



**POLITECNICO
DI MILANO**

Feed the hungry.

Surplus food as an opportunity

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Executive Summary

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This volume presents the findings of a research project on surplus food and food waste. The investigation was carried out by Politecnico di Milano and Fondazione per la Sussidiarietà in 2011, and benefited from a close collaboration with Fondazione Banco Alimentare ONLUS and Nielsen Italia.

Study objectives and motivations

The whole research focused on surplus food and food waste, which can be defined as follows. Surplus food consists of edible food products that for various reasons are not purchased or consumed by customers or people for whom they were produced, processed, distributed, served or purchased. Instead, food waste is the part of surplus food that is not recovered for human consumption (social perspective), for feeding animals (zoo-technical perspective), for producing goods or energy (environmental perspective).

The study had the following objectives:

- To study the origin and nature of surplus food in the different stages of the food supply chain (agriculture and farming, processing industry, distribution, catering industry, households);
- To analyse the practices adopted in the different stages for the management of surplus, including “bad” practices, i.e. those cases in which the surplus becomes food waste;
- To develop a methodology for the empirical evaluation of surplus food and food waste; the methodology is required to be replicable at both the micro (companies, households, sectors) and macro level (country);
- To obtain a quantitative assessment of the phenomenon in Italy at the country level and in the different stages of the food supply chain;
- To support the development of business strategies and public policies through the identification of critical issues and best practices.

Today the issue of food industry sustainability is at the centre of a debate involving citizens, social organizations, companies, policy-makers and scholars. In particular, the research was inspired by the following facts.

- Considering the current global economic crisis, the instability of markets of agricultural commodities, the new problems of food poverty even in the industrialized countries and the growing environmental awareness, the reduction of food waste is an increasingly important challenge.
- Scholarly and governmental analyses on this topic have yielded only partially comparable results and offered methodologies that cannot be easily reproduced. Most of the available studies, indeed, focus on agriculture. In addition, when processing, distribution, catering and consumption are considered, analyses suffer from several ambiguities. For example, surplus food is not always clearly distinguished from food waste; food waste may comprehend only non-edible scraps or may also include edible food; the border between the consumption stage and the upstream stages is

sometimes blurred; it may not be explained whether and when a social or environmental perspective is adopted. Finally, empirical methodologies are not presented in details; as a result the reader may be left with doubts about the size and the composition of the sample, the data sources, the statistical techniques, and so on.

- The public debate on this topic seems to be affected not only by objective difficulties to use the results produced by scientific research. A sensationalist approach to the problem seems to prevail on the media (e.g. titles such as “We throw away the food of a second Italy”, or “Christmas: 40% of food will be wasted”).
- On the contrary, in contrast to the problems of research and debate just mentioned, it is important to point out that over the years many companies and many NGOs, also in Italy, have gained a valuable experience in the management of surplus food and in the reduction of food waste. However, the aggregate and top-down approach that dominates research on this topic does not allow to represent in an appropriate way the heterogeneity of players and the diversity of the food supply chain stages. A bottom-up or mixed approach is more likely to reveal the best practices.

Therefore this research assumed that more in-depth examinations and revisions of models and methods were needed in order to obtain a robust information on surplus food and food waste in the industrialized countries, and to design policies and strategies suitable for fighting food poverty and reducing food waste. For this purpose, the research dealt with this topic through the following steps.

- *Conceptualization*. Starting from a thorough literature survey, an overall conceptual model of surplus food generation and management has been developed. The model defines food waste according to social, zoo-technical and environmental perspectives.
- *Specification*. On the basis of 30 interviews and explorative case studies, the conceptual model has been refined. In addition, it has been “customized” to the different stages of the food supply chain. For each stage, the main kinds of surplus food, causes of generation and management procedures have been identified.
- *Protocols of empirical analysis*. An analytical version of the conceptual model has been produced and for each stage protocols of an extensive empirical analysis have been prepared.
- *Empirical assessment*. The analytical model has been applied in order to obtain an empirical assessment of surplus food and food waste in the different stages of the supply chain, in individual stage segments, and at national level.

