WORKING TOGETHER TOWARDS CIRCULAR ECONOMY: RECOVERY AND REDISTRIBUTION OF SURPLUS FOOD FOR SOCIAL PURPOSES

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Abstract

This paper examines how food donation, meaning the recovery and redistribution of surplus food for social purposes, can promote the transition towards a circular economy and enhance at the same time the collaboration between the different players of the food supply chain. Food donation, indeed, not only can contribute to tackle food insecurity but also stimulate a more sustainable food and agriculture system, with several long-lasting effects: the prevention of food waste, the promotion of a more efficient food supply chain, the reduction of impacts on the environment. The paper addresses this issue taking into consideration different perspectives: the findings of scientific literature, the evolution of European and legislation, and the impact of the activity of Food Banks, in particular the Italian Banco Alimentare. An important conclusion is that multi-stakeholder collaborations involving public institutions, the profit and non-profit sectors are the key successful approach towards a circular economy because they can put forward a new model and foster innovation in different areas such as management, logistics, and legislation.

Keywords: circular economy, food waste, surplus food, food donation.

Preface

We are grateful for the honour of presenting this paper to the 6th International Conference on Sustainable Solid Waste Management which takes place on the Island of Naxos on 13-16 June 2018. This is a great opportunity to emphasize the importance of prevention of food waste in order to promote circular economy and to ensure access to food to the most deprived. A special acknowledgement to Valentina D'Arrigo for the precious revision of the paper.

1. Introduction

In general, issues related to food production and consumption and to the sustainability of the food supply chain are becoming more and more prevalent in the media, at scientific meetings, and in public and non-governmental organization reports while creating a wide debate involving citizens, civil society organizations, businesses, policy-makers and scholars. The origin of this interest probably stems from the recognition of the so-call "paradox of scarcity in abundance" (Campiglio and Rovati, 2009; see also Winne, 2008), meaning that in our modern society, including the richest countries, abundance and scarcity coexist. Entire countries and social groups are in a situation of food insecurity, with a limited access to a sufficient amount of food for a healthy and active life, while the overall quantity of available food should be sufficient to fulfil everybody's needs. It is universally acknowledged that food constitutes a basic human need and is essential for any living being but on a global level entire countries and individual social groups live in a situation of food insecurity. At the same time, there are sufficient quantities of food to feed everyone while roughly one third of the food produced every year (1,3 billion tonnes) gets lost or wasted (FAO, 2011) and according to *The State of Food Security and Nutrition in the World* report, nearly 815 million people suffer from chronic undernourishment in 2016, up from 777 million the year before (FAO, IFAD, UNICEF, WFP and WHO, 2017). This complex phenomenon is a challenge also at European level where around 88 million tonnes of food are wasted annually, with associated costs estimated at 143 billion euros (FUSIONS, 2016), and in 2015 118.7 million people, or 23.7 % of the population in the EU-28 were at risk of poverty or social exclusion (Eurostat, 2016).

This issue attracts the attention of many observers but public debate is often extremely biased by objective difficulties in the use of scientific results. Furthermore, it is influenced by media which usually approaches the problem from a sensationalist perspective, despite the reporting of scientific data and the need for clarity. Media do not communicate the complexity of this phenomenon but rather the more sensational data neglecting to clearly explain the different definitions, such as food waste, scraps and surplus food or the sources of information and the methods of analysis. Above all, the business, commercial and household processes that lead to the creation of food waste receive very little attention, making it very difficult to appreciate the full extent of the problem, its causes, its potential solutions, and the valuable experience gained by food business operators and civil society organizations over the years in managing surplus food and reducing food waste. A consequence of this sensationalist approach consists in asserting that "food waste" is a result of modern times, of our dispelled way of life and therefore the solution is to reduce production and consumption. Instead, it should be noted that, especially in the decades from post-war to the early 2000s, there has been a progressive total disregard and disinterest to food in excess, from farm to fork, thus losing the value of food for the person. The value of food has been lost due to an incorrect identification between food and its price at the expense of the relation between food and its intrinsic value. Only by reaffirming the centrality of aspects such as culture, anthropology, spirituality, health and science, it could be possible to address the concept of food in a comprehensive holistic dimension.

