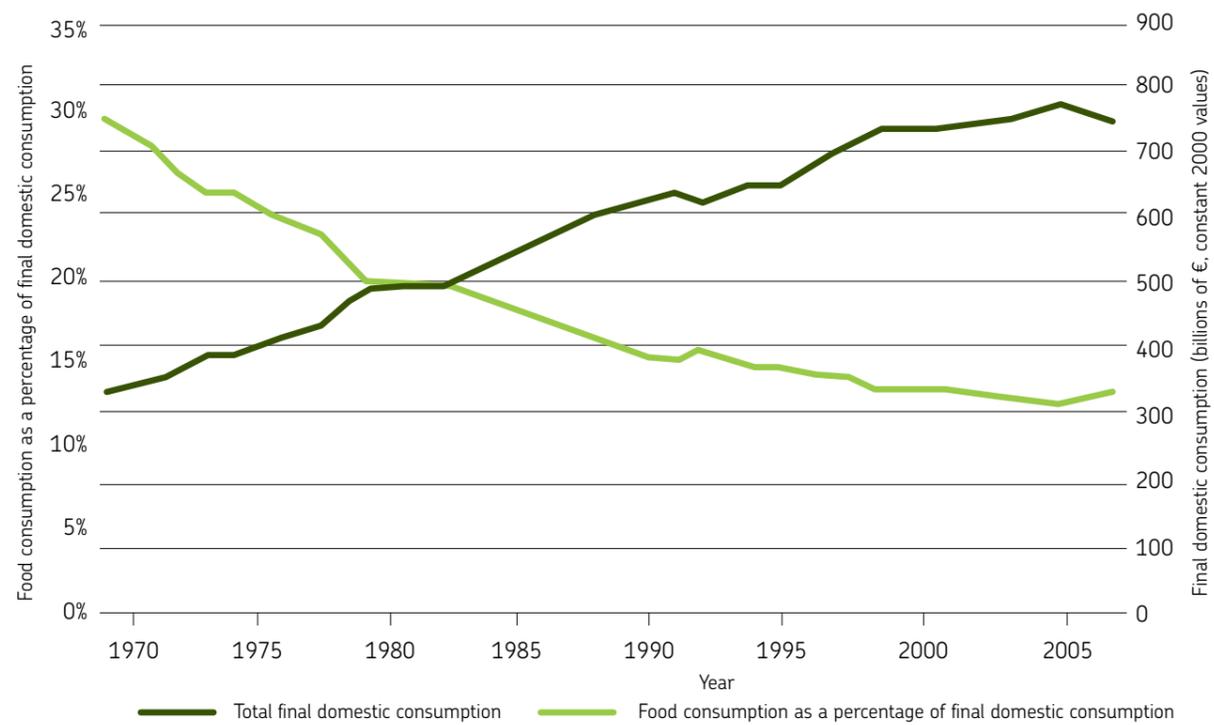


3.1 THE ORIGIN OF FOOD WASTE

During the 20th century, progress in agriculture, cultivation, and the food industry allowed most developed countries to overcome the condition of food scarcity which had been prevalent prior to that time. In addition, the increase in average income has given ever-larger segments of the population access to greater quantities and higher quality of food.

As a result, the increasing availability and variety of food, its decreasing price, and a lower percentage of income spent on food has progressively led to greater tolerance to food waste. In the United States, the amount of spending on food as a percentage of average family income is 5-10% today, while in 1937 it was 35% and in 1914 it was 60%.¹ In Italy it went from 30% in 1970 to around 12% in 2009.²

Figure 3.1. Food consumption as a percentage of final domestic consumption and total amount of final domestic consumption in Italy



Source: Istat (Italian national institute for statistics), 2011.

3.2 THE CAUSES OF FOOD LOSSES AND WASTE ALONG THE SUPPLY CHAIN

Before discussing each of the various stages in the agribusiness supply chain, it is worthwhile to note some worldwide trends that have important implications on the amount of food losses and waste, especially in developing countries.³

The most important of these is urbanization, which has resulted in the progressive lengthening of the agribusiness supply chain in order to satisfy the food requirements of the population residing in cities. The greater distance between the place of production and that of final consumption, in fact, requires that food be transported greater distances, with the need to improve transportation, storage, and sale infrastructure to avoid additional losses.⁴ The second element is the change in the composition of the diet, which is associated with the increase in available income.⁵ This phenomenon is particularly evident in economies in transition such as Brazil, Russia, India, and China, and has meant that instead of starchy diets, consumers are increasingly eating meat, fish, and fresh products, such as fruits and vegetables, all of which are more perishable.⁶

The third element consists in the increasing globalization of commerce and the rapid diffusion of large-scale mass distribution in many emerging countries. Supermarkets have become the dominant intermediaries between growers and consumers, replacing retailers in many countries in Africa, Asia, and South America, and enabling greater diversification of diets. In addition, the need for higher quality products and safety standards for consumers and the increase in the volume of food products marketed impact the level of waste generated.⁷

3.2.1 Cultivation and harvest

Food losses occurring at this stage are primarily attributable to climatic and environmental factors, the spread of disease, and the presence of parasites.

Obviously, losses due to these factors vary depending on different types of cultivation, the seasons, and different production areas.

In addition, adverse climatic events increase crop losses even before their harvest.

However, significant differences exist at this stage between developed and developing countries. In fact, different techniques for preparing the soil, seeding (seeds selected, treated seeds, seeding time, etc.), and cultivation (proper use of water, fertilizers, pesticides, and other agrochemicals) can result in completely different yields, representing the first cause of waste. For example, many fields are abandoned because rain is insufficient and growers lack irrigation equipment. Appropriate use of agronomic practices even before harvest and storage makes it possible to avoid an increase in the level of loss incurred.

A FEW GLOBAL TRENDS HAVE ACCELERATED THE RISE IN FOOD LOSSES AND WASTE

RELEVANT DIFFERENCES BETWEEN DEVELOPED AND DEVELOPING COUNTRIES IN THIS PHASE OF THE FOOD SUPPLY CHAIN

**ECONOMIC FACTORS
BEHIND FOOD LOSSES IN
THIS PHASE**

Even during the harvest, handling, and storage stages, there are significant differences between developing and developed countries.

In fact, in developing countries, losses are primarily the result of:

- labor-intensive agriculture conducted on a smaller scale, which is often inefficient;
- limited technical, financial, and managerial resources;
- premature harvests due to urgent need for food or to obtain income;
- harvesting methods which are frequently inefficient and primitive;
- inadequate infrastructure (for example, roads that are barely passable) and unavailability of transportation modes, which make the transportation of crops difficult;
- storage facilities that do not ensure proper temperature and humidity and which promote deterioration or insect infestation;
- use of techniques to control insect infestations (pesticides);
- absence of efficient logistical management which can ensure proper conservation during transport.

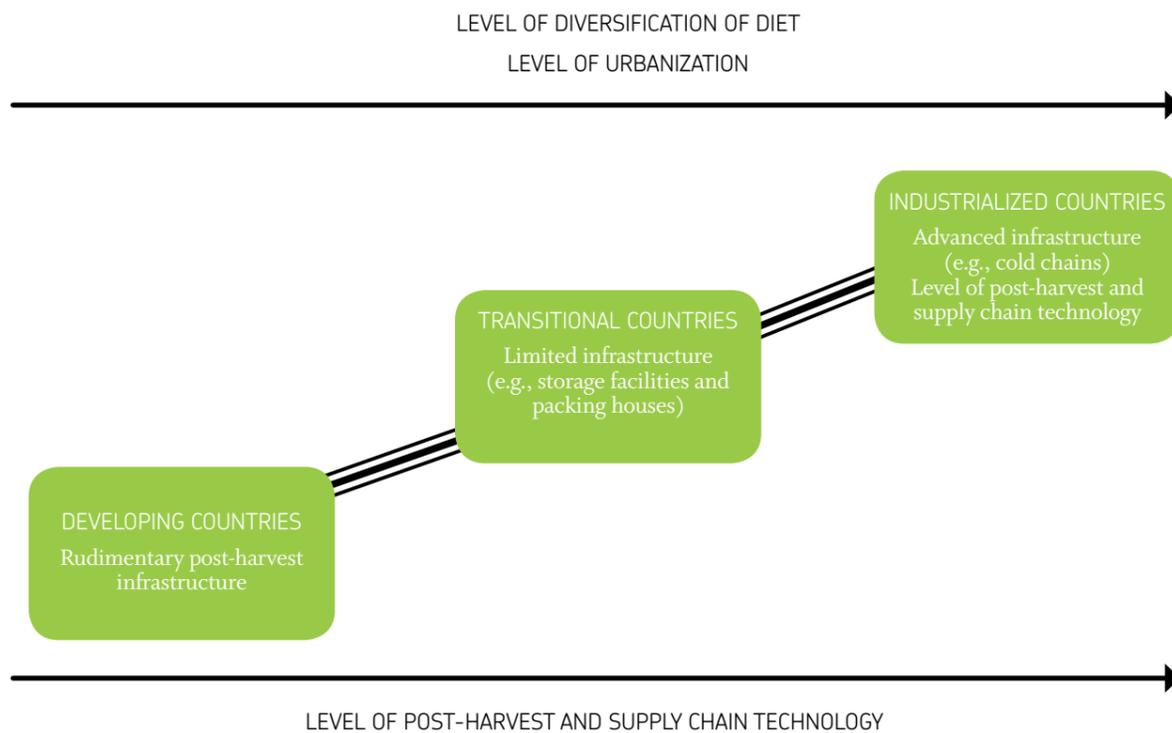
On the other hand, in the highest-income countries, the greater technological and infrastructure resources, agronomic expertise, more advanced techniques, and more favorable environmental conditions often result in a significantly lower level of loss.

In developed countries, and sometimes also in developing countries, regulatory and economic factors also play a role.

Thus, it can happen that growers leave crops in the fields or decide to divert crops for animal feed that were originally intended for human consumption when:

- supply is greater than demand;

Figure 3.2. Level of infrastructure in the post-harvest stage in relation to a country's development



Source: Parfitt, 2000.

- qualitative standards for human consumption imposed by national and international law or established by distributors (increasingly, large-scale distributors) are not met;
- aesthetic requirements demanded by customers for shape and size of agricultural products are not satisfied.

This happens frequently in the case of fruits and vegetables because these products, if harvested, are subject to being “rejected” down the supply chain.⁸

Lastly, certain inappropriate agricultural planning policies (such as the policies that were put in place in Europe in the past) can converge to produce waste when there is productive surplus.



Mitsuhiko Imamori / Minden Pictures / National Geographic Stock

Waste and overproduction of citrus fruits and bananas in Australia

Recently, Australia has experienced the greatest excess of citrus production in the last three decades. As a result, citrus growers in the state of Queensland have had to let some of the fruit rot on the trees.

The main cause for this surplus production has been a decrease in the demand for fruit by foreign buyers, caused by an excessive increase in the Australian dollar.⁹ A similar situation also occurred in the banana production industry.

Although in the aftermath of hurricane Yasi (which destroyed 90% of the banana crop in February 2011), the Australian Banana Growers' Council asked producers to phase in resuming production, the number of growers who complied with that request was insufficient to avoid the risk of banana overproduction.¹⁰

Data for December 2011 indicates, in fact, that sale prices for Australian bananas fell below the cost of production (up to 6 dollars less per crate).

3.2.2 Initial agricultural processing and industrial processing

In the initial processing stage of agricultural products and semi-processed products, the causes of waste are principally technical malfunctions and inefficiencies in productive processes, leading to losses and damage to the products, which are then rejected.

This happens most often in developing countries, where technology is often inadequate and cannot always ensure the proper conservation of food products (especially for fresh foods), but also to a certain extent in developed countries. In particular, errors during food processing procedures cause defects in terms of weight, shape, or packaging of the product. Even though these defects have no effect on the safety or nutritional value of the products, they are rejected.

TECHNICAL MALFUNCTIONS AND INEFFICIENT INDUSTRIAL PROCESSES CAUSE WASTE IN THIS PHASE

3.2.3 Distribution and sale

In this stage (for both wholesale and retail distribution), waste is generally the consequence of inappropriate ordering and incorrect projections of demand for food products, resulting in enormous quantities of merchandise which are not sold before the expiration date and/or natural deterioration (which is mainly a concern for fruits and vegetables). Estimating demand for food products, in fact, is very complex and is influenced by multiple factors, such as climate, season, specific marketing campaigns, new product launches, promotions, and holidays.

Additional causes of food waste at this stage are:

- limits of the technology used to conserve products, particularly fresh products (*cold chain*);
- damage to the product and food packaging during transportation and storage, which renders them unfit for sale;
- inadequate professional training of sales staff, who at times do not display the merchandise in an appropriate fashion on the shelves and do not perform proper *stock rotation* procedures;
- recalls of certain products from the market, following a determination that they do not meet given qualitative and safety standards;
- contractual agreements between suppliers and distributors such as *take back*¹¹ systems which, in the supply contract, involve the addition of clauses giving distributors the right to return to suppliers unsold merchandise that has exceeded a given level of remaining shelf life (usually 75%);
- sales standards which lead to aesthetic problems and packaging defects excluding a food product from sale;
- marketing strategies, such as 2x1 (buy one, get one free) or 3x2 (buy two, get one free) options, which are intended to promote the sale of products close to their expiration date and solve overstock problems, but which result in transfer of the risk of waste from distribution to final consumption.

The listed causes are generally valid in industrialized countries, while in developing countries this stage of the agribusiness supply chain is characterized by a total absence or tremendous inefficiency of wholesale distribution. The waste is attributable to the characteristics of the markets: small, crowded, with poor hygiene, and ineffectual refrigeration and storage equipment.¹²

DIFFICULTY IN FORECASTING DEMAND ARE BEHIND WASTE IN THIS PHASE OF THE FOOD SUPPLY CHAIN



Food waste produced by aesthetic standards

In the context of research conducted for the writing of his book *Waste – Understanding the Global Food Scandal* (2009), Tristram Stuart visited several English farms to better understand the extent to which qualitative standards influence the creation of food waste. Among other farms, Stuart visited M.H. Poskitt Carrots in Yorkshire, one of the major suppliers of the Asda supermarket chain.

During the visit, he learned that carrots with a slightly irregular bend are pulled from production and set aside for animal feed. In fact, the staff at the farm explained that “Asda expects all the carrots to be straight, so that customers can peel the full length in one easy stroke.”

In the farm’s packing house, all carrots pass through machines with particular photographic sensors which reveal any defects. Carrots that are not bright enou-

gh in color or are blemished or broken are thrown into the livestock feed container. In all, 25–30% of all carrots processed by M.H. Poskitt Carrots are rejected. About half of these are rejected due to aesthetic defects, such as the wrong shape or size; the other half of the carrots are rejected for being broken or having clefts or blemishes. Another similar example of food waste due to aesthetic standards is from the English distribution chain Marks and Spencer. Every day, an average of 13,000 slices of bread are wasted by suppliers of sandwiches intended to be sold. In fact, for purposes of preparation of these products, the standards imposed by the distributor specify that the end slices and the crusts of sandwich loaves not be used.¹³ This results in the waste of approximately 17% of the raw material utilized during the production stage.¹⁴

3.2.4 Household consumption and catering

Generally, waste in the final stage of the agribusiness supply chain in developing countries is more contained. In fact, families’ low incomes make it unacceptable to waste food. In addition, in these countries, distribution occurs primarily by means of small local markets which, on the one hand, favor more frequent purchases and, on the other, have inadequate hygienic and sanitary conditions.

The situation in industrialized countries is different; in fact, in these countries, waste is considerable, both at home and during catering.

The results of research carried out in Great Britain (WRAP, 2008) identify the two principal causes of avoidable household waste:

1) Too much food is cooked, prepared, and served, thus producing so-called “leftovers,” which include foods “damaged” during cooking (e.g., burned food).

2) Food is not consumed in time: food and beverages are “thrown away” because they exceeded the expiration date stated on the package, deteriorated, or no longer seem to be edible.

In more detail, the causes of household waste are:

- the interpretation of the wording on the food label: in fact, it is particularly difficult to grasp the difference between the phrase “best if used by” (which relates to an evaluation of food quality) and “use by” (which refers to food safety),¹⁵ which influences purchasing decisions. Consumers have a tendency to select, during the purchasing stage, food products with a longer remaining shelf life. This contributes to an increase in unsold merchandise and, as a consequence, to the waste of food that would otherwise have been perfectly edible;¹⁶
- no or incorrect planning of purchases, which at times leads to the purchase of excessive quantities of foods to take advantage of promotional offers;
- improper food storage and little attention to the instructions stated on the labels (storage conditions vary depending on the climate and the temperature in the home);
- inadequate wrapping and use of materials, which affect healthy preservation of food and reduce the consumption period;
- limited knowledge of methods to consume more efficiently and reduce waste (e.g., how to use leftovers from meals in another way or how to create dishes with available ingredients);
- lack of awareness of the amount of waste one produces and its economic and environmental impact.