Key concepts

First of all the study is about surplus food, meaning edible food products that for various reasons are not purchased or consumed by consumers or people for whom they were produced, processed, distributed, served or purchased. The reasons of the generation of surplus food can be different and are carefully described and classified in the volume. For example, in the

upstream stages, factors behind the generation of surplus food include errors in demand forecasting and qualitative flaws that reduce the perceived value of the product (aesthetic imperfections, damaged packaging, etc.). At the consumption stage, surplus food may be caused by shopping mistakes, indivisibility of packages, impulsive purchases. The result is a surplus that must be managed outside of the usual market and consumption channels.

Once defined and analysed surplus food in the different stages of the food supply chain, food waste was defined as surplus food that cannot be recovered for human consumption (social perspective), for feeding animals (zoo-technical perspective), for the production of goods or energy (environmental perspective). Food waste does not include production and processing scraps as well as surplus food placed in secondary markets.

The degree to which surplus food is recoverable plays a key role in our analysis. The "recoverability degree" of surplus food is defined as the opportunity to make use of surplus food with a minimum additional work by the players of the food supply chain. Moreover, the recoverability degree depends both on the "intrinsic recoverability" of the product and on the required "management intensity".

Surplus food, therefore, is at the same time a source of opportunities and a source of waste. It is a source of opportunities because it shows that resources are available for the needs of the most deprived people. It is a source of waste because most of this surplus at the end is not used for the primary purpose (to satisfy food needs) and it becomes "waste" with an inefficient use of the production resources (fields, water, energy, etc.).

Methodology

The investigation relied upon a combination of methods. In order to develop the conceptual model, to "customize" it and to obtain an analytical version of the model, we relied upon a survey of scholarly and "grey" literature, 30 explorative case studies of Italian companies of the food industry and interviews with experts.

Coherently with our protocols for the extensive empirical analysis, we then used the followings methods.

- 100 in-depth case studies of Italian companies in the processing, distribution and catering stages;
- 15 interviews with experts and descriptive case studies in the agriculture-farming stage;
- Analysis of primary and secondary information from public sources in the agriculture-farming stage;
- A specific focus on the final consumer, in collaboration with Nielsen, and the development of a survey on a sample of 6.000 Italian households, which were stratified in terms of geographical location, income, composition and other characteristics.

Findings from case studies, data collection and survey were then projected through sector size indicators in order to obtain an overall empirical assessment of surplus food and food waste at national and sectorial levels.

Main results

Table 1 presents our key empirical findings.

Table 1 – Key empirical findings

Stages - Segments	Quantity flows [000ton / year]	Surplus food [000ton / year]	Surplus food [%]	Foodwaste [000tons / year]	Foodwaste [%]	Recoverability degree
Farming – Vegetables and Fruits	41,728	2,187.1	5.2%	1948.2	89%	Medium
Farming - Cereals	22,031	68.1	0.3%	67.4	99%	Low
Farming – Cattle and Poultry	14,989	52.5	0.3%	20.3	39%	Low
Farming - Fishing	475	10.5	2.2%	9.4	90%	Low
Manufacturing – Ambient	34,641	118.2	0,3%	36.1	30%	High
Manufacturing - Chilled	8,553	51.5	0,6%	33.5	65%	Medium
Manufacturing - Frozen	1,592	11.7	0,7%	11.4	97%	Medium
Distribution – Distribution centres	24,524	73.6	0,3%	47.8	65%	High
Distribution - Stores	30,655	704	2.3%	671.3	95%	Medium
Catering - Collective	869	86.9	10.0%	73.8	85%	Medium
Catering - Commercial	2,443	122.2	5.0%	116.1	95%	Low
Households	31,268	2513.5	8.0%	2,513.5	100%	Low
TOTAL	34,580	5,999.8	17.4%	5,548.8	92.5%	

The main results of the research can be summarized as follows:

- Surplus food in the Italian food supply chain, including households, is 6 million tons/year. It represents 17.4% of yearly consumption at national level.
- The causes of surplus food are different according to the considered stage of the food supply chain. For instance, five main causes have been identified at the stage with a greater recoverability degree, i.e. processing companies: sell-by date exceeded (66.9%), aesthetic problems (12.2%), packaging defects (5.7%), returned goods at the delivery (9.1%) and finally the returned goods for unsold (6.1%).
- The importance of surplus food varies over the food supply chain: in the agriculture-farming stage it is equal to 2.9% of production; in the industrial processing stage, it amounts to 0.4% of production; in the retail stage it is 2.5 % of sold products; in the catering stage surplus food is equal to 6.3% of served food; in households surplus food reaches 8.0% of the purchased food.

- Most of surplus food currently becomes food waste from the social perspective. According to the definition previously mentioned only a small part of surplus food is destined to human consumption (donating it to food banks and charitable organizations): the amount of waste is 5.5 million tons/year. This amount represents 92.5% of surplus food and 16,0% of yearly consumption.
- The importance of food waste, again for the purpose of reducing food poverty, varies according to the different stages of the food supply chain and the different categories of products, due to the degree of recoverability: in the agriculture-farming stage (low recoverability) 88.2% of surplus food is wasted; in the processing stage (medium-high recoverability) 44.7% of surplus food is wasted; in the distribution stage (medium recoverability) 92.5% of surplus food is wasted; in the catering stage (medium-low recoverability) 90.8% of surplus food is wasted; in households, surplus food is completely wasted (low recoverability).
- The analysis of management practices shows that the most established attempts to reduce food waste occur where recoverability is higher, that is in the processing companies. However, it is important to point out that even in this stage behaviours are really heterogeneous. On average, even if 35.3% of surplus food is donated to food banks or charitable organizations, 32.2% of surplus food is still disposed of by waste management companies. Given the degree of recoverability, the reasons behind the business choices are different: economic evaluations; reputation risks; weak process management; player's specific characteristics. The relevance of these factors varies according to the different stages of the food supply chain.

Implications of the results and proposals

The research has various implications for the companies, the public players and the citizens.

- Firstly, the spreading of practices for the management of surplus food among the processing companies, with a high degree of recoverability, becomes an essential commitment: the industry already hosts successful cases of waste reduction and collaboration with established food banks. The research demonstrates that it is important to increase the knowledge of the features and the benefits of the virtuous practices and to adapt the logistics-production process in order to increase the degree of implementation.
- Secondly, in the other stages (agriculture, catering and distribution) there is still much work to do. In these areas, where the recoverability is lower, coordinated efforts at the system level are required. The players of the food supply chain can collaborate with the non-profit organizations (such as the food banks), business association and administrations in order to find out the most critical elements of surplus food management in the stage, and to identify which organizational and technological solutions are also sustainable from an economic point of view. In this field public

players, the administrations and the government should foster and enable the innovative efforts of sector players, by monitoring and evaluating the management practices of surplus food, and whenever possible by enforcing regulations that limit the most disruptive conducts and stimulate companies to adopt good practices in this domain.

- Thirdly, the consumer represents an important challenge in order to reduce food waste, although many Italian families normally adopt practices that prevent surplus, reducing the cases of food expiry and recovering the "left-overs". At this level, in the medium-short period a significant outcome can be obtained through the diffusion of a greater awareness about correct food conducts in the families, e.g. the adoption of more efficient purchase practices. At the same time, processing and distribution companies should be induced to implement solutions that can promote such practices (e.g. in the fields of packaging and use of promotions).

In sum, this research project offers a contribution to all those who are interested in the sustainability of the food supply chain and in the fight for food security.

- It offers a compact representation of the surplus-waste phenomenon, and identifies the types of surplus food that have a greater "social value";
- It does not limit to assess the overall phenomenon, but it yields empirical evidence for the different supply chain stages, and for different product classes.
- It points out good practices and it indicates possible actions to recover surplus food and to avoid food waste;
- It yields a method that can be replicated internationally and over time.

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