2. From the dawn of human history to findings of scientific literature

It is possible to truly understand this phenomenon only starting with a deep comprehension of the meaning of surplus food and the meaning of food waste. It is possible to make a better use of these concepts observing reality and then making a comparison with some studies carried out by Politecnico di Milano in collaboration with Fondazione Banco Alimentare Onlus and Fondazione per la Sussidiarietà in recent years.

However, it is essential to start with the dawn of human history in order to discover that the words abundance or excess have always been matched to joy and gratitude. Across of all human history, man has always thanked nature or gods for the abundance of what he was offered by creation and then the forces of nature for the magnanimity to reward his work. It is not possible remembering or finding historical documents that report episodes or celebrations in times of poor harvests; on the contrary anywhere at any times in the world, man gratefully celebrates when the products of nature abound in the fields and also on the table. In abundance man is grateful and recognizes that what he gathers is an attention to his life: a precious gift. A gift to share, exchange and preserve.

Now, to make it even more clear the above, let's try to imagine seeing the first men on earth in action. Among the millions of “things” they come across, that they do not know, they recognize some things that meet their daily need: hunger. Fruits, animals and water are the first and foremost allies. With the passing of time, man evolves, human intelligence discovers that what he needs to live not only reproduces spontaneously but he is able to govern its reproduction. Man becomes a farmer and breeder. For better or for worse, agriculture was a driving force behind the growth of civilizations. Farming probably involved more work than gathering and hunting, but progress led to increased productions and more abundant supplies could support denser populations, and farming tied people to their land. Small settlements grew into towns, and towns grew into cities. Agriculture produced enough food that people became free to pursue interests other than worrying about what they were going to eat every day and simultaneously hunting, gathering and farming could complement one another in ways to provide people with a more varied and abundant food supply. For the first time man had to decide how to manage food that exceed the quantity for its own consumption and of his household. A possibility is to share food with other tribes, not as a good subject to exchange with other men but as an act of pure coexistence. Then man begun to diversify and specialize its production and therefore could use farming and breeding as a bargaining chip with those who were not involved in these activities but produced the necessary tools for this work. With the evolution of the organization, the barter system based on the exchange of goods and services for other goods or services without using a medium of exchange was transformed into a system using money, which defines the value of goods and systematizes payments for transacting goods and services. Thanks to this increased capacity and knowledge, man could modify his agricultural production both in terms of increased quantity and differentiation of food and therefore not everything could be immediately consumed or sold. It is necessary to conserve what exceeds, especially the most perishable foods. Food preservation has been an essential activity throughout history. The very cycle of the seasons creates periods of shortage, especially in winter and years of famine, but also periods of abundance of different foods at different points of the year. This problem was worsened with the development of agriculture as people sacrificed their mobility and came to rely on fewer sources of food, each with its own growth cycle. Only through human effort and ingenuity man was able to obtain some of these foods throughout the year or to preserve food using techniques such as drying, pickling, fermenting and smoking. Although the methods are diverse what they all have in common is an attempt to extend the shelf-life of food. Preserving, conserving and transforming food also allow man to expand its own trade and therefore in this continuous evolution a constant innovation takes place: from farm to fork, up to the market. Notwithstanding this evolution from harvesting to self-sufficiency in food production and then

production for the market, the gratitude for food and the sharing of crops has always remained as a key element in human history. The finest example is gleaning: the custom of allowing the poor to follow the reapers in the field and glean the fallen spears of grain. It was not done just with grain but with all kinds of agricultural products: fruit, olives, chestnuts, and more. Gleaning is an ancient tradition, deeply embedded in the agricultural world, and it was so important in the past rural societies that it was even sacred. The idea of gleaning went far beyond the mere agricultural activity because it had to do with the very fact of being human and of helping each other, an early form of informal welfare for the needy. Gleaning is the counter-proof that food is a gift to be shared and is rooted in the Bible where God explicitly ordered to owners to give to the poor a chance to glean in their fields. And even the origin of David's lineage in the biblical tradition is related to gleaning, as described in the story of Ruth, a poor Moabite girl who married the owner of the fields where she gleaned. Other religions do not have such an explicit reference to gleaning but most of them convey the idea that the rich should partake with the poor and that food is a gift, food is the first gift. Food has an impact on every aspect of human existence and determines the quality of society. When man forgets that food is a gift to be shared the result is an abuse of power leading to conflicts, abuses, violence and consequently food waste. The fact that prolonged food shortages can lead to drastic and violent behaviour is becoming increasingly clear. And even the evidence that in countries that lack a social welfare net, the only alternative in many cases is to obtain food through stealing and looting, unless the intervention of