Lastly, the factors causing variability in the amount of waste generated at the household level are:

- family size and composition (adults waste more than children in absolute terms, and larger families waste less per person compared to smaller families);¹⁷
- family income¹⁸ (food waste is less in low-income families);
- culture of origin (for example, in the United States, families of Hispanic origin waste 25% less than non-Hispanic families);¹⁹
- seasonal nature of products (more is wasted in the summer than other seasons of the year);²⁰
- gender (women on average waste more than men).²¹

For waste generated in the catering sector (such as in hotels, restaurants, and cafeterias), the causes of waste are more or less the same, but have even more significant effects:

- the excessive size of food portions served which, in part, are left on the plate;
- difficulty in planning food purchases, which is further complicated in the case of buffet service (buffets usually involve preparation of a larger amount of food than is necessary);
- lack of acceptance of practices allowing customers to take home the “leftovers” from their own meals.

PREPARING OVER-
GENEROUS PORTIONS
AND NOT CONSUMING
THE FOOD PRODUCTS
IN TIME ARE THE 2
MAIN CAUSES OF FOOD
WASTE AT HOME AND
IN RESTAURANTS



Robert Sisson/National Geographic Stock

Differences between the phrases “use by” and “best before” in Great Britain

In Great Britain, the government decided to abolish the “sell by” warning (to be sold by a certain date) which appeared on packages for all types of food products.²²

The objective was to limit and, if possible, avoid the waste of food products that have passed their sale dates, but in reality are still perfectly edible, thus reducing the consumers’ margin of error in interpreting food labeling at the purchase stage.

The fact that many products bear two or more dates can, in fact, create confusion: one date relates to the expiration of the period during which the merchandise can be displayed and sold, one indicates the period during which it should be consumed (“use by”), and still another the period during which the product would be optimal (“best by”).

The new measure was initiated by the Department for Food, Environment and Rural Affairs following consultations with producers, distribution chains, and con-

sumer associations. It was determined that the label will state:

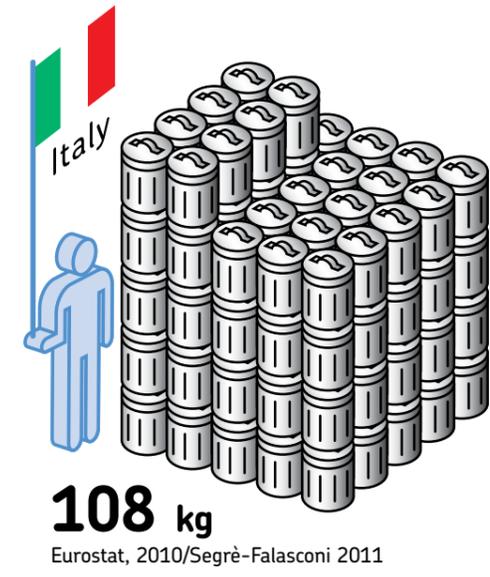
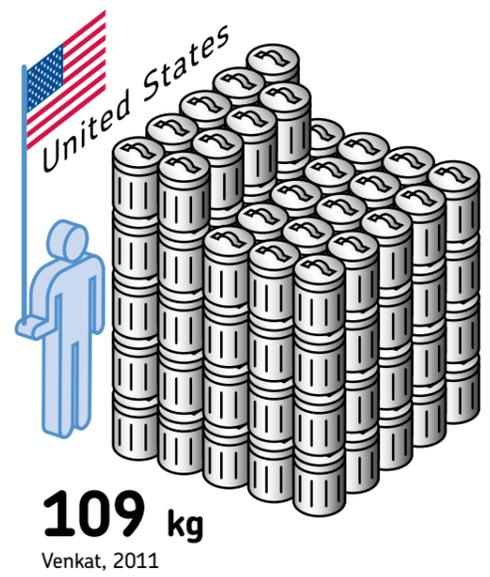
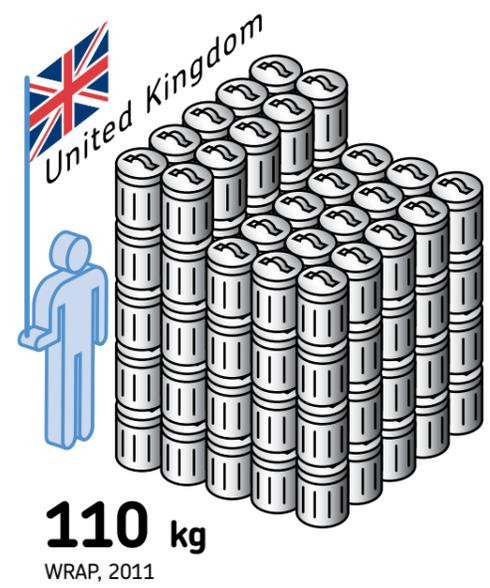
- only the phrase “best by” (to be consumed preferably by) for canned or jarred food, snacks, jams and jellies, cookies, and other similar products, which will inform consumers that before a certain date the product is in the best condition for consumption, but can be consumed even after that date;

- only the phrase “use by” (to be consumed by) for foods that are actually harmful if consumed after a certain date, such as soft cheeses, fresh meat, fish, and eggs.

In that regard, the Food Standards Agency²³ also clarified the distinction between the two phrases. As opposed to the “use by” date (which refers to food safety), the “best by” date mainly relates to product quality. Going past the expiration date does not, in fact, imply that the product is harmful to one’s health but that it may have partially lost taste and flavor.



PER CAPITA FOOD WASTE: GENERAL COMPARISON



4. THE IMPACT OF FOOD LOSSES AND WASTE



4.1 THE ENVIRONMENTAL IMPACT

THE ECOLOGICAL, CARBON, AND WATER FOOTPRINTS ARE USEFUL IN EVALUATING THE ENVIRONMENTAL IMPACT OF WASTED FOOD

The production of food that will not be consumed needlessly uses up natural resources, generates greenhouse gas emissions, and creates waste.

In order to assess the environmental impact of a food product, we need to take into consideration its entire life cycle, tracing each step throughout the food supply chain. We can take three indicators into account: carbon footprint, ecological footprint, and water footprint. Below, we can see the results of a few studies quantifying the environmental impact of food losses and waste, calculated using the three indicators.

Segrè and Falasconi (2011) have provided a few estimates of the environmental impact of the waste of some products, using all three indicators; WRAP (2011) provided estimates for the single food categories and measured the carbon and water footprints specifically in household consumption in Great Britain. Venkat's US study (2011) quantified the GHGs that could be attributed to the whole "life cycle" of the wasted food products, without providing estimates concerning the ecological and water footprints. The calculations were made using the food waste data provided by the US Department of Agriculture of food available for the final stages of the chain in 2009 (distribution and final consumption).

Figure 4.1. Available data

SOURCE	STAGE IN THE CHAIN WHERE THE WASTE WAS QUANTIFIED	CARBON FOOTPRINT (KG OF CO ₂ EQUIVALENT)	WATER FOOTPRINT (M ³ OF WATER)	ECOLOGICAL FOOTPRINT (M ² GLOBAL)
Italy	Segrè, Falasconi (2011) Distribution	●	●	●
Great Britain	WRAP (2011) Consumption	●	●	●
United States	Venkat (2011) Distribution and consumption	●	●	●

Source: BCFN elaboration, 2012.

Italy

The Italian analysis refers to the impact of wasted fruits and vegetables and meat in the distribution stage.¹ Figure 4.2. shows the environmental impact of fruits and vegetables

Figure 4.2. Environmental impact of fruit and vegetable waste in Italy

	CARBON FOOTPRINT (KG OF CO ₂ EQUIVALENT)	WATER FOOTPRINT (M ³ OF WATER)	ECOLOGICAL FOOTPRINT (M ² GLOBAL)
Per kg	0.08	0.7	3.7
Total	8.4 Mil.	73.8 Mil.	390 Mil.

Source: Segrè and Falasconi, 2011.

Carbon Footprint

The *carbon footprint* represents greenhouse gas emissions (GHGs) generated during production. In the specific case of the agri-food sector, GHGs are comprised primarily of CO₂ generated through the use of fossil fuels, from methane (CH₄) derived from livestock enteric fermentation, and emissions of nitrous oxide (N₂O) caused by the use of nitrogen-based fertilizers. An accurate calculation of the carbon footprint of wasted food must necessarily take into account all the stages of the food supply chain, along with the Life Cycle Assessment (LCA) method.

a single unit of measure, which includes specific conversion and equivalence factors: the *global hectare*.

The calculation approach for the ecological footprint is similar to that of an LCA study. It allows us to convert the environmental aspects of the production process, CO₂ emissions in particular, and the use of the land, in an "equivalent" surface (global hectare).

As in the case of the carbon footprint, the final value obtained with these calculations does not refer to the land actually occupied, but is a theoretical representation that takes into account the burden of the various factors.

Ecological Footprint

The *ecological footprint* is an indicator used to assess the impact of a specific population's consumption on the environment: it quantifies the total area of land and water ecosystems needed to sustainably provide all the resources used and to sustainably absorb all the emissions produced. The ecological footprint is a composite indicator, measuring the various ways environmental resources are used through

Water Footprint

The *water footprint* or *virtual water content* is a specific indicator of the use of fresh water and is devised to convey both the actual quantities of water resources used and the way the water is used. In the case of food production, the water used in the industrial production stage is taken into account, as well as the evapotranspiration of irrigated agriculture.

per kg of waste and per total quantity. The data shows how the amount of fruits and vegetables thrown away during point of sales consumes more than 73 million m³ of water, the use of environmental resources equal to about 400 million m², and the emission into the atmosphere of more than 8 million kg of equivalent carbon dioxide.²

Figure 4.3, which contains the data on the impact of meat, shows us that throwing away 22,000 tons of meat products means wasting about 127 million m³ of water, the emission of the equivalent of 9.8 million tons of carbon dioxide into the atmosphere, and exhausts the environmental resources of the equivalent of 8,360 hectares of land.

Figure 4.3. Environmental impact of meat waste in Italy

	CARBON FOOTPRINT (KG OF CO ₂ EQUIVALENT)	WATER FOOTPRINT (M ³ OF WATER)	ECOLOGICAL FOOTPRINT (M ² GLOBAL)
Per kg	4.449	5.8	38
Total	9.8 Mil.	127 Mil.	83 Mil.

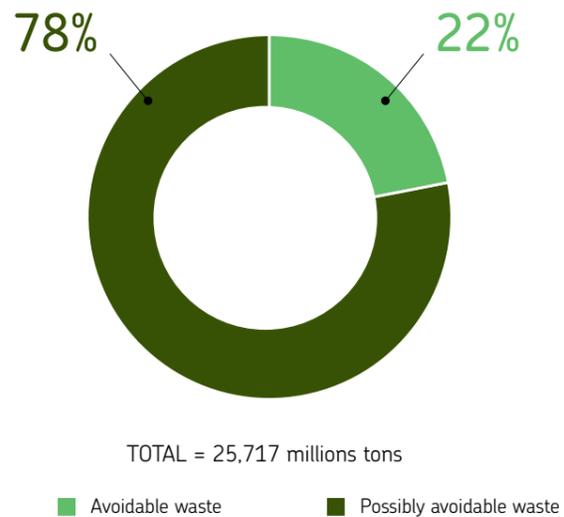
Source: Segrè and Falasconi, 2011.

Great Britain

In Great Britain, the WRAP (2011) study quantifies food and drink waste, including waste that is considered always avoidable and possibly avoidable during household consumption, and leaves out unavoidable waste.³

The calculation of the carbon footprint⁴ estimates the emission of 25.7 million tons of equivalent CO₂ per year, of which 78% is due to always avoidable waste, while 22% refers to possibly avoidable waste (Figure 4.4.).

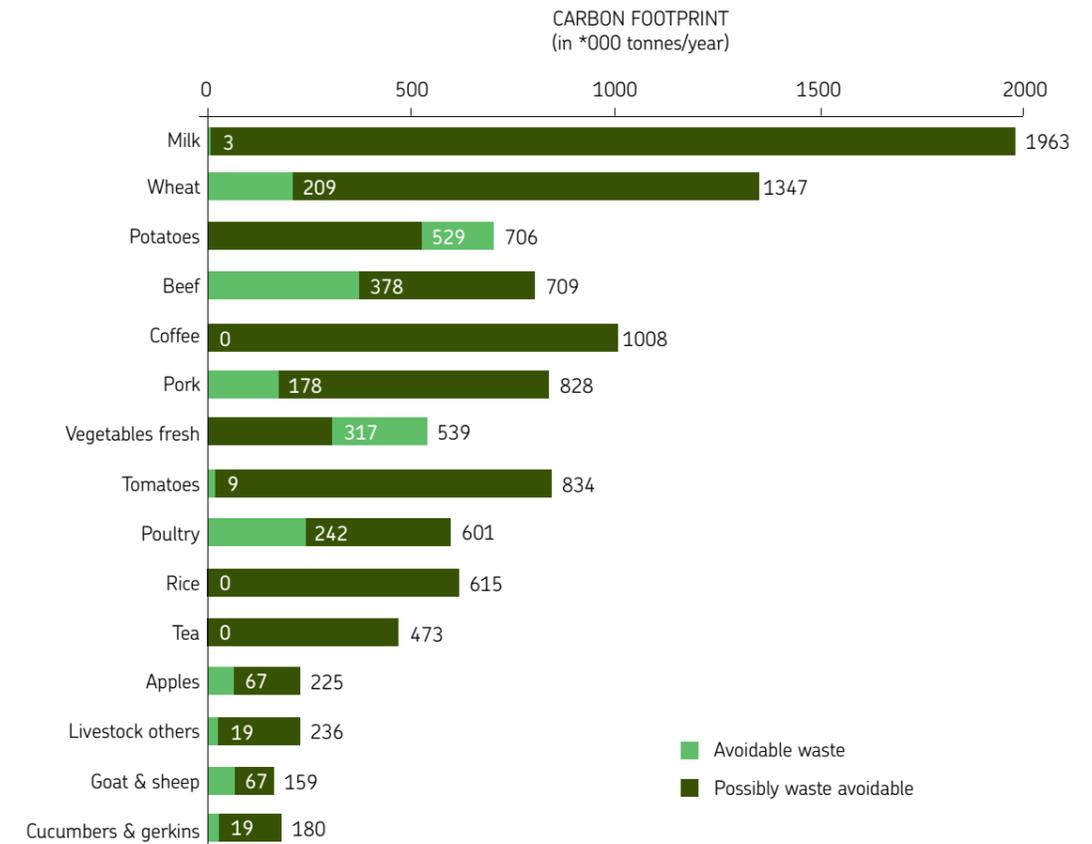
Figure 4.4. Total Carbon Footprint of waste during the consumption stage in Great Britain



Source: BCFN elaboration of WRAP data, 2012.

The food type that has the greatest impact on the environment (higher carbon footprint levels) is animal products (mainly milk, beef, pork, and poultry), as can be seen in Figure 4.5. Furthermore, WRAP estimates that the water footprint⁵ of the food wasted at home amounts to 6,262 million m³ of water per year (Figure 4.6.), of which 5,368 million is

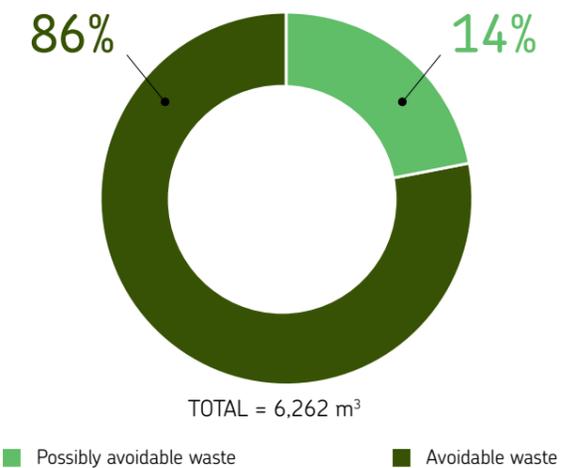
Figure 4.5. Total Carbon Footprint of waste at the household consumption stage in Great Britain for the main food categories



Source: BCFN elaboration of WRAP data, 2012.

from avoidable food waste and 894 million from possibly avoidable waste (representing 5 and 1%, respectively, of the total English water footprint). The per capita waste of water is 284 liters per day.