Since the dawn of human existence another important characteristic that has emerged is that food is a relationship and eating is an incredibly social ritual. More than any other practice, eating connects us to family and friends, our religion and culture, by using social constructs as meal times or traditional holiday feasts. Man and woman receive a gift and want to share with their peers. The relation with food is an intimate nourishment that we feed daily and occurs in nature in a very ordinary way: every creature since the still in foetal life and then as soon as it comes to light establishes its first relationship with the mother thanks to nourishment. This is why food brings with it affection, cohabitation, fraternity, solidarity and celebration.

Taking these observations as a starting point, it is possible to formulate a first hypothesis: human history shows no evidence of any direct relationship between excess food and abundance, and food waste. As mentioned above, food systems emerged with the dawn of civilization when agriculture, including the domestication of animals, set the stage for permanent settlements. Man could grow more crops and breed more animals than necessary to feed those who tended them. This changed human culture forever: unlike earlier hunter-gatherers, man no longer had the need to be in constant motion to find new sources of food. Since agriculture began, food systems have constantly evolved, each change bringing new advantages and challenges and ever-greater diversity and complexity. As society has evolved over time, food systems have also evolved over centuries into a global system of immense size and complexity. The historical evolution of global food systems has made possible rapid urbanization and population growth, contributing significantly to welfare improvements in the world. Furthermore, the commitment to make further progress on the areas of food science and the development of products while ensuring a safe and abundant food supply, and to contribute to food security, and health and nutrition is an indispensable element of this evolution. As the food system has drastically changed, from subsistence production to food preservation and then to our modern food system, now the whole food supply chain, including agricultural production, food manufacturing and distribution, and food service, is designed for ensuring a better quality and food safety.

As already anticipated, in addition to a concise historical-anthropological analysis, this paper aims at presenting a review of the results of a study started in 2011 by Politecnico di Milano in collaboration with Fondazione Banco Alimentare Onlus and Fondazione per la Sussidiarietà. To date, a first volume "Feed the Hungry. The potential of

surplus food recovery" (Garrone P., Melacini M., and Perego A., 2013) was published in 2013 and a second volume "Surplus Food Management Against Food Waste. Il recupero delle eccedenze alimentari. Dalle parole ai fatti" (Garrone P., Melacini M., and Perego A., 2015) in 2015. These two studies followed a combination of research methods:

- an overall conceptual model of surplus food generation and management, defining food waste according to social, zoo-technical and environmental perspectives;
- a specification on the basis of exploratory case studies and interviews with experts (in number 30), customized to the different stages of the food supply chain;
- the production of an analytical version of the conceptual model of surplus food and food waste;
- more than 100 case studies relating to the manufacturing, retail trade and food service stages;
- a review of economic, policy, management, and industrial engineering literature;
- a specific focus on the final consumer, in collaboration with Nielsen Company, and the development of a survey on a sample of 6.000 Italian households, which were considered to be representative in terms of geographical location, income, composition and other characteristics;
- use of research findings and official public data on the volume of business in the different sectors to obtain quantitative estimates of surplus food and food waste both overall and at sectorial level.

In particular, the exploratory case studies and interviews with experts were accomplished in the initial phase of the research and allowed to deepen the object of the analysis (food surplus), the measurement methods at company level (and therefore the best model to measure data) and the characteristics of the companies of the food supply chain in terms of logistic-production model. The exploratory case studies involved both experts in the field and managers of companies in the food supply chain with experiences in several different companies. The development of the conceptual model, called ASRW (Availability-Surplus-Recoverability-Waste) served to provide a clear definition of the boundaries of the analysis and of the meaning of the terms. On the one hand, the model maintains the social perspective of managing surplus as a lever to reduce poverty, on the other hand it does not lose sight of the economic and environmental impact for the actors in the supply chain and the broader set of stakeholders.

In the first study, the methodology for analysing the food supply chain involved over 100 in-depth case studies, including interviews with operational managers at companies in the manufacturing, distribution and food service sectors. The sample examined represents about 10% (in terms of revenue) of each stage of the food supply chain examined. The analysis of the cases made possible to obtain evidence on the percentage of the extent of the phenomenon under consideration, in particular quantitative data on the percentage of surplus food and food waste as well as information on the sources of surplus food and on the available options for managing surplus food. Moreover, the results of the case studies, the Nielsen survey, and the results of data analysis for the primary sector, were used to assess surplus food and food waste at the country level, at individual stages in the supply chain and for individual segments within each stage. The main purpose of this study was to present a comprehensive overview of the generation of surplus food and food waste at the various different stages of the food supply chain and above all to determine the definitions on the bases of data collected and analysed. The result of this initial study led to realise that "excess" does not necessarily imply "wasteful". Indeed, surplus food is defined as

> *edible food that is produced, processed, distributed or served but for a variety of reasons is not purchased or consumed. It includes food produced at the agriculture and fishing stage, food processed at the manufacturing stage, food distributed at the retail trade stage, and food prepared or served at the food service stage, but not sold to the downstream client or to the final consumer. It also includes food purchased by*

> *the consumer that is not consumed"* (Garrone P., Melacini M., and Perego A., 2013).

On the contrary, food waste

> *is the surplus of food that is not recovered for human consumption (social optics), for animal feed (zootechnical optics), for the production of goods or energy (environmental perspective). In any case, waste from food production and preparation, as well as surpluses that are placed in secondary markets, are not included in food waste* (Garrone P., Melacini M., and Perego A., 2013).

In order to provide reliable definitions, the study deeply analysed the origin and nature of the surplus food in the different stages in the food supply chain (agriculture and farming, processing industry, distribution, catering, and households). Then, the study examined the practices adopted in the different stages for the management of surplus, including bad practices meaning those cases in which surplus food becomes food waste. Finally, it was developed a methodology for the empirical evaluation of surplus food and food waste, being replicable at both the micro (companies, households, sectors) and macro levels (country) in a social, environmental and economic perspective in order to obtain a quantitative estimate of the phenomenon in Italy at the country level and in the different stages of the food supply chain. Finally, the study also presents suggestions and proposals for encouraging the responsible use of surplus food and for the reduction of food waste as much as possible both in the context of the efficiency of the production and distribution process and of the promotion of public polies.

An interesting element to take into consideration is that the overall quantity of food waste is a direct function of how surplus food is managed: an appropriate management reduces the amount of surplus food that becomes waste. It should be noted that surplus food can be recovered in several ways: "*one solution is to collect it from the fields, from manufacturing companies, from retailers and from food service providers for distribution to the needy*". If surplus food is not recovered for human consumption it can be used for other purposes, including feeding animals, or in industrial processing and composting. As last possible option, food products that are not recovered must be disposed of as waste either by incineration or in landfills. However, the cost impact of the different ways of managing surplus food may not always be economically or logistically feasible due to the level of effort required. Indeed, there are considerable differences in the various stages of the food supply chain and, above all it is not correct to compare them with data referring to final consumers. In fact, a reduction of food waste in the food supply chain is possible changing the management of processes but in the case of consumers it is necessary to intervene in education when dealing with young generations and training for other age categories.

In order to further define the use of surplus food for human consumption the study introduces the concept of "Degree of Recoverability" (DoR) implying "*the relative ease of recovering surplus food for human consumption*" which depends on the intrinsic recoverability (IR) of surplus food, meaning "*the facility with which a potential beneficiary could make use of the surplus food for human consumption in the absence of additional management efforts and/or intermediation*". This indicator concerns the ease of direct use by consumers even in the absence of further management activities. For instance, a precooked and packaged edible food product which remains unsold in a store, due to a dent in the primary packaging, has a high level of IR because no further processing is required. Whereas the effort required to preserve the quality of a product by a donor company, or the need for NPOs to recover, store and distribute frozen products is much higher and therefore the DoR is lower. In general, it is possible to affirm that the higher the intrinsic recoverability, the easier it is to recover and destine surplus food for human consumption. For instance, fruit and vegetables have a lower degree of recovery because they request harvesting, packaging and storage