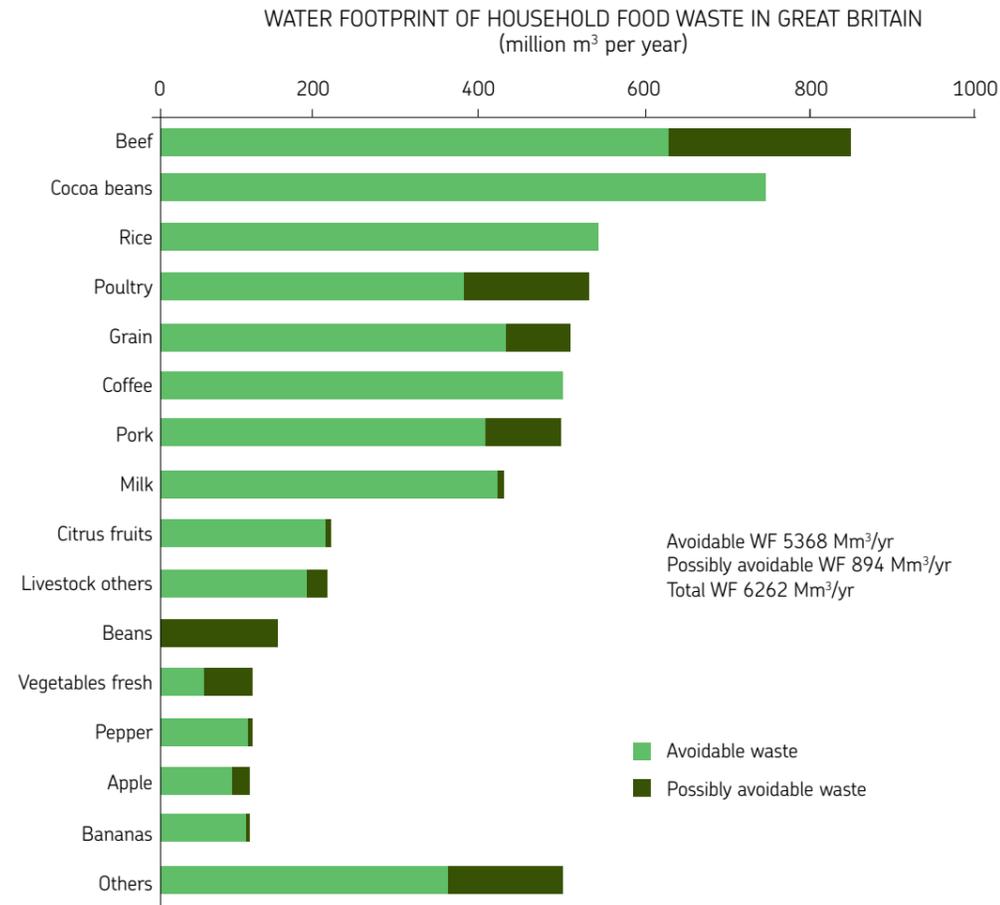
Figure 4.6. Total Water Footprint of waste during the consumption stage in Great Britain



Source: BCFN elaboration of WRAP data, 2012.

However, 71% of virtual water consumption affects other countries, from which the wasted foods and drinks are imported. Finally, as shown in Figure 4.7., the food category which has the greatest impact on the consumption of water resources is beef.

Figure 4.7. Total Water Footprint of waste at the household consumption stage in Great Britain for the main food categories



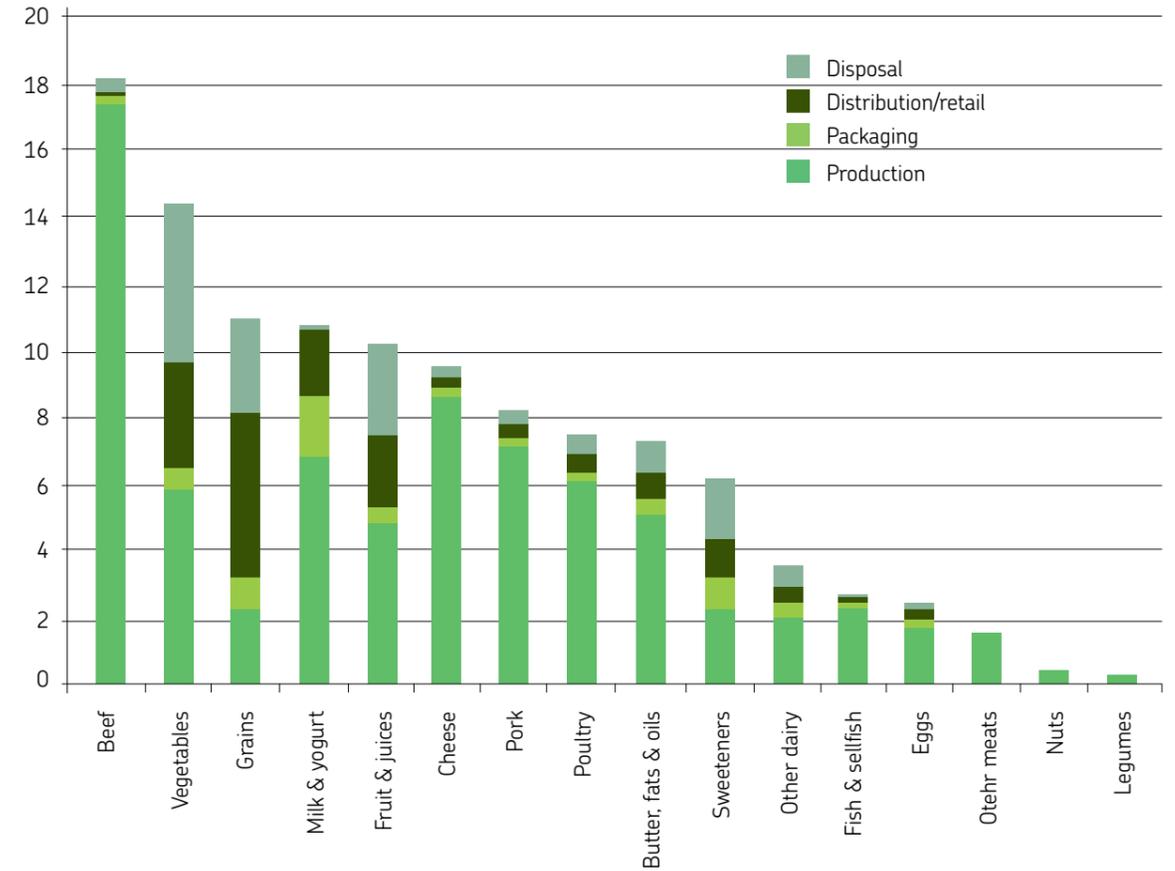
Source: BCFN elaboration of WRAP data, 2012.

United States

The study carried out by Venkat, which refers to the United States, only calculates the carbon footprint of the various wasted food categories. It was revealed that the emissions during the production, transformation, packaging, distribution, and disposal stages of food that was not consumed annually amount to about 112.9 million tons of equivalent carbon dioxide (2009 datum).

Figure 4.8. shows how beef is the food responsible for the greatest amount of GHGs (16% of total emissions), even though it amounts to only 2% of the total amount of food wasted.⁶ In conclusion, in all three countries analyzed, empirical evidence shows how animal-derived waste, though less in terms of weight, has a greater impact on the environment than vegetable-derived waste.

Figure 4.8. Greenhouse gas emissions from waste for the main food categories in the United States (2009, million tons of equivalent CO₂ per year)



Source: BCFN elaboration of WRAP data, 2012.



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4.2 THE ECONOMIC IMPACT

There are two main ways in which the economic impact of food waste can be valorized, which refer to the production cost and the market price of goods. In the first case, according to the classic school of economic theory, the value of a good is proportional to the resources that are necessary to produce it. Therefore, the economic impact could be estimated as the “value that is lost with waste,” using a calculation criteria that includes the costs of obtaining the individual goods.

In the second case, according to the neoclassical school of economic theory, the value of a good does not depend on the production cost, but on its utility, represented by the price at market. Therefore, the economic impact of waste could be estimated using “the price of the individual goods” as a calculation criterion.

To this we can add an assessment based on the theory of the economics of well-being, which estimates food waste as the “impact on the usefulness of the entire society.”

Therefore, we must not only include the market price in the calculation, but we must also consider the negative externalities produced, thus summing the estimation of a society’s willingness to pay the price of the environmental impact (as is the case, for example, of the CO₂ emission valorization system created by the European Union).

Furthermore, considering a sizeable portion of land is used in a less useful way (to produce food that is not consumed) compared to alternative ways, the economic impact can be evaluated calculating the opportunity cost of the agricultural surface used to produce the wasted goods. Below we can see some significant data concerning the quantification of the economic impact of waste in Italy (Segrè and Falasconi, 2011) and in the United States (Venkat, 2011). Estimates for Great Britain also show that 30-40% of the annual production of food that is wasted has an estimated economic value equivalent to about €18 billion.

Italy

The analysis of the economic impact of food waste in Italy is determined by the losses and waste in the agricultural sector and the amount of waste created by the food industry and

Figure 4.9. Methods for the calculation of the economic impact of food losses and waste

	PRODUCTION COST	MARKET PRICE	MARKET PRICE AND CO ₂ ALLOWANCES	MARKET PRICE AND OPPORTUNITY COST OF AGRICULTURAL SURFACE
Agriculture	●	●	●	●
Food industry	●	●	●	●
Distribution	●	●	●	●

Source: BCFN elaboration, 2012.

The economic impact of the surplus produce owed to the CAP

Economic theory in the past has shown little interest in the valorization of food waste. An exception to this disinterest was represented by the European studies on the surplus caused by the old Common Agricultural Policy (CAP). Before recent reforms, the CAP, on one hand, aided in reaching essential targets, such as market stabilization, and allowed an increase in productivity and the security of the food supplies;

on the other hand, however, it also favored a number of negative effects, including the proliferation of surplus produce. This surplus, as well as a physical excess, also meant significant economic squandering, because both the production and disposal (destruction) of crops have weighed exceedingly on the European Community budget and on the environment.



THE ECONOMIC IMPACT OF WASTED FOOD INCLUDES CALCULATING THE NEGATIVE EXTERNALITIES, BESIDES THE COST OR THE PRICE OF THE PRODUCTS THROWN AWAY

distribution, is and calculated by adopting the various quantification methods described above (Figure 4.9.). The economic impact was quantified in all three stages of the food chain according to the market price.

At the agricultural level, because of the greater availability of data, the impact was also estimated in relation to the production cost and included the valorization of CO₂ emissions and the opportunity cost of the agricultural land.

More specifically, in the agricultural stage the production costs include, for example:

- the purchase of seeds, fertilizers, and other technical resources;
- amortization charges, maintenance, and insurance;
- machines and warehouses;
- irrigation systems;
- taxes;
- remuneration of labor.

By price we mean, “the monetary value at which farmers sell their produce” and this expresses the balance between supply and demand.

Figure 4.10. shows the estimate of the economic impact of waste in agriculture calculated according to the production cost and the market price.

Figure 4.10. Economic impact of waste in agriculture in Italy, estimated according to the production cost and the market price of goods

	PRODUCTION COST (€)	MARKET PRICE (€)
Total agriculture	8,156 Mil.	9,776 Mil.

Source: Segrè and Falasconi, 2011.

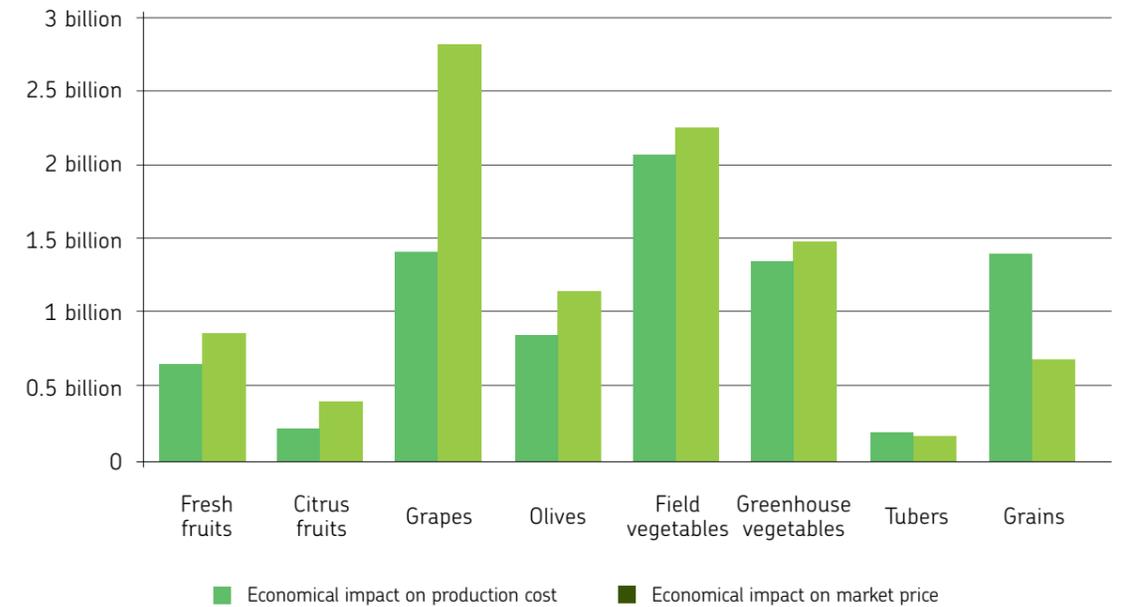
The estimates show an economic impact equal to about €8 billion, if we use the calculation method set on the production cost, and equal to almost €10 billion, if we use the calculation method set on the market price, equivalent to €136 and €163 per person, respectively. It can be noted that the two figures, though both very high, differ by almost €1.6 billion (the impact on the market price is higher by about 16% compared to the production cost). Both methods are correct, but they have different applications. In this case, the use of these two methods has allowed us to verify that, in the year in question (the data refers to 2009), for tubers and especially for grains, market prices were not remunerative: in fact, because of the collapse in the prices of grains, the prices were lower than the production costs (Figure 4.11.) and some farmers had chosen to abandon their crop (thereby increasing the waste), rather than trying to sell it.

If we also include the negative consequences of food waste in terms of environmental pollution, the estimate of the economic impact turns out to be greater than €10 billion.⁷

Finally, if we also valorize the opportunity cost of the area of land used for the production of food that is not consumed, the estimate of the economic impact increases further. The opportunity cost should be, in fact, a value at least equal to the best alternative use of the land (such as construction potential, quantified in the Segrè and Falasconi study by approximately €20,000 per hectare) and, in the case of Italy, it amounts to €30 billion.⁸ Continuing along the food supply chain, the economic impact of the waste that can be attributed to the food industry is equivalent to almost €1 billion, if we use the calculation method based on the market price, and almost €1.2 billion, if we include the valorization of CO₂⁹ emissions in the calculation. Finally, in the distribution segment, the waste is quantified as a little above €1.5 billion concerning the market prices.

In Figure 4.12., a table sums up the economic impact of food waste along the entire Italian supply chain, calculated on the basis of the products’ market price and also the emission of GHGs as a negative external consequence for the agricultural and industrial stages (Figures 4.12. and 4.13.).

Figure 4.11. The economic impact of waste in agriculture in Italy, estimated according to the production cost and the market price of goods



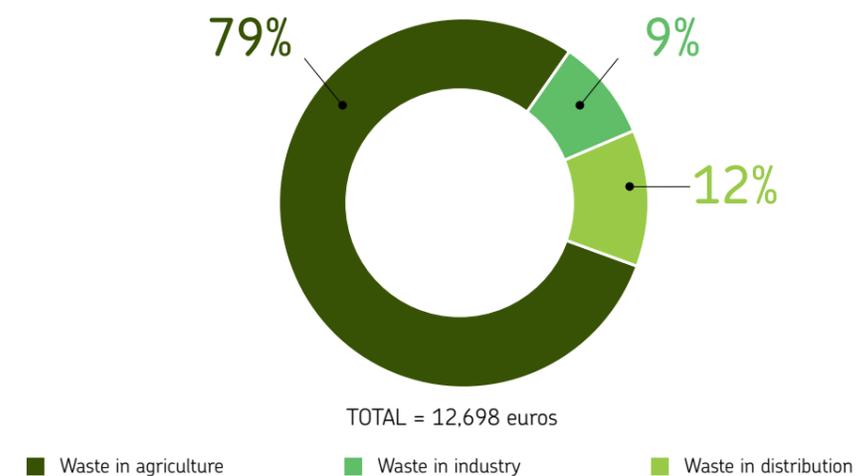
Source: Segrè and Falasconi, 2011.

Figure 4.12. Economic impact of the food waste along the supply chain

ECONOMIC WASTE IN AGRICULTURE (€)	ECONOMIC WASTE IN THE FOOD INDUSTRY (€)	ECONOMIC WASTE IN THE DISTRIBUTION (€)	ECONOMIC IMPACT WASTE IN THE FOOD SUPPLY CHAIN (€)
10,008 Mil.	1,178 Mil.	1,512 Mil.	12,698 Mil.

Source: Segrè and Falasconi, 2011.

Figure 4.13. Economic impact of food waste in the main sectors of the industry in Italy



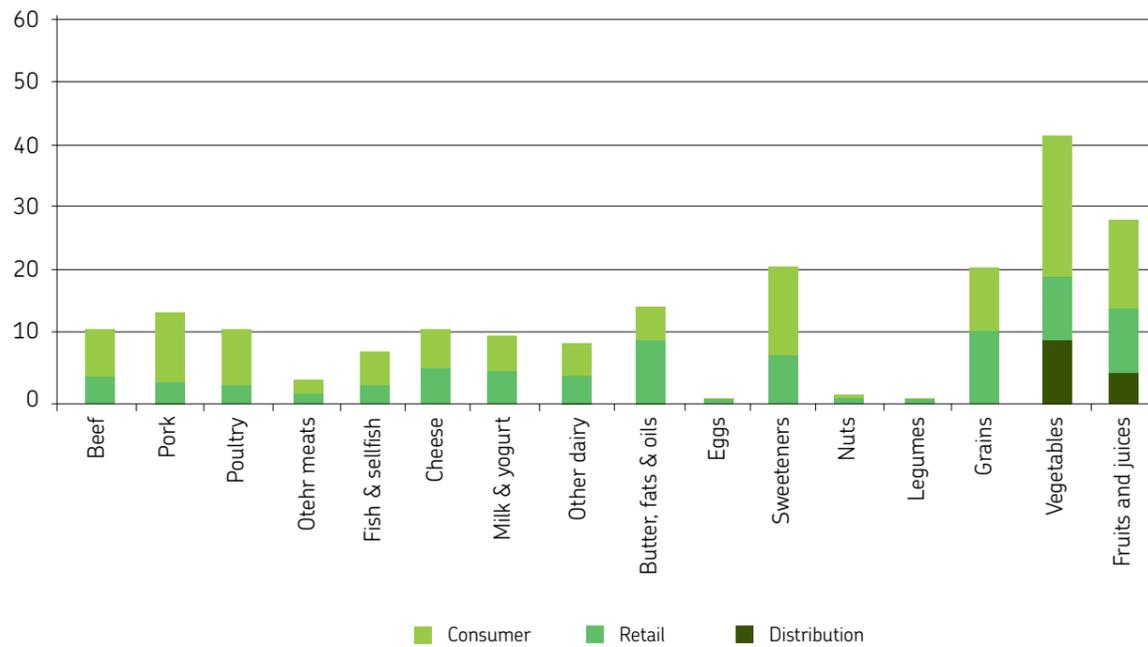
Source: BCFN elaboration of Segrè and Falasconi data, 2011.

United States

Contrary to the Italian scenario, which estimates the economic impact by adopting different calculation methods, in the United States food waste is quantified based on the sole market price (distribution prices in 2011 applied to the quantity of food waste in 2009) for the various food categories, the different wholesale distribution stages, retail distribution (which in this case also includes restaurants and food services), and final consumption. The economic impact of waste in the United States is equal to \$197.7 billion and the waste during the sole consumption stage is equivalent to \$124.1 billion (that is about 63% of the total), costing on average, for a family of four people, about \$1,600 dollars per year. In the distribution stage, waste amounts to \$64.6 billion.

Animal-derived products have a lower economical impact than vegetable-derived foods, contrary to their environmental impact. In fact, the impact of these products is equal to 37% of the total, while that of grains, fruits, and vegetables is equal to 47%.

Figure 4.14. Economic impact of waste in the United States assessed according to the market price of goods



Source: BCFN elaboration of WRAP data, 2012.

4.3 THE SOCIAL IMPACT

The social impact of waste can partly be tackled using the concepts of *food security* and *access to food*.

The definition of food security, which is commonly accepted today, is from the World Food Summit in 1996, which describes a situation where “all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life.”¹⁰

Generally, the concept of security refers to the availability of food nationally, in such quantities that will satisfy the energy requirements of the reference population. Along with energy requirements, a diet should also guarantee an adequate nutrient content.

Relevant literature provides various estimates on the daily energy quantities necessary for the balanced nutrition of a person, but on average this quantity is equal to about 2,700 kcal. Although the data concerning the supply shows an availability of food that should be sufficient to fulfill the global population’s energy requirements, there continues to be malnutrition in the world. These problems can be traced back to difficulties in access to the supply of food caused, for example, by the high levels of poverty or the presence of conflict in a particular country or region. There is indeed a strong correlation between areas with a high percentage of malnourished populations and areas with high percentages of extremely poor people, indicating how poverty can prohibit people from being either able to produce or buy enough food for adequate health.¹¹ A similar correlation can be seen between the areas with a dry climate and poor availability of water and high malnutrition levels.¹²

In societies where availability is abundant and access to food is guaranteed, we see the increase of food waste from overeating. The number of people who have a higher caloric intake than is necessary is, in fact, increasing, contributing to the obesity phenomenon.

We will conclude recalling how the FAO study¹³ showed that the quantity of food that ends up in the garbage in industrialized countries (222 million tons) is nearly equal to the available food production in Sub-Saharan Africa (230 million tons).

THE QUANTITY OF FOOD WASTED IN INDUSTRIALIZED COUNTRIES MATCHES THE FOOD PRODUCTION AVAILABLE IN SUB-SAHARAN AFRICA

5. THE MAIN INITIATIVES
TO COMBAT
FOOD WASTE



5.1 TYPES OF ACTION FOR WASTE REDUCTION AND RECUPERATION OF FOOD

THERE IS A BROAD ARRAY OF INITIATIVES TO REDUCE AND RECUPERATE WASTED FOOD

There are many organizations and action initiatives in the world aimed at the reduction and/or recuperation of food products that can no longer be sold but are still edible.¹

The main organizations in industrialized economies and developing countries alike can be grouped into the following categories which include advocacy, education, and direct action:

- *Organizations (for profit and non-profit) that provide food aid* that – through donations from industry, restaurants, and food services – collect food that would be destroyed or thrown away, and distribute it to facilities devoted to the assistance of poor and marginalized people. These are mostly non-profit organizations, such as the Banco Alimentare (Food Bank) and the Società del Pane Quotidiano (Daily Bread Association) in Italy, FareShare in Great Britain, City Harvest in the United States, and Mesa Brasil del SESC in Brazil; or private organizations, including the Italian university spin-off Last Minute Market, which favors a direct relationship between supply and demand. In other cases, the organizations can recover and prepare food in community kitchens and then serve it in cafeterias, as FoodCycle does; at charity dinners, such as *The Dinner Exchange*; or during collective events like the initiative *Feeding the 5000* in London. Food that is still intact and never used before can also come from public events, catering services and concerts such as the project *Rock and Wrap It Up!* in the United States. Finally, discarded food can be collected even directly from the food supply chain, including *Feeding America* and *Society of St. Andrew* in the United States.
- *Initiatives to reduce, reuse, and recycle food, promoted by local government or municipal agencies* including: WRAP in Great Britain; the U.S. Environmental Protection Agency (EPA) and the recycling certification designed by the supermarkets promoted by the Massachusetts Department of Environmental Protection; the information campaign *Too good to trash!* of the Federal Ministry for Food, Agriculture and Consumer Protection in Germany; or the *Buon Samaritano* (Good Samaritan) of the Municipality of Turin in Italy.
- *Food waste awareness campaigns* including: WRAP's nation-wide *Love Food, Hate Waste* and the *This is Rubbish* campaign in Great Britain; the ADEME campaign in France; and the Stop Wasting Food movement in Denmark. Sometimes campaigns are targeted specifically at adolescents, through projects started in schools such as the *Edible Schoolyard Project* in the United States and the *Manger autrement dans les collèges* in France.
- *Private cooperatives in the agricultural sector* such as *Grow Sheffield's Abundance Project* in Great Britain and the *City Slicker Farms* in the United States.
- *Initiatives by main retailers*: through the collection and distribution of unsold food such as by *Buon Fine* (Good End) by Coop in Italy; the deferred purchase of commercial

promotions such as the formula “*buy one, get one later*” adopted by Sainsbury's and esco in Great Britain; the use of food waste as fuel by Sainsbury's and Tesco in Great Britain; fair trade programs from A.N.D.E.S. in France; improvements in packaging by Morrisons and Marks & Spencer in Great Britain; the offer of suggestions to customers on the best ways to preserve food, shown on product labels or via web sites including Morrisons.

- *Internet websites that market food products at discounted prices close to the recommended expiration date*, including the experience of *Quel che c'è* (What there is) in Italy and of *Approved Food* in Great Britain.
- “*Zero impact*” initiatives in restaurants and food services for the recovery of food leftovers and wine left by customers, such as the Italian campaigns *Il buono che avanza* (The goodness that's left over) in Lombardy and *Buta Stupa* in Piedmont, or the *Portami via* (Take me away) campaign by the Italian Sommelier Association.
- *Initiatives launched by individual facilities*, such as the reorganization of the catering service at the Hvidovre Hospital in Denmark and the *People's Supermarket* in London, which involve local communities.

We will now look at the most interesting initiatives in Europe (Great Britain, Italy, France, Germany, and Denmark), in the United States, and in some developing countries (India and Brazil). English-speaking countries (Great Britain and the United States) and Northern Europe were among the first to advocate for food waste reduction.

We will see how the concept of “recovery” (often directed toward charities) and the final consumption stage are the most popular programs, but there are also initiatives tackling the pre-harvest stages and food processing.

The initiatives presented are classified according to their objectives (reduction and/or recovery of waste), the public or private nature of the organization, the national or local range of action, the relevant stages of the food chain and, where available, the main results obtained.

THE MOST IMPORTANT INITIATIVES IN EUROPE, THE UNITED STATES AND DEVELOPING COUNTRIES

ORGANIZATIONS (FOR PROFIT AND NON-PROFIT) THAT PROVIDE FOOD AID THAT COLLECT FOOD AND DISTRIBUTE IT (12)



INITIATIVES TO REDUCE, REUSE, AND RECYCLE FOOD, PROMOTED BY LOCAL GOVERNMENT OR MUNICIPAL AGENCIES (7)



INITIATIVES BY MAIN RETAILERS (7)



FOOD WASTE AWARENESS CAMPAIGNS (9)



Agence de l'Environnement et de la Maîtrise de l'Energie

INTERNET WEBSITES THAT MARKET FOOD PRODUCTS AT DISCOUNTED PRICES CLOSE TO THE RECOMMENDED EXPIRATION DATE (2)



"ZERO IMPACT" INITIATIVES IN RESTAURANTS AND FOOD SERVICES FOR THE RECOVERY OF FOOD LEFTOVERS AND WINE LEFT BY CUSTOMERS (3)



PRIVATE COOPERATIVES IN THE AGRICULTURAL SECTOR (2)



INITIATIVES LAUNCHED BY INDIVIDUAL FACILITIES (2)

THE PEOPLE'S SUPERMARKET

INITIATIVES LAUNCHED BY LARGE-SCALE COMMERCIAL FACILITIES TO HEIGHTEN AWARENESS OF FOOD WASTE (1)



5.2 MAIN INITIATIVES SET UP IN EUROPE

5.2.1 Great Britain

The Waste & Resources Action Programme (WRAP) and the Love Food, Hate Waste campaign

BY 2015, WRAP AIMS TO FULFILL IMPORTANT OBJECTIVES OF ENVIRONMENTAL SUSTAINABILITY, STARTING WITH THE REDUCTION OF FOOD WASTE

WRAP – Waste & Resources Action Programme (www.wrap.org.uk) is a non-profit organization founded in 2001; it operates in England, Scotland, Wales, and Northern Ireland to help companies and individuals exploit the advantages of waste reduction, the development of sustainable products, and the efficient use of resources. In fact, every year WRAP aims to do the following:

- 7 million tons less of CO₂ emissions;
- 3 million tons less of biodegradable waste in British landfills;
- £1.9 billion saved by consumers, companies, and the public sector;
- £130 million more for resource management;
- 3 million tons less of primary resources used;
- 2 million tons less of waste products.

By 2015, WRAP aims to save 3.2 million tons a year of equivalent CO₂ emissions, from the “avoidable” waste of food and drinks. In order to reach this objective, WRAP works with manufacturers and distributors, offers consumers suggestions on how to reduce food waste, promotes actions for food waste reduction in the hotel, tourist, and public administration sectors, and cooperates with the packaging sector to optimize packaging design and functionality.

WRAP’s *Love Food, Hate Waste* 2007 campaign aimed to raise food waste reduction aware-

Figure 5.1. A few examples taken from WRAP’s awareness campaign *Love Food, Hate Waste* in Great Britain



ness in citizens and companies: this initiative prevented 137,000 tons of wasted food from being sent to landfills and saved £300 million.

Their website www.lovefoodhatewaste.com offers suggestions and useful advice – for example, how to prepare the right portions or correctly preserve food in the refrigerator, in the freezer, or in the cupboard, as well as practical recipes on reusing meal leftovers.

In Great Britain, they are also researching the introduction of new technologies that would replace the “use by” label with indicators that would, instead, show a product’s history in terms of time/temperature and signal its exposure to an excessive temperature (and relative exposure time at that temperature).

SINCE 2007, A NATIONWIDE CAMPAIGN TO RAISE FOOD WASTE REDUCTION AWARENESS IN CITIZENS AND COMPANIES

Initiatives promoted by Large-scale retailers

In 2005, the British government and WRAP inaugurated the *Courtauld Commitment*, a voluntary agreement stipulated with the country’s most important retailers and food industries to reduce waste by intervening on packaging (with the aim to reduce the impact of CO₂ emissions by 10%), on household consumption behavior (with the aim to reduce food and drink waste at home by 4%), and on waste along the entire distribution chain (with the objective to reduce product and food waste by 5%). In the project’s first four years, 1.2 million tons of wasted food and packaging were saved, worth approximately £1.8 billion.

Among the initiatives of individual retailers, Morrisons supermarket developed the *Great Taste Less Waste* campaign. They introduced “best kept” stickers on fresh products to show customers the best way of preserving fresh products at home for a longer time, to reduce food waste and save money. They also include practical advice in their store departments, along with suggestions and recipes on their website (www.morrisons.co.uk). A new packaging system for fresh and cooked products was also introduced. Furthermore, customers who need a smaller quantity of food can purchase a single product at a time (steak, fish, etc.).

Marks & Spencer redesigned their meat packaging to use less plastic and maintain the product fresh for as long as possible, while Warburtons introduced a new bread loaf format designed for single consumers.

From the second half of 2009, the chains Sainsbury’s (www.sainsburys.co.uk) and Tesco (www.tesco.com) introduced the *Buy One, Get One Later* (BOGOL) campaigns to reduce food waste and help customers save money. Because the British government’s “Food 2030” report indicated “2x1” promotions were among the reasons customers buy more food than they really need, Tesco adopted a mechanism to stagger purchases over time: customers can purchase one item and then pick up a second, identical product at a later time for free, rather than having to purchase both at the same time.

As far as the environmental impact is concerned, Tesco intends to become a “zero impact” chain by 2050: the new Widnes superstore will be powered 100% by food waste-generated renewable energy. In partnership with the logistics operator Stobart and the PDM Group active in food waste recycling, this project will reduce CO₂ emissions by 7,000 tons a year. In 2010, the supermarket chain Sainsbury’s also developed a weekly waste program for 42 tons of food products wasted in its stores in Scotland, which are then transformed into biofuel for electricity at the refinery in Motherwell (Scotland). Every ton of food waste converted into energy will generate sufficient electricity for 500 households and will save three tons of CO₂.