by farmers and then a fast transport to NPOs in order to avoid the decay of the product. The DoR depends also on the required management intensity (MI). The management intensity has two components: the maintenance effort needed to maintain the qualitative and nutritional properties of the food product; and the enhancement effort required to increase the opportunities for using surplus food. In general, the higher the MI, the lower the DoR of food, and in addition the DoR decreases when moving from the upstream stages (transformation companies) to those downstream stages of the food supply chain (e.g. the food service sector), with the exception of the primary sector which has low levels of recoverability on average. There are also specificities at single stage level, for instance in the primary sector the recoverability of fruit and vegetables is much greater than that of cereal products.

The main results of the 2 research can be summarized as follows:

- in the Italian food supply chain, the amount of surplus food was equal to 6 million tons/year in 2012 (17.4% of annual consumption at national level) and 5.5 million tons/year in 2015.
- the causes of surplus food generation are different according to the considered stage of 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.

Thanks to this all dissertation a more complete picture of the phenomenon is available and it is possible to formulate a second hypothesis: surplus food is simultaneously a wealth and a waste. Indeed, it is a wealth because it shows that there are enough resources available to meet the need of the needy and it is a waste because much of this surplus food is not actually used for its primary purpose (human consumption) and becomes food waste, unnecessarily consuming all

the resources (raw materials, water, energy, etc.) which were necessary to produce it. However, the study also aimed to suggest possible partial solutions to main stakeholders as the food supply chain, public institutions and 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 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.
- The consumer represents an important challenge in the reduction of 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. In addition, educational programs in schools for children and teenagers.

In short this study offers a compact representation of the surplus-waste phenomenon, and identifies the types of surplus food that have a greater "social value". At the same time, 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. Moreover, it points out good practices and it indicates possible actions to recover surplus food and to avoid food waste, and it provides a replicable method also on an international scale and over time.

In 2015 a second volume "Surplus Food Management Against Food Waste. Il recupero delle eccedenze alimentari. Dalle parole ai fatti" (Garrone P., Melacini M., and Perego A., 2015) was presented during Expo Milano 2015. This study goes beyond the quantitative assessment of food waste and surplus food and identifies how food business operators manage surplus food, the costs of this management, and the critical issues that still exist in making managerial decisions. The quality of the process through which surplus food is managed depends on choices that are made over four key variables: measurement of surplus food, degree of process organization, extent of coordination between corporate functions, and the logic driving the relationships between business and non-profit organizations. The process can be defined as well structured when the measurement of surplus food is systematic, activities and decision-making hubs are formalized, explicit mechanisms of coordination between the various functions involved in the process are provided, and clear mechanisms of relationship with non-profit organizations are present. The study shows that if the management process is highly structured then it has a positive impact in terms of a greater amount of recovered surplus food. For instance, among companies of the manufacturing sector, the ambient temperature segment (or dry segment) has highly structured processes and may donate up to 80% of surplus food (compared to an average of 42%). Similarly, in the retail sector, the retailers with a structured process can donate up to 30% of fresh surplus food (compared to an

average of 10%). The first observation is that the donation of surplus food implies a preparatory work for companies in the supply chain to identify non-profit organizations. Activating a priori allows not to waste precious time to manage the donation when the surplus is generated. In particular, it is necessary to define the modality of the relationship between the donor and the receiving organization. The relationship can be developed according to two action axes: the donation frequency and the call management mode. The frequency of donation can be periodic, with an agreement between the parties defining the date of recovery of the product (for instance a day of the week) or a variable day. The choice depends not only on decisions within the company, but also, for instance, on the stage of the chain considered and the type of product. The agreement can take place upon a request for confirmation of the availability of excess by the management of the company, or is the company itself to contact. It has been noticed that from the point of view of the process, a donation with a variable frequency is well suited for large quantities of surplus generated in particular stages of the year (e.g. an unsuccessful promotional campaign or seasonal products left unsold). Vice versa, the constant donation rate lends itself above all to not necessarily large quantities of excess generated regularly, where the daily mix of products can change but the amount is fairly regular (e.g. supermarkets). In this case, working on a fixed date allows the non-profit organization to optimize the process and the actor of the supply chain to work in order to make the surplus easily recoverable.

In brief, it is