SINCE 2005, AN AGREEMENT BETWEEN IMPORTANT RETAILERS AND THE BRITISH FOOD INDUSTRY TO REDUCE FOOD WASTE

MANY INITIATIVES BY INDIVIDUAL RETAILERS

Other important initiatives in Great Britain

VARIOUS INITIATIVES INVOLVING CHARITIES AND FOOD RECUPERATION, FROM COLLECTION TO INDEPENDENT DISTRIBUTION

Other particularly interesting initiatives in Great Britain are:

- The charity association FareShare (www.fareshare.org.uk), which provides quality food (collected from the food industry surplus) to organizations that assist disadvantaged people. Product delivery to FareShare depots is part of the various stages of the products' distribution chain and takes place before shipping to the retail outlets or directly to the individual point of sales. In 2010-2011, FareShare distributed more than 8.6 million meals, with a reduction of 1,800 tons of CO₂ emissions.
- *This is Rubbish* (www.thisisrubbish.org.uk) is an initiative created by a group of young people in Wales to raise awareness about the extent of food waste in Great Britain and highlight the shared responsibility of individuals and companies. The campaign is set up so that all merchants document the amount of food products wasted during their business, certified by an independent commission, and made public. *This is Rubbish* has supported numerous initiatives, including *Feeding the 5000*, *Dining Down to Earth* (a dinner for 100 people), *Hungry for Activism*, and *Feast Machynlleth* (a communal dinner party made with local surplus).
- Founded in 2009, the charity group *Food Cycle* (www.foodcycle.org.uk) aims to strengthen local communities by organizing groups of volunteers who collect surplus food that is produced locally and prepare meals from it in the unused spaces of food service and restaurant kitchens. Operating in five collection centers in London and in nine other cities in Great Britain (Birmingham, Bristol, Cambridge, Durham, Edinburgh, Leeds, Liverpool, Manchester, and Norwich), the organization provides meals to people in need in the community. The group is also developing community kitchens, where hearty meals are served at affordable prices for lunch, four days a week.
- The *Feeding the 5000* initiative (www.feeding5k.org), held in London in 2009 and 2011, made it possible to offer a free meal to 5,000 people, using only food that would otherwise have been discarded. Similar in scope and very sensitive to environmental and humanitarian themes, The Dinner Exchange (www.thedinnerexchange.zzl.org) is a non-profit organization in London that organizes dinner for 30 people once a month in a different location. They serve vegetarian, nutritionally balanced dishes, and cook with foods that would otherwise be wasted, which are donated by New Covent Garden and Earth Natural Foods market vendors. Guests who take part are required to make a donation (starting from £10) and all proceeds from the dinners are donated to charity.
- *People's Supermarket* (www.thepeoplessupermarket.org) is a cooperative run by its customers, which responds to community needs and provides local food at affordable prices. In fact, for a modest membership fee (£25), consumers are entitled to a 10% discount on all products sold, with the commitment to provide four hours of volunteer work in the supermarket. Among the objectives of the organization, is to minimize waste through processing food that is close to its expiration date into sandwiches, pies, and cakes, which are sold in the supermarket, and for food waste composting.
- *Grow Sheffield's Abundance Project* (www.growsheffield.com) is a group led by the local community that redistributes surplus from fruit orchards around the city of Sheffield. In 2010, the association embarked on a new adventure, renting a kitchen with the help of volunteers and producing its own brand of chutney and jams. Revenue from the sale of these products in local farmers' markets and food events in Sheffield are reinvested into the project.
- *Approved Food* (www.approvedfood.co.uk), the main channel for online sales of dry goods and beverages in Great Britain, tries to increase awareness among consumers

FACTS & FIGURES LOVE FOOD, HATE WASTE



Type of initiative FOOD WASTE AWARENESS CAMPAIGN AND OFFER OF USEFUL SUGGESTIONS FOR CORRECT FOOD PRESERVATION AND REUSE OF MEAL LEFTOVERS

Date of establishment 2007

Founder WRAP – WASTE & RESOURCES ACTION PROGRAMME

Aims TO REDUCE FOOD WASTE

Stages of food chain involved



Type of promoter NO-PROFIT COMPANY

Type of recipient FINAL CONSUMER

Level of action NATIONAL

Main results obtained 137 THOUSAND TONS LESS OF WASTED FOOD AND A SAVING OF £300 MILLION IN GREAT BRITAIN

Website WWW.LOVEFOODHATEWASTE.COM, WWW.WRAP.ORG.UK

who can afford to buy food at “normal” prices and who are aware that the useful life of foods is often longer than the expiration date printed on the label. The products advertised through this channel are sold at a discounted price.

5.2.2 Italy

Last Minute Market (LMM)

LMM ENCOURAGES A DIRECT RELATIONSHIP BETWEEN SUPPLY AND DEMAND

Last Minute Market (LMM) is a University of Bologna spin-off company, founded in 1998 as a research activity that became a business reality throughout the country by 2003, with projects aimed at the recovery of unsold (or un-marketable) goods for charitable organizations. LMM uses an operational team supported by teachers and researchers of the University of Bologna. With over 40 projects implemented in Italian municipalities, provinces and regions, LMM has developed a working method that activates the donations/pick-up system progressively, checking nutritional, sanitation, logistical, and tax aspects.

The logistical and organizational models they use allow the completely safe recovery of all types of products, including those that fall into the categories of “fresh” and “very fresh.” LMM, in fact, does not directly handle unsold products, nor does it have stores, or its own collection means: the organization promotes the direct encounter of demand and supply, ensuring safety for all stages of the system.

LMM’s activities address the recovery of food products, collection of surpluses from business and manufacturing activities (LMM-FOOD), vegetables that were not harvested and remained in the fields (LMM-HARVEST), and ready-made meals recovered from the foodservice channel, such as schools and businesses (LMM-CATERING).

Over the years, the model has been extended to other types of goods, businesses, and manufacturers (chemist or over-the-counter drugs close to expiration, books or publishing goods ready for pulping, and other non-food items), intervening wherever waste is “produced.”

A few statistics on the actual results obtained by the Last Minute Market:

- every day, 30 ready meals for the cafeteria are recovered from a hospital in Bologna, for over €35,000 per year;
- in Verona, eight tons per year of cooked products, amounting to 15,000 meals, were recovered from eight school cafeterias;
- between 2010 and 2011, 43,000 meals were redistributed in the provinces of Bologna and Ravenna.

FROM JOINT DECLARATIONS AT THE EUROPEAN PARLIAMENT...

Among the many side initiatives undertaken by LMM are:

- the design, launch and promotion of the “Joint Declaration against Food Waste,” presented on October 28, 2010 at the European Parliament in Brussels, which specifies the objectives to be achieved by 2025 to reduce waste by 50% across the food chain;
- support for the European Resolution, presented by MEP Salvatore Caronna and approved by the European Parliament plenary session, to reduce food waste and improve food supply chain efficiency;
- the contribution to the promotion of the “Waste-prevention Law” (Law 244/December 24, 2007), to encourage the donation of non-food items;
- the multi-year campaign *A Year Against Waste* which is being promoted with the high patronage of the European Parliament’s Agricultural and Rural Convention to raise European and Italian awareness on the causes and consequences of waste, how to reduce it, and the promotion of a scientific and civic-oriented culture along the principles of sustainability and solidarity. The campaign against food waste, active since 2010,

...TO THE DECLARATION OF 2014 AS “EUROPEAN YEAR AGAINST FOOD WASTE”

FACTS & FIGURES LAST MINUTE MARKET



Type of initiative FIT FAVORS THE DIRECT ENCOUNTER OF DEMAND AND SUPPLY, AND PROMOTES LOCAL PROJECTS AIMED AT THE RECOVERY OF UNSOLD OR NOT MARKETABLE GOODS FOR CHARITABLE ORGANIZATIONS

Date of establishment FOUNDED IN 1998, IT BECAME A COMPANY IN 2003

Founder UNIVERSITY OF BOLOGNA

Aims TO REDUCE AND RECOVER FOOD WASTE

Stages of food chain involved



Type of promoter UNIVERSITY SPIN-OFF

Type of recipient CHARITABLE ORGANIZATIONS AND FOOD AID

Type of recovered products FOOD PRODUCTS, FRUITS, VEGETABLES, AND READY MEALS (AS WELL AS BOOKS, MEDICINES, SEEDS, AND OTHER PRODUCTS THAT CAN BE RECOVERED)

Level of action NATIONAL

Main results obtained PROMOTION OF THE “WASTE-PREVENTION LAW” AND A YEAR AGAINST WASTE CAMPAIGN, THE LAUNCH OF THE “JOINT DECLARATION AGAINST FOOD WASTE” AND SUPPORT FOR THE EUROPEAN PARLIAMENT RESOLUTION FOR THE REDUCTION OF FOOD WASTE BY 2025 AND THE ESTABLISHMENT OF 2014 AS “EUROPEAN YEAR AGAINST FOOD WASTE”

Website WWW.LASTMINUTEMARKET.IT

continued in 2012 with the year dedicated to the fight against energy waste, and will continue in 2013 with the year dedicated to the fight against water waste. It will end in 2014, which has been declared the “European Year against Food Waste;”

- the development, with other groups, of the *Carocibo* (cost of food) indicator, which tracks the cost of food expenditures for Italians.

Fondazione Banco Alimentare Onlus (Italian Food Bank Foundation, Non-profit Social Organization)

IN 2011, OVER 68 THOUSAND TONS OF FOOD WERE RECOVERED AND COLLECTED FOR THE MOST NEEDY

The Food Bank Foundation Onlus (FBAO) was established in 1989, following the example of other projects in the United States and Europe.²

The purpose of its activity is to provide “the collection of surplus from agriculture, industry, especially the food industry, large-scale retailers, and franchise restaurants; to collect food at large-scale retail centers during the National Food Collection Day; and redistribute to organizations that deal with aid and assistance to the poor, the marginalized and, in general, to all those in need.”³

FBAO operates nationwide with 21 food bank organizations, the Rete Banco Alimentare (Rete BA), or Food Bank Network, which employs 1,500 volunteers and 118 paid staff to carry out its activities.

In 2011, the Food Bank Network recovered 58,400 tons of food and also collected another 10,124 of food thanks to the National Food Collection Day (GNCA)⁴ and other donations. The 68,524 tons of food were then redistributed to the 8,673 charitable facilities affiliated with the Network, which in turn have assisted more than 1.7 million people in need.

Figure 5.2. The food collected and recovered (tons) from the Food Bank in Italy (2011)

FOOD RECOVERED (tons)	
UE - AGEA (Agenzia per le Erogazioni in Agricoltura) [Agency for supplies in agriculture]	41,073
Agri-food Businesses	10,025
Fruits and vegetables	3942
LSR	3000
Restaurants and food service	360
Total	58,400
FOOD COLLECTED (tons)	
National Food Collection Day	9600
Other donations	524
Total	10,124
TOTAL FOOD RECOVERED AND COLLECTED	68,524

Source: The European House-Ambrosetti elaboration of Italian Food Bank Foundation Onlus data, 2012.

Concerning the recovery of surplus, through more than twenty years of work, FBAO managed to intercept surplus food – food with no market left or that can no longer be used, from all over the food chain. Specifically:

- Industry: there are already more than 800 companies that donate their surplus food. The more than 10,000 tons of products collected in 2011 are, on the one hand, a significant achievement and, on the other hand, evidence of a long-standing collaboration.
- Fruits and vegetables: with its logistical organization, the Food Bank Network is able to handle surplus fruits and vegetables, which by nature have a very short life cycle (re-

FACTS & FIGURES ITALIAN FOOD BANK FOUNDATION ONLUS



Type of initiative A SUBSIDIARY FOOD AID ACTIVITY IN SUPPORT OF CHARITABLE FACILITIES

Date of establishment 1989

Founder LUIGI GIUSSANI, FOUNDER OF COMUNIONE E LIBERAZIONE (COMMUNION AND LIBERATION MOVEMENT) AND DANILO FOSSATI (FOUNDER OF STAR FOOD COMPANY)

Aims RECOVERY AND SUBSEQUENT REDISTRIBUTION OF SURPLUS FOOD

Stages of food chain involved



Type of promoter NON-PROFIT ASSOCIATION/ONLUS

Type of recipient CHARITABLE SERVICES FOR THE NEEDY

Type of recovered products FRESH PASTA AND FILLED PASTA; CANNED VEGETABLES AND LEGUMES; TOMATO PRESERVES; FRESH DAIRY PRODUCTS; FRUIT JUICES; COOKIES AND SNACKS; FRUITS AND VEGETABLES

Level of action NATIONAL

Main results obtained FREE ASSISTANCE TO 8,673 CHARITABLE FACILITIES SCATTERED THROUGHOUT THE ITALIAN TERRITORY, REACHING MORE THAN 1.7 MILLION PEOPLE IN NEED. IN 2011, 58,400 TONS OF FOOD WERE RECOVERED AND ANOTHER 10,124 TONS OF FOOD WERE COLLECTED

Website WWW.BANCOALIMENTARE.IT

FOOD BANK INITIATIVES INVOLVE THE ENTIRE FOOD SUPPLY CHAIN

quiring cold storage in all warehouses) and therefore need a particularly rapid reception and redistribution system throughout the entire country. In 2011, the Food Bank Network managed to recover and distribute 3,900 tons of food.

- Large-scale retailers (LSR): the recovery of surplus through two different, complementary actions. On the one hand, FBAO intercepts products offered by the Distribution Centers (DI.CE.); and, on the other hand, through a complex logistical organizational system, it organizes direct collection from points of sale. Today, the Food Bank Network collects food in more than 400 points of sale, generating a significant flow of high quality and diverse products.
- Foodservice channel: the “Good Samaritan Act” of 2003,⁵ promoted by FBAO, launched a highly innovative program of surplus collections from the foodservice channel, *Siticibo* (www.siticibo.it). The program is aimed at company cafeterias for the collection of cooked foods and school cafeterias for the collection of bread and fruit. Currently, *Siticibo* operates daily in 53 company cafeterias and 130 school cafeterias, 5 catering companies, and 23 commercial services throughout Italy, directly supporting 146 charitable residential facilities.

There are still many tons of food that can be recovered throughout Italy, requiring greater cooperation between the Food Bank Network and people involved in the food supply chain. In particular, supporting the logistical development of FBAO will permit recovering more and more food from the industry, from the DI.CE. and LSR. Indeed, “surplus is not waste, but valuable food that can be given to those who are temporarily unable to get it.”⁶

Initiatives promoted by Large-scale retailers

THE FOOD WASTED BY LARGE-SCALE RETAILERS IN ITALY COULD FEED 620 THOUSAND PEOPLE PER DAY

The Italian food distribution chain throws away 238 thousand tons, worth €881 million: this commodity could feed (breakfast, lunch, and dinner) 620,000 people a day. In Italy, several supermarket chains have intervened to contain the food waste.

An example of this was facilitated by the Coop Group through the initiative *Buon Fine o Brutti ma Buoni* (Good End or Ugly but Good), a project to recover unsold food products (due to defects in the packaging or because they are close to expiration) and donated to associations and non-profit organizations, Onlus, and charitable organizations dealing with poor people. Since 2007, the recovery of industrial food and non-food products has accompanied the recovery of fresh and very fresh products (close to their expiration date, but still edible) to be allocated to cafeterias for the needy.⁷

Nationally, in 2010, *Buon Fine* coordinated 471 points of sale (equivalent to 63% of the nine large cooperatives of the Coop network) and 1,009 non-profit organizations, to save and redistribute more than 2,990 tons of food, worth €18 million.⁸ This is a project that can integrate, in a collaborative way, many players (Coop members and staff, the local community) and create added value for the entire system. Indeed, there are many benefits, including: ethical (reducing food waste), environmental (reduction of waste to be disposed), social (distribution of food to those who need it), and community (benefits arising from the building of relationships with local communities). The amount of donated goods has increased over time, due to the expansion of the project.

Attention to reducing waste is still high, as evidenced by the choice of some cooperatives to offer fresh products at discounted prices close to the expiration date.

Esselunga also signed an agreement with the Food Bank Foundation for the collection of food and other surplus: food products were recovered for a value of €1 million in 2009. Moreover, in 2009, Esselunga introduced polypropylene trays for the preservation of

FACTS & FIGURES GOOD END



Type of initiative UNSOLD GOODS ARE MADE AVAILABLE FOR SOLIDARITY

Date of establishment 2003

Founder COOP

Aims RECOVERY OF FOOD WASTE

Stages of food chain involved



Type of promoter LARGE-SCALE RETAILERS

Type of recipient CHARITABLE ASSOCIATIONS AND ONLUS

Type of recovered products FRESH PRODUCTS, PACKAGED FOODS, BABY PRODUCTS, AND LIQUIDS

Level of action NATIONAL

Main results obtained IN 2010, RECOVERY OF MORE THAN 2,990 TONS OF FOOD, FOR A VALUE OF DONATED GOODS EQUIVALENT TO €18 MILLION FOR 1,009 NON-PROFIT ASSOCIATIONS INVOLVED

Website WWW.E-COOP.IT

fruits and vegetables sold as self-service, which reduces packaging weight and maintains the technical characteristics of the product. Recycling and processing of new packaging trays used for the same purpose can reduce the amount of plastic that is thrown away, with a decrease of CO₂ equivalent to about 500 tons per year.

Many other food retailers have taken steps to recover food locally with charitable organizations. Finally, the initiative *Quel che c'è* (www.quelchece.it), sponsored by a company that has gained broad experience in retail, operates in Milan and online with the sale of a variety of products, not just food, in stock and at discounted prices.

Other important initiatives in Italy

MANY LOCAL INITIATIVES

There are many other initiatives, often voluntary, charitable or private, aimed at reducing the waste of food in Italy:

- Founded in Milan in 1898, the Società del Pane Quotidiano (www.panequotidiano.org) is aimed at that segment of the population living in poverty (workers, pensioners, and the elderly), who are offered basic necessities such as bread, milk, yogurt, fruit, vegetables, pasta, and cookies, donated directly by the food industry. The daily number of assisted people increased from 80-100 in 1970 to 3,000 in 2010, for a total of 660,000 people who were fed in 2010.
- The *Buon Samaritano* Project is promoted by the Turin Municipality, which has been organizing the collection of unused food from school cafeterias for relief organizations since 2005. After the “Law of the Good Samaritan” came into force, the project became fully operational in all local schools, collecting unused bread and fruit daily. The service was sponsored by the Environment and Educational Services Division in collaboration with companies that supply food, and they provide food to cafeterias that assist the needy. Food collection at an Auchan Group Superstore, which provides food that is no longer marketable, was added to the collections from school cafeterias. The total food collected and donated to relief organizations amounted to 117 tons in 2009.⁹
- Initiatives promoted by restaurants through the *Il buono che avanza* project (www.ilbuonochevanza.it), launched by the volunteer Onlus association, Cena dell'Amicizia (Friendship Dinner) in collaboration with other partners,¹⁰ has now spread to 45 restaurants with “zero leftovers” in Milan and its province (as well as 19 in the rest of Italy). The project gives customers the option to take home their leftovers in a special bag, as well as their unfinished bottle of wine. The initiative *Buta Stupa* (www.butastupa.net), which started in Piedmont in 2000 and has been adopted by 100 venues, is similar in purpose: the unfinished bottles (hence the name of the initiative, which in Piedmont dialect means “uncorked bottle”) are given back to customers in a stylish bag. In 2011, the Association of Italian Sommeliers (www.aisitalia.it) also launched a campaign called *Portami via* (Take me away), which gives wine bags to customers so they may leave the restaurant with what is left of the wine they ordered (and paid for).
- A group of seven producers of Slow Food Presidia have set up a collection for organic cosmetics: *IoMiAmo* (I Love Myself) obtains ingredients from the residues of the most qualified food products from the Emilia region, such as Modena balsamic vinegar or the Sangiovese grape. Even the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) has developed a technology that exploits all the chemical components of industrial waste products, such as whey,¹¹ using it to produce specialty beverages with particular nutraceutical qualities.

5.2.3 France

Association Nationale de Développement des Épiceries Solidaires (A.N.D.E.S.)

In 2010, as a reaction to food waste and a growing number of needy people who have access to food aid, the French National Association for the Development of Solidarity Groceries (A.N.D.E.S. Association Nationale de Développement des Épiceries Solidaires)¹² was set up as an initiative directed by Guillaume Bapst. The A.N.D.E.S. network addresses the problem of hunger and malnutrition within a broader resocialization aim of individuals living below the poverty line, offering them choices as consumers and helping them better manage their daily lives.

The solidarity stores are commercial businesses where low income consumers can purchase everyday products at about 10-20% less than their normal retail price, choosing from a wide range of goods: the *épiceries solidaires* (solidarity groceries) are a form of food aid that spread to France in the late 1990s and that distribute food to the homeless or very poor. The solidarity stores address that segment of the population with low incomes (such as working poor, unemployed, pensioners, or people who must cope with the condition of poverty because of unexpected events) who cannot afford to buy food within the normal supermarket distribution channels and tend to be reluctant to contact charitable organizations, and experience the impossibility of purchasing food as a form of social exclusion.

The key objectives of the A.N.D.E.S. network are:

- to reduce fruit and vegetable waste, collecting unsold but still edible products that would otherwise be destroyed from the distribution channel;
- to promote better eating habits within the poorer population frequenting the food aid facilities, offering fresh fruits and vegetables each day;
- to promote the active inclusion of people excluded from the labor market, supporting them in finding stable employment and professional development;
- to support sustainable agricultural models through the transformation of national food surpluses into other products (for example, soups, fruit juices, jams, and ice creams, etc.) and their distribution of food aid to organizations at a European level.

The A.N.D.E.S. network works closely with local social services to supply quality products through the development of national and local agreements with manufacturers, industry, and food distribution, as well as associations and foundations.¹³ A.N.D.E.S. also partners with the Ministry of Food, Agriculture and Fisheries, the Ministry of Ecology, Energy, Sustainable Development and the Sea, and other public bodies at national and local levels.

Through the centralized management of supply and logistics, a “short” chain, and economies of scale, A.N.D.E.S. solidarity stores can offer basic products for the preparation of quality meals, affordable to families on low incomes, while remaining broadly sustainable. With its option to choose different foods, it also promotes a sense of independence and the adoption of a balanced diet. In fact, the results of the project’s impact on dietary habits are encouraging: there was an increase of 50% in the consumption of fruits, and 30% of vegetables among the French population that is targeted.¹⁴

In 2011, A.N.D.E.S. recovered and delivered 1,289 tons of fresh fruits and vegetables from the wholesale markets at Rungis, Perpignan, Lille and Marseille to solidarity stores and local food aid facilities. In the only wholesale market in Rungis (the largest fruit and vegetable market in the world), five tons of fruits and vegetables are collected and redistributed each day to food aid associations that work in the Paris area.

A.N.D.E.S. PROMOTES A NATIONAL NETWORK OF FAIR TRADE STORES

IN 2011, OVER 1,200 TONS OF FRUITS AND VEGETABLES WERE RECOVERED FROM THE MAJOR WHOLESALE MARKETS

At the end of 2011, the A.N.D.E.S. network had 230 members in France,¹⁵ with an average of 120,000 customers per year: on average, one solidarity store supplies 100 private individuals per year. Customers go to solidarity stores for a two or three month period, which can be extended up to six months or even a year, depending on individual circumstances. A.N.D.E.S. also promotes training activities such as cooking classes and family activities through its website (www.epiceries-solidaires.org).

Other important initiatives in France

ATTENTION TO RAISING AWARENESS IN SCHOOLS

In France, several other initiatives have been launched to raise awareness about food waste at the final consumer and school levels:

- One of the many areas of action of the French Environment and Energy Management Agency (ADEME) is the fight against food waste. The Agency's mission is to encourage, supervise, coordinate, facilitate, and carry out operations aimed at protecting the environment and managing energy. ADEME's food waste campaign aims to inform families about the production of waste and to prevent this phenomenon through a change in individual behavior. Their website offers practical advice for reducing food waste, both in the purchase and home consumption stages.
- Another interesting initiative, within the scope of initiatives of the "Plan National Nutrition Santé" (PNNS), is the *Manger autrement dans les collèges* program, promoted in secondary schools of many regions of France. The project was started in 2006 to raise awareness among students about the amount of wasted food in school canteens and cafeterias, and help them adopt a balanced diet and understand the link between agriculture, nutrition, environment, and health.

5.2.4 Other initiatives in Central and Northern Europe

GERMAN INDUSTRY HAS LAUNCHED THE "SAVE FOOD" CAMPAIGN WITH FAO

In March 2012, Germany's Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) launched a broad campaign, *Zu gut für die Tonne* (Too good for the garbage), to provide consumer information and practical advice on food management, from better shopping habits to food preservation.

The German Logistics Association (BVL) also launched an informational campaign on the expiration date of food products. Among the initiatives of the German industrial sector, we should also note SAVE FOOD (www.save-food.org): the project began in May 2011 at Interpack (the world's leading trade fair of the packaging industry¹⁶) with the cooperation of the Düsseldorf Trade Fair (Messe Düsseldorf GmbH) and FAO, and it aims to bring together experts in economics, politics, and research to stimulate dialog and help develop solutions along the food chain, in order to combat food waste in the world.

In 2009, in Denmark, operators in the hotel and restaurant sectors created a partnership to produce fish snacks rich in Omega-3 from fish that is no longer saleable. At the end of 2009, the program was to pass the verification phase, having already negotiated agreements with manufacturers and buyers. Although concrete results are not yet available, more than 50% of the fish in Denmark is considered a non-edible scrap; this experience can be an interesting solution for a product that would otherwise be discarded.

In the food services sector, at the Hvidovre Hospital, in the Hovedstaden region, the hospital cafeteria catering system was changed to reduce food waste:¹⁷ chef Mogens Pedersen Fonseca and his team of 100 collaborators studied the way patients choose

FACTS & FIGURES

ASSOCIATION NATIONALE DE DÉVELOPPEMENT DES ÉPICERIES SOLIDAIRES – A.N.D.E.S.



Type of initiative REDISTRIBUTION OF DISCARDED FOOD

Date of establishment APRIL 2000

Founder GUILLAME BAPST

Aims TO REDUCE AND RECOVER FOOD WASTE

Stages of food chain involved



Type of promoter PUBLIC-PRIVATE FOOD-AID ASSOCIATION

Type of recipient FINAL CONSUMERS

Type of recovered products MAINLY FRUITS AND VEGETABLES

Level of action NATIONAL AND LOCAL

Main results obtained IN 2011, 1.289 TONS OF FRESH FRUITS AND VEGETABLES COLLECTED FROM WHOLESALE MARKETS AND DISTRIBUTED TO NEEDY PEOPLE (120,000 CUSTOMERS PER YEAR ON AVERAGE)

Website WWW.EPICERIES-SOLIDAIRES.ORG

IN DENMARK, THE NGO "STOP WASTING FOOD" RAISES THE FOOD WASTE AWARENESS OF ITS CITIZENS

food and designed an "à la carte" menu that takes budget constraints into account. The program allowed the hospital to save 40 tons of food waste a year and the "à la carte" style has encouraged the management of individual portions: the savings were then re-invested in further food waste reductions and in improving the quality of the food offered in the restaurant.

Finally, among the Danish NGOs, *Stop Spild Af Mad* (Stop Wasting Food, www.stop-spildafmad.dk) is the largest private consumer movement in the country committed to stopping food waste. Because €2.15 billion of food is wasted each year, the organization seeks to raise public awareness on the issue of food waste and its reduction, creating campaigns in schools, public lectures, and seminars, but primarily through information and communication mediums. In collaboration with renowned Danish chefs, the movement also created a series of cookbooks (the *Leftovers Cookbook*) that explain how to reuse meal leftovers in order to cook new dishes.



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5.3 MAIN INITIATIVES SET UP IN THE UNITED STATES

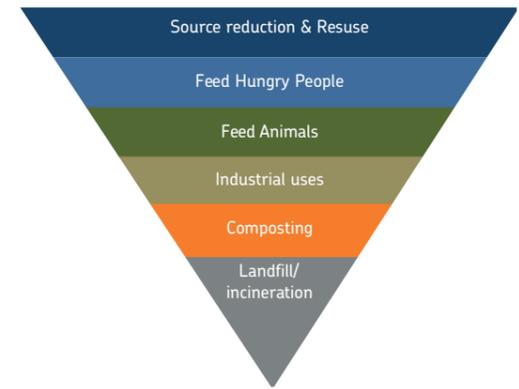
U.S. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) has launched the Food Recovery Challenge, under the Sustainable Materials Management Program. The project challenges participants to minimize their food waste, helping them save money, improve local communities, and contribute to environmental protection. Companies that join the program must conduct an assessment of the food waste they generate and establish a three-year goal to reduce the amount of food waste sent to landfills. In the first year, the company must commit to reduce food waste by 5%, which is then donated or used for composting, or, alternatively, must commit to achieving an overall increase of 5% in all three categories of target destinations. In the following two years, specific objectives are imposed for their facilities. In addition, corporate partners must undertake activities to reduce food waste (for example, reducing the amount of food purchased, changing the processes of food production/processing, reducing the portions of food, donating the surplus to the needy, or composting it).

LESS WASTE, FROM REDUCING RESOURCES TO THE DUMP
LESS WASTE, FROM REDUCING RESOURCES TO THE DUMP

On its website (www.epa.gov), the EPA offers tools and information on programs that promote waste reduction and recycling, whether food-related or not.

Figure 5.3. The food waste recovery pyramid



Source: *Food Recovery Hierarchy*, set by the United States EPA to dispose of surplus food, EPA, 2012.

AN EXAMPLE OF FOOD RECOVERY IN A FARMING COMMUNITY

West Oakland City Slicker Farms

City Slicker Farms is an organization based in a suburb west of Oakland, California, made up of seven community farms (open to the public) that manage more than 100 vegetable and backyard gardens, offering fresh produce to the local community at affordable prices. The clientele consists mainly of low-income families or those who live in poverty. City Slicker Farms also accepts donated food and waste from residents of West Oakland, which is used for composting and for farms and orchards.

In addition to the simple reduction of food scraps that end up in landfills, food programs for the recovery of agricultural waste, such as City Slicker Farms, link the production of food waste of a single family with the food production of the entire community. In 2010, the Community Market Farms Program produced over 4,300 tons of fruits and vegetables for 725 people and has created nearly 11 tons of compost from agricultural or community food waste.

Supermarket Recycling Program Certification del Massachusetts Department of Environmental Protection

INITIATIVES UNDERTAKEN BY SUPERMARKET CHAINS IN THE STATE OF MASSACHUSETTS

To promote the reduction, recycling, and reuse of food waste and other organic materials¹⁸ to large-scale retailers, the Massachusetts Department of Environmental Protection (MassDEP) and the Massachusetts Food Association (MFA) established a program of voluntary certification of recycling carried out by supermarkets (SRPC).

Today, the 87 supermarkets in Massachusetts which have joined the initiative may obtain annual SRPC certification, by proving to MassDEP that they have a comprehensive recycling and active reutilization program. Two chains that have joined the program with at least 80% of their stores in Massachusetts (Hannaford Bros. and Whole Foods Market) were SRPC certified for the whole chain. The recycling and reuse programs include donations of food to the needy locally and the dispatch of food waste, paper, cardboard, plants, and wooden boxes for composting. In turn, the MassDEP provides technical assistance to participating supermarkets to develop their programs, such as the *Supermarket Composting Handbook*. Thus, the participating supermarkets save money, receive positive recognition, and a regulatory relief: waste disposal is a significant operating cost and is increasing for the large-scale retail sector, especially in Massachusetts, where disposal fees range from \$80 to \$100 per ton.

Because 75-85% of waste in a supermarket is biodegradable, composting for these stores is a low-cost alternative to disposal. In August 2005, Massachusetts achieved a recycling rate of 60-75% for food waste and other organic products. On average, supermarkets participating in the program have saved more than \$4,400 a year for storage, recycled 65.9% of the total flow of their food waste, and have saved \$700,000 in disposal costs. In July 2010, the recycling and reuse of food waste introduced in the stores of the seven participating chains have resulted in a saving of between \$3,000 and \$20,000 per store per year.

Other important initiatives in the United States

There are also various initiatives within agricultural production and final consumption, both locally and nationally, as demonstrated by the following examples:

- Promoted by the U.S. government in 1971, *Feeding America*¹⁹ (feedingamerica.org) is the leading national organization against hunger in the United States: every year, it distributes 1.3 million tons of food and food products to over 37 million Americans with low

FACTS & FIGURES CITY SLICKER FARMS



Type of initiative THE SUPPLY OF FRESH PRODUCE TO THE LOCAL COMMUNITY AND RECYCLING WASTE AS COMPOST

Date of establishment 2001

Founder RESIDENTS OF WEST OAKLAND, CALIFORNIA (UNITED STATES)

Aims RECYCLING AND RECOVERY OF FOOD WASTE

Stages of food chain involved



Type of promoter FARMERS' COOPERATIVE AND PRIVATE CITIZENS

Type of recipient PEOPLE WITH LOW INCOMES AND POOR SEGMENTS OF THE POPULATION

Level of action LOCAL

Main results obtained IN 2010, RECOVERY OF 4,300 TONS OF FRUITS AND VEGETABLES AND THE CREATION OF ABOUT 11 TONS OF COMPOST

Website WWW.CITYSLICKERFARMS.ORG

incomes, including 14 million children and 3 million seniors. Food aid from Feeding America comes from 200 food banks scattered all over the country.

- The Society of St. Andrew (www.endhunger.org), a Catholic organization established in 1992 in North Carolina, works on the recovery of fresh fruits and vegetables from farms and their redistribution to charity organizations and needy people. Each year, a network of 30,000 donors, volunteers, and farmers collect up to 6,800 tons of fresh produce for the needy. Among the programs launched by SoSA are *The Potato & Produce Project*, *The Gleaning Network*, *Harvest of Hope* and *The Seed Potato Project*.
- Since 1982, New York's City Harvest association (www.cityharvest.org) collects food from restaurants and has distributed more than 136,000 tons of food to a network of about 600 food aid programs throughout New York. The organization now offers about 45 tons of food a day, for a total of 15,000 tons of food in 2011. City Harvest inspired the Siticibo program, launched in Italy by the Banco Alimentare.
- The *Weekly Pickup – Green Yard Trimmings and Food Scraps Cart* program, promoted by the StopWaste association (www.stopwaste.org) and by the Waste Management Authority of Alameda County, California, allows residents to recycle food scraps, along with other agricultural organic waste. Currently, the collection of food waste affects about 95,000 people. Participation rates are evaluated periodically, but the weekly collection process facilitates Oakland residents to recycle more and waste less.
- *Rock and Wrap It Up!* (RWU) is a national program to combat poverty that recovers food that is still intact at the end of public or private events (like concerts, sporting events, school activities, business meetings, or TV shows) and redistributes them to local food banks and charity organizations. Since its founding in 1991 by Syd Mandelbaum, the organization has collected more than 113,000 tons of food and fed more than 500 million people, working with 60 sports clubs, 150 musical bands, and 200 schools and universities.
- In 1995, the Chez Panisse Foundation, a non-profit organization founded by chef and author Alice Waters, launched the *Edible Schoolyard Project* (ESY), a program at the Martin Luther King, Jr. Middle School in Berkeley, California. The school has a half-acre organic garden, supplying food for the school cafeteria. Thanks to the ESY, students participate in all aspects of growing, harvesting, and preparing meals, taking care not to waste food. These lessons promote good nutrition practices, responsible food choices, and care for the environment.

FACTS & FIGURES SUPERMARKET RECYCLING PROGRAM CERTIFICATION



Type of initiative CERTIFICATION OF THE RECYCLING PROGRAM OF THE DISTRIBUTION CHAINS

Date of establishment 2003

Founder MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (MASSDEP) AND MASSACHUSETTS FOOD ASSOCIATION (MFA)

Aims RECYCLING OF FOOD WASTE

Stages of food chain involved



Type of promoter STATE PROGRAM

Type of recipient LARGE-SCALE RETAILERS (87 OUTLETS OF 7 RETAIL CHAINS IN MASSACHUSETTS)

Level of action LOCAL

Main results obtained PARTICIPATING SUPERMARKETS HAVE SAVED A TOTAL OF \$700,000 IN DISPOSAL

Website WWW.MASS.GOV/DEP/RECYCLE/SUPERMKT.HTM#SRPC



Joel Sartore/National Geographic Stock

5.4 INITIATIVES STARTED IN DEVELOPING COUNTRIES: THE CASE OF BRAZIL AND INDIA

Brazil is one of the leading world manufacturers of food, but it wastes up to \$12 billion annually, an amount of food that could feed 30 million poor people (the *Fome Zero* program is aimed at 44 million people). 64% of the food intended for household consumption is lost at different stages of the food chain: in particular, 20% during the agricultural harvest, 15% during industrial processing, and 20% within the home. In Brazil, there are currently 67 food banks operating, supported by the Ministério do Desenvolvimento Social e Combate à Fome (MDS), which distributes about 39,000 tons of food in 66 counties every year. In particular, *Mesa Brasil* (www.sesc.com.br/mesabrasil), part of the Brazilian National network against hunger and food waste (Rede Nacional de Bancos de Alimentos), is a food and nutrition security program of the Serviço Social do Comércio (SESC).

Developed from the SESC project *Sopa & Pão* (Soup & Bread) in Paraná in 1991 and then launched as a food bank in São Paulo in 1994, since 2000 Mesa Brasil has taken on a national dimension: in 2011, they distributed 38,793 tons of food (donated by retailers, food and horticultural companies, etc.) to over 1.49 million people in 389 cities across the country, with the assistance of 5,594 organizations and 3,248 partner companies. The objectives for 2012 are to reach the threshold of 41,000 tons of food distributed, helping 1.74 million people and 5,808 assisted organizations.

In addition to food distribution, the program also develops educational activities in the areas of nutrition and social work, in order to promote a balanced diet and educate toward proper nutrition.

The Akatu Brazilian Institute for Consumer Consciousness (www.akatu.org.br), an NGO founded in 2001 in São Paulo, has launched a campaign to raise consumer awareness, showing the actual cost of all food waste generated and planning solidarity actions in the world.

Recently, some laws were passed to reduce food waste. A particularly successful recycling program was launched in the city of Curitiba²⁰ within a city environment program: 10,000 families took part in the Garbage that is not Trash program, where they receive 2 kg of food for every 4 kg of recyclables collected and delivered to collection points. Even upon entry at local outdoor shows, families are asked to bring a bag for recycling scraps. India is the third largest manufacturer of food globally, but only 2% of the food produced in the country is industrially processed. A significant proportion of food waste comes from agriculture and is due to the lack of post-harvest infrastructures, such as cold chain infrastructure, transport, and adequate food storage. Consequently, the federal government is working to improve the storage and preservation infrastructure of agricultural products, while the Supreme Court is working on laws allowing the donation

ALMOST 39 THOUSAND TONS OF RECOVERED FOOD DISTRIBUTED THANKS TO MESA BRASIL

GROWING ATTENTION TO THE PROBLEM OF FOOD WASTE IN INDIA AND CHINA, AS WELL

of food to the needy. Among the most interesting initiatives, in Calcutta, the municipal staff recovers 80% of municipal waste by collecting it directly from homes.

In cities like Bangalore and Pune, women's associations collect dry and food waste for recycling for a fee. The poorer neighborhoods are particularly efficient: the 419 slums of Mumbai have adopted a system of waste collection. Hotels also collect food waste: non-vegetable food scraps are sent to pig farms, while leftovers are distributed to the homeless or orphanages. In Indian city markets, food scraps are collected from individual stalls every hour.

In many other countries – both developing and emerging – there is very little information about initiatives to fight food waste or losses. However, it is encouraging that in China – where, every year, there is an estimated 60 million tons of household food waste – municipal authorities are considering proposing a national law to combat this phenomenon and encourage recycling of food waste.



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FACTS & FIGURES MESA BRASIL



Type of initiative FOOD BANK

Date of establishment 2000

Founder SERVIÇO SOCIAL DO COMÉRCIO (SESC)

Aims RECOVERY OF FOOD WASTE

Stages of food chain involved



Type of promoter FOOD-AID ASSOCIATION

Type of recipient CHARITABLE ORGANIZATIONS

Level of action NATIONAL

Main results obtained IN 2011, 38,793 TONS OF FOOD DISTRIBUTION TO OVER 1.49 MILLION PEOPLE

Website WWW.SESC.COM.BR/MESABRASIL

6. THE BCFN RECOMMENDATIONS



7 RECOMMENDATIONS TO REDUCE THE SIZE AND THE IMPACTS OF FOOD WASTE

ASSIGNING A STANDARDIZED MEANING TO THE TERMS “FOOD LOSSES” AND “FOOD WASTE,” AND HARMONIZING THE COLLECTION OF STATISTICAL DATA AT AN INTERNATIONAL LEVEL

UNDERSTANDING IN GREATER DETAIL WHY FOOD WASTE OCCURS IN THE VARIOUS FOOD SUPPLY CHAINS AND BETTER ASSESSING ITS IMPACTS

The BCFN has identified seven priority recommendations for reducing the scale and impacts of waste:

- 1) *Common definitions and metrics.* Assigning a standardized meaning to the terms “food losses” and “food waste,” and harmonizing the collection of statistical data at an international level.
- 2) *Understanding the causes.* Understanding in greater detail why food waste occurs throughout the various stages of the food supply chain and better assessing its impacts.
- 3) *Reducing in order to recover less.* Investing first in reducing food losses and waste, and then in their recovery.
- 4) *(Re)use.* Launching initiatives to recover waste through distribution to disadvantaged persons, for use as animal feed, or, as a last resort, for producing bioenergy.
- 5) *A political priority.* Managing the reduction of waste at an institutional level, and also ensuring that the adoption of standards does not introduce unjustified losses and waste along the food supply chain.
- 6) *Cooperating to save.* Developing supply chain agreements between farmers, producers, and distributors for more appropriate planning of food supply.
- 7) *Information for education.* Increasing consumer awareness about waste and teaching consumers how to purchase, preserve, prepare, and ultimately dispose of food in a more sustainable way.

• *Common definitions and metrics*

In this document, we have gathered numerous definitions and various accepted meanings of food losses and food waste, as proposed by institutions and researchers (Chapter 1). There is significant variety, which undoubtedly reflects the growing attention being paid to this phenomenon at an international level. The absence of a shared definition of food loss and waste is, however, a significant limitation on the possibility of gathering comparable data and developing shared metrics at an international level, which is necessary for understanding the scope of the phenomenon and defining the common objectives for reducing it. For this reason, the BCFN recommends developing shared calculation methodologies appropriate for quantifying the impacts of food losses and waste.

• *Understanding the causes*

There have been few studies analyzing in detail the causes of food losses and waste, and there are no analyses carried out for the individual food supply chain. In our opinion, there is still much analysis and further study to be done. In this document, we have described some of the causes of food losses and waste along the various stages of the food supply chain (Chapter 3), in particular distinguishing the most significant factors between developing and developed countries. We undoubtedly need to take a closer look at the developed countries, because in some cases it seems actually “convenient” from the economic perspective to generate food losses and waste. We also need to pay more attention to monitoring certain factors involved in the industrial production and distribution stages, which, while not directly causing the generation of food waste, transfer that risk downstream to the household consumption stage. The various players within the food supply chain, especially consumers, waste food partly because of their poor understanding of the scale of the waste that each person

produces and its environmental and socio-economic impact (described in Chapter 4). The BCFN considers it necessary to invest more in the analysis of the causes and impacts (including, but not limited to, environmental impact) of losses and waste for the individual food supply chains. It is necessary to understand, above all, why it seems actually economically “convenient” to waste: only then will it be possible to identify the most effective solutions.

• *Reducing in order to recover less*

We need to concentrate our resources and efforts (at all levels) on initiatives aimed at reducing food losses and waste, addressing first and foremost the causes, rather than focusing only on recovery initiatives. The primary objective should, in fact, be to minimize the inefficiencies that lead to losses and waste, taking account of the particular features of the individual food supply chains.

• *(Re)use*

For waste that cannot be eliminated (in the case of food products that are no longer saleable but still edible to humans), the priority should be to take action to recover and redistribute it to struggling sections of society. When waste cannot be redistributed, it should be designated for reuse for other purposes, such as animal feed or the production of bioenergy (non-edible scraps). There are a number of worthy initiatives that can be replicated at an international level. The initiatives we consider the most interesting are proposed in Chapter 5.

• *A political priority*

The reduction of food losses and waste needs to be prioritized within political agendas. Within European institutions, recent discussions on the subject appear to have launched a process of defining concrete reduction targets and initiatives for influencing public opinion. The BCFN recommends evaluating the impacts in terms of waste within the various stages of the food supply chain, when (for reasons not concerned with food safety) new food standards and regulations are introduced (for example, in relation to size and shape).

• *Cooperating to save*

It is important to facilitate horizontal cooperation between farmers to reduce waste and to incentivize longer-term vertical (production-distribution) food chain agreements, enabling better planning to help respond appropriately to demand from the final consumer, both quantitatively and qualitatively. Establishing agreements between businesses throughout the food supply chain, thereby enhancing the coordination of their planning, may be the key to achieving greater correspondence between food product supply and demand.

INVESTING FIRST IN REDUCING FOOD LOSSES AND WASTE AND THEN IN THEIR RECOVERY

LAUNCHING INITIATIVES TO RECOVER THE WASTE BY DISTRIBUTION TO DISADVANTAGED PERSONS, USE AS ANIMAL FEED OR, AS A LAST RESORT, FOR PRODUCING BIOENERGY

MANAGING THE REDUCTION OF WASTE AT AN INSTITUTIONAL LEVEL AND ENSURING THAT THE ADOPTION OF STANDARDS DOES NOT INTRODUCE UNJUSTIFIED LOSSES AND WASTE ALONG THE FSC

DEVELOPING SUPPLY CHAIN AGREEMENTS BETWEEN FARMERS, PRODUCERS, AND DISTRIBUTORS FOR MORE APPROPRIATE PLANNING OF FOOD SUPPLY

The topic of food waste on the European agenda

On October 28, 2010, during the conference on Transforming Food Waste into a Resource, organized by the Last Minute market at the European Parliament in Brussels, in relation to the initiative A Year Against Waste: Food, the “Joint Declaration Against Food Waste” (<http://www.europarl.europa.eu/sides/getDoc.do?type=REPORT&reference=A7-2011-0430&language=IT&mode=XML>) was presented.

In the declaration, which was presented to European officials and members of parliament, with nongovernment organizations, journalists and members of civil society also present, the Parliament and the European Commission were requested to develop strategies and resolutions aimed at reducing food waste by at least 50% by 2025. A new objective is added each year to the Declaration (which amounts to a kind of manifesto, as well as a commitment for European and international institutions).

Previous declarations included, in 2011, to reduce water waste, and in 2012, to reduce energy waste.

Based on the contents of the Declaration, the Report on How to Avoid Food Waste: Strategies for a More Efficient Food Chain in the EU was drawn up. This was approved by the European Parliament with a huge majority on January 19, 2012.

This was a non-legislative initiative aimed at raising the awareness of the Commission, the Council, and the Member States, in order to make combating

food waste a priority within the European political agenda.

In this context, in order to gain the attention of the national governments and promote sustainable food use practices, the European Union has declared that 2014 will be the “European Year Against Food Waste.” The Member States will be invited to introduce food education courses in schools and universities, explaining how to preserve, cook, and dispose of foods.

The report pays particular attention to actions aimed at reducing waste. For example, it suggests adopting dual-date labeling – containing the commercial expiration date to indicate up to what point the food may be sold, and the consumption expiration date to indicate up to what point it may be consumed – which would be useful for limiting uncertainty by consumers as to whether foods to be purchased are edible, to help reduce waste. It also promotes the efficient use of packaging, with the availability of variable package sizing, to keep the products as fresh as possible and to allow consumers to be able to purchase just what they really need. Moreover, foods close to their expiry date should be on sale at a lower price.

The exchange and sharing of good practices between Member States and interested parties, along with participation in programs for the redistribution of uneaten foods to less fortunate members of society, are treated as matters of prime importance within the report.

The fight against food waste in the United States

The Clinton presidency (1993–2001) was the first to be interested and involved in food waste issues.

Dan Glickman, who was Secretary of Agriculture, created a program aimed at encouraging food recovery and food gleaning initiatives, or in other words, activities for the recovery of losses (or waste) from the harvesting directly in the fields. For this purpose, a major promotional campaign was directed at farmers, companies, schools, and hospitals, to encourage them to donate food generously for charitable purposes.

The Bill Emerson Good Samaritan Food Donation Act of 1996 is aimed at encouraging the donation of food and food products to non-profit organizations for redistribution to needy sections of society. This statute does this by limiting the liability of the “donor” participants to cases of gross negligence or inten-

tional misconduct and establishing that, in other cases, they do not incur civil or criminal liability for harm resulting from the supply of apparently safe and edible food.

In 2005, the EPA (Environmental Protection Agency) began to encourage the composting of organic substances and to promote a substantial reduction in the levels of food waste.

Certain recycling initiatives promoted directly by individual states – including in the city of San Francisco – are also worthy of note. San Francisco set a target of reaching the “zero waste” level by 2020, and since 2009 it has been offering all residents the necessary tools for composting food waste. The compost produced in this way by the city is then sold to farms and vineyards in the Bay Area, allowing recovery of 72% of waste products.



Information for education

TEACHING CONSUMERS HOW TO PURCHASE, PRESERVE, PREPARE, AND ULTIMATELY DISPOSE OF FOOD IN A MORE SUSTAINABLE WAY

Education and information initiatives need to be promoted at the consumer level in order to prevent and reduce food waste, with particular reference to food culture, food preparation, and the correct ways of preserving food.

The correct interpretation of the expiry date shown on products plays a particularly significant role.



What each of us can do, starting today

How do we adopt behaviors aimed at progressively reducing and eliminating food waste? Some possible recommendations for consumers are:

- to buy only what they think they will use;
- to always check the expiration dates;
- to remember that wasting food means wasting money;
- to check that the refrigerator setting is correct;
- to put products close to expiration where they can be seen;
- to reuse meal leftovers;
- not to serve excessive portions;
- to preserve food correctly.



NOTES AND
REFERENCES

NOTES

CHAPTER 1

1. «Wholesome edible material intended for human consumption, arising at any point in the food supply chain (FSC) that is instead discarded, lost, degraded or consumed by pests». (FAO, 1981).
2. FAO and SIK, *Global Food Losses and Food Waste. Extent, Causes and Prevention*, 2011.
3. «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». (FAO and SIK, 2011).
4. «Food losses take place at production, post-harvest and processing stages in the food supply chain. Food losses occurring at the end of the food chain (retail and final consumption) are called “food waste”, which relates to retailers’ and consumers’ behavior». (Parfitt *et al.*, 2010).
5. «At later stages of the FSC, the term food waste is applied and generally relates to behavioural issues. Food losses/spoilage, conversely, relate to systems that require investment in infrastructure». (Parfitt *et al.*, 2010).
6. Lundqvist, J., C. de Fraiture and D. Molden (2008), *Saving Water: From Field to Fork – Curbing Losses and Wastage in the Food Chain*, in “SIWI Policy Brief. SIWI,” p. 22: “Losses generally refer both to quantitative and qualitative reductions in the amount of and the value of the food. At the field level, part of the crop is lost due to rodents, pests, and diseases. Similarly, a part of the produce is lost during transport and storage due to the same type of problems. The lack of effective harvesting, transport and storage technologies will augment the losses at the farm level and during latter stages in the food chain. [...] Spoilage is another term used to highlight problems with the harvested crops and other food items during transport, storage, processing and packaging. Conversion refers to the use of cereals and other plant-based products as feed to produce animal foods.”
7. «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”». (FAO and SIK, 2011).
8. «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 non-food use (feed, bioenergy). This approach distinguishes “planned” non-food uses to “unplanned” non-food uses, which are hereby accounted under losses». (FAO and SIK, 2011).
9. «[...] edible material that is intentionally fed to animals or is a by-product of food processing diverted away from the human food». Stuart, T. (2009), *Waste, uncovering the global food scandal*, Penguin, London, UK.
10. «Avoiding food waste: strategies for improving the efficiency of the food chain in the EU.» Commissione per l’Agricoltura e lo Sviluppo Rurale, European Parliament, 22 June 2011.

11. Segrè, R. and L. Falasconi (2011). In this study, the quantification of waste is obtained by calculating the difference between how much food is potentially available and what is actually consumed.
12. The WRAP (Waste & Resources Action Programme) is an English non-profit association formed in 2000 and supported by the British government, with the purpose of combating waste, developing sustainable products, and using resources more efficiently.
13. USDA (2009), *Supermarket Loss Estimates for Fresh Fruit, Vegetables, Meat, Poultry, and Seafood and Their Use in the ERS Loss-Adjusted Food Availability Data*, in “Economic Information Bulletin”, 44, March, p. 1: «In the mid-1990s, USDA’s Economic Research Service (ERS) developed methods to adjust the availability data for spoilage and other losses. In particular, the Loss-Adjusted Food Availability data series refines the Food Availability data more fully for three general types of losses: (1) loss from primary (e.g., farm) to retail weight; (2) loss at the retail level; (3) loss at the consumer level. This includes losses for food consumed at home and away from home (e.g., restaurants, fast-food outlets, etc.) by consumers and foodservice and has two components: (a) “Non-edible share” of a food (e.g., asparagus stalk, apple core); (b) “Cooking loss and uneaten food such as plate waste” from the edible share».
14. «[...] including over-nutrition – the gap between the energy value of consumed food per capita and the energy value of food needed per capita». (Smil, 2004).

CHAPTER 2

1. Segrè, A. and S. Gaiani (2012), *Transforming Food Waste into a Resource*, RSC Publishing. Il metodo della *waste sorting analysis* (analyzing differentiated collection of waste materials) is used to obtain information on the composition of household food waste. In this method, information is collected on food waste thrown away in the garbage, but no account is taken of waste disposed of in other ways (for example, using a garbage disposal unit, by household composting, or by feeding the scraps to pets).
2. Gustavsson, J., C. Cederberg, U. Sonesson and Swedish Institute for Food and Biotechnology (SIKGothenburg) (2011), *Global Food Losses and Food Waste*, FAO.
3. Reported in Lundqvist, J., C. de Fraiture and D. Molden (2008), *Saving Water: From Field to Fork*, in “SIWI Policy Brief.” SIWI
4. European Commission – DG Environment Unit C1, *Food Waste in the EU: a study by the European Commission, Workshop on Municipal Waste Prevention*, Barcelona, November 24, 2011.
5. It is important to note that the data is not entirely reliable, insofar as the methodologies for identifying and classifying waste vary from one member state to another and are not entirely comparable.
6. Segrè, A. and L. Falasconi (2011), *Il libro nero dello spreco in Italia: il cibo*, Edizioni Ambiente.
7. *Last Minute Market* is an academic spin-off of the University of Bologna, the purpose of which is to provide services for the prevention and reduction of food waste. See Chapter 5 for further details.
8. WRAP (2011), *New estimates for household food and drink waste in the UK*, November.
9. WRAP (2008), *The food we waste*, April.
10. Eurostat, 2010 (2006 data).
11. ADEME – MODECOM, 2007.
12. ADEME, 2011.
13. Federal Ministry of food, Agriculture and Consumer Protection, *Too good for the bin: Consumer Protection Minister Aigner presents new initiative against food waste*.

14. C. Nellemann *et al.* (2009), *The environmental food crisis – The environment's role in averting future food crises*, UNEP.
15. Scott Kantor, L. *et al.* (1997), *Estimating and Addressing America's Food Losses*, in "Food Review", January-April, pp. 2-12.
16. Venkat, K. (2011), *The Climate Change and Economic Impacts of Food Waste in the United States*, CleanMetrics Corp.
17. Segrè, A. e S. Gaiani (2012), *Transforming Food Waste into a Resource*, RSC Publishing.

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1. Segrè, A. e S. Gaiani (2012), *Transforming Food Waste into a Resource*, RSC Publishing.
2. Istat [National Statistics Institute], *Conti economici nazionali*, 2011.
3. Centre for Non-Traditional Security Studies, *Mind The Gap: Reducing Waste And Losses In The Food Supply Chain*, 2011.
4. Centre for Non-Traditional Security Studies, *Mind The Gap: Reducing Waste And Losses In The Food Supply Chain*, 2011.
5. Parfitt *et al.*, 2010.
6. Lundqvist *et al.*, 2008.
7. Centre for Non-Traditional Security Studies, *Mind The Gap: Reducing Waste And Losses In The Food Supply Chain*, 2011.
8. Kantor L. S. *et al.* (1997), *Estimating and Addressing America's Food Losses*, in "Food Review".
9. Australia tackles the largest overproduction of citrus fruits in 30 years, available at http://www.freshplaza.it/news_detail.asp?id=37914
10. Banana prices in Australia continue to fall, available at http://www.freshplaza.it/news_detail.asp?id=37914
11. DEFRA (2007), *Report on the Food Industry Sustainability Strategy Champions' Group on Waste*.
12. Gustavsson J., C. Cederberg and U. Sonesson (2001), *Global Food Losses and Food Waste*, FAO.
13. <http://ecolutionist.com/2011/07/22/dont-waste-your-food-people-are-starving-in-africa/>
14. <http://paulkingsnorth.net/journalism/waste/>
15. WRAP (2008), *Research into Consumer Behaviour in relation to food dates and portion sizes*.
16. Segrè, A. and S. Gaiani (2012), *Transforming Food Waste into a Resource*, RSC Publishing.
17. Parfitt J., M. Barthel and S. Macnaughton (2010), *Food waste within food supply chains: quantification and potential for change to 2050*, The royal society.
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21. Muth M. K., K. M. Kosa and S. A. Karns (2007), *Explanatory research on estimation of consumerlevel food conversion factors*, RTI International.

22. England, putting a stop to food in the trash can – the expiry dates revolution, available at <http://www.uomoplanetario.org/wordpress/2011/10/inghilterra-stop-al-cibo-inpattumiera-la-rivoluzione-delle-date-di-scadenza/>

23. The Food Standards Agency is an independent government department formed in 2000 under an Act of Parliament for the purpose of protecting public health and consumer interests in relation to food products.

CHAPTER 4

1. As already noted in Chapter 1, the wholesale markets and retailers in Italy are responsible for 263,645 tons of food product waste (latest data 2009), of which 40% (around 105,458 tons) consists of fruits and vegetables, and 9% meat (around 22,000 tons).
2. Given that agriculture is the second largest cause of carbon dioxide emissions in the atmosphere, it is fair to assume that the waste of agricultural products is one of the main phenomena contributing to CO₂ emissions in the environment. Segrè, A. and L. Falasconi (2011), *The black book of waste in Italy: food*, Edizioni Ambiente.
3. *Always avoidable waste* refers to food and drinks thrown away that are still edible (for example, slices of bread, apples, meat); *sometimes avoidable waste* is food and drink that some people eat or drink and some don't (for example, bread crusts) or food that can be edible if cooked one way instead of another (for example, potato skins); *unavoidable waste* means waste deriving from the preparation of food or drinks that are not, and could not, be edible in normal circumstances (for example, meat bones, egg shells, pineapple skins, etc.).
4. The calculation shown was performed using the *top down* method, attributing the CO₂ emissions within the various stages of the productive life cycle to the wasted food and drinks.
5. In this analysis, the estimate of the water footprint is limited to the agricultural production stage, which is the stage with the highest water footprint out of the entire FSC. Moreover, the calculation does not take account of the grey water footprint resulting from the other stages of the food life cycle.
6. Meat production causes far greater greenhouse gas emissions than vegetable-based foods. This is clear from the fact that, while products of animal origin account quantitatively for 30% of all food waste, they are responsible for 57% of total emissions. Grains, fruits, and vegetables, on the other hand, represent 56% of waste, but contribute only 31% of the emissions.
7. Economic impact = market price of the goods + price of the quotas corresponding to the CO₂ emitted to produce the wasted goods = 9776 million + 232 million = €10,008 million.
8. Economic impact = market price of the goods + opportunity cost of the agricultural surface used for its production = 9776 million + 30,329 million = €40,105 million.
9. Economic impact = market price of the goods + price of the quotas corresponding to the CO₂ emitted to produce the wasted goods = 994 million + 184 million = €1178 million.
10. FAO (1996), *The state of food and agriculture*.
11. Lundqvist, J., C. de Fraiture and D. Molden (2008), *Saving Water: From Field to Fork*, in "SIWI Policy Brief.", SIWI.
12. Falkenmark, M. and J. Rockström (2004), *Balancing water for humans and nature: The new approach in ecohydrology*, Earthscan, London.
13. FAO and SIK, *Global Food Losses and Food Waste. Extent, Causes and Prevention*, 2011.

CHAPTER 5

1. See Chapter 3 for an account of the main causes of food waste.
2. The Banco Alimentare [Food Bank] is a member of the Fédération Européenne des Banques Alimentaires [European Federation of Food Banks] (since 1990). It is linked to the American Food Bank via the Chicago Feeding America network (since 1992) and has been collaborating since 2002 with City Harvest, which operates in New York, collecting food from restaurants and food service establishments, and was the inspiration for the *Siticibo* program in Italy.
3. Art. 2 of the Bylaws of the Fondazione Banco Alimentare Onlus [Italian Food Bank Foundation, Non-profit Social Organization].
4. During *National Food Collection Day*, people are invited to purchase non-perishable foods to donate to the Food Bank Network, which redistributes them free of charge to the designated welfare associations. It is held on the last Saturday of November in each year, in thousands of Italian supermarkets. During the 2011 event, 9600 tons of food was collected.
5. Act No. 155/2003 (dubbed the “Good Samaritan” Act).
6. BCFN, *Measuring well-being and its sustainability: the BCFN Index 2011*.
7. The types of goods put to *Buon Fine [Good End]* by Coop are: fresh products (vegetables, fruits, prepared meat products and dairy products, meat, fresh mass-produced products), packaged food products (pasta, rice, preserved foods, cookies, cereals, sweet baked snacks, etc.), products for young children (baby foods, small pastries, diapers), liquids (all non-alcoholic drinks and detergents).
8. Coop (2010), *Cooperazione di Consumatori [Consumer Cooperation Association] Seventh National Report*.
9. Turin Municipal Authority – Environment and Educational Services Divisions, 2011. The *Buon Samaritano [Good Samaritan]* project is carried out in collaboration with AMIAT (Azienda Multi-servizi Igiene Ambientale Torino, a Turin firm offering a range of sanitation and environmental services).
10. This relates to restaurants, and also other partners, such as Slow Food Milano, Legambiente Lombardia, EDENRED, COMIECO and Altreconomia. Supported by the Milan Municipal Health Department, the Province of Milan, the EPAM and the Union of Trade.
11. Italy is a major producer of whey, in connection with the quantity of cheeses produced. However, whey has no classification within the food and nutraceutical sectors, since it is considered a special waste product under the current environmental regulations, due to its high pollutant load. The problem of whey disposal is therefore keenly felt by the cheese producers, which hand over huge quantities of whey to large foreign industrial groups, which take it away and then extract high-added-value refined products from it. These are then widely reintroduced onto the Italian market.
12. According to recent studies, only 8% of surplus fruits and vegetables in France is donated to organizations that redistribute food products. The remainder is wasted or used as compost or livestock feed. Every day, whole pallets of fruits and vegetables are wasted because a part is no longer edible or does not comply with esthetic and/or size criteria.
13. A.N.D.E.S. partners include, among others: within the food industry, Coca Cola and Ferrero France; in food distribution, Carrefour, Auchan and Simply Market; among the charitable associations, the Red Cross, Fédération Française des Banques Alimentaires, Fédération des Paniers de la Mer, Secours Populaire and Restos du Coeur.
14. According to a 2005 study conducted by ABENA, only 1.2% of public welfare recipients consume five portions of fruits and vegetables per day, as recommended by the National *Nutrition Santé* program.
15. Similar experiments have also been launched in Belgium and Greece, with the support of

the Carrefour International Foundation.

16. The project came about through awareness that packaging solutions have a key role to play in the effort to reduce losses of food goods, especially in developing countries.
17. The program allows hospital patients to order their own menus and has resulted in a 72% average reduction in wasted food, as compared to fixed-menu meal planning. See: Freil, M. et al. (2006), *Reorganization of a hospital catering system increases food intake in patients with inadequate intake*, in “Scandinavian Journal of Food and Nutrition,” 50(2), pp. 83–88.
18. Distribution in the state of Massachusetts is an important source of food scraps, with over 400 supermarkets generating around 90,600 tons of organic waste per year. In Massachusetts, food waste represents around 19% of all commercial waste generated, but less than one tenth of this waste is recycled, composted or designated for uses other than disposal. The 400 supermarkets identified by MassDEP produce around 90,600 tons of organic materials discarded each year. Massachusetts Department of Environmental Protection (MassDEP), 2012.
19. Until 2008, the organization was known as America’s Second Harvest Food Bank.
20. Curitiba is an example of excellence in town planning and transport, representing a success story of town planning in developing countries.

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Water management

The importance of policies, models and integrated management tools to ensure the availability of fresh water for people and agricultural productivity



Climate change, Agriculture & Food

Analysis of the impact that climate change will have on agricultural production and hence, on the availability of food and fresh water and the evaluation of individual and collective behavior to be implemented



Food & Health

The value of lifestyles and healthy eating habits in the prevention of chronic diseases, to ensure the widespread well-being of populations



The Challenges of Food Security

How to strengthen the mechanisms of global governance to increase agricultural productivity and manage the volatility of prices in order to ensure that everyone has equitable access to food



The cultural dimension of food

The relationship between food and religion, the conviviality and the identity of the populations within the great culinary traditions and its role in influencing lifestyles and productive and economic factors

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Healthy growth and nutrition in children

Relationship between the development of good eating habits during childhood and adolescence and the prevention of diseases in adulthood



Double Pyramid: healthy food for people, sustainable food for the planet

Illustration of the model that relates nutritional balance with the protection and preservation of the environment



Measuring people's well-being: the BCFN Index

Construction of a multi-dimensional index designed to measure the level of people's well-being from the consideration that their well-being depends on several variables, not attributable only to the economic aspects



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In-depth study on the dual dialectical relationship between the Mediterranean people and the food they eat, as to quantity and how to eat, which converge into a single system of values and traditions



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Analysis of the current debate on the role of GMOs in solving the problem of access to food while ensuring safety for people and the environment

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Water economy

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Food Security: Challenges and Outlook

Promote the productivity of the agricultural system, aid the development of rural communities; increase awareness of the impact of the diet on the sustainability of the food chain to address the renewed emergency of the access to food



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Proposal of an interpretive model that provides a systemic view of the elements that determine the evolution of prices of food commodities



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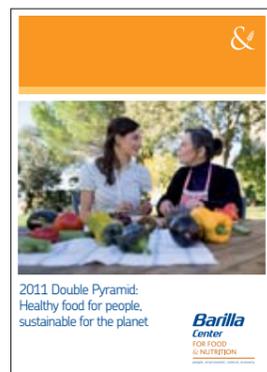
Beyond GMOs. Biotechnology in the agri-food sector

Comparison on a global scale of different positions and schools of thought on the sustainability of genetic engineering and the new biotechnology applied to food



New models for sustainable agriculture

Survey on new agricultural models that can withstand the impact of climate change and the demographic developments while ensuring a sufficient productivity for everyone



2011 Double Pyramid: Healthy food for people, sustainable for the planet

Development and evolution of the model of the food and environment double pyramid focused on childhood and adolescence, to induce correct eating habits starting from the first years of life



Longevity and well-being: the role of diet

In light of the continued aging of populations worldwide, the evaluation of the role of a healthy lifestyle and eating habits to ensure increased life expectancy in better health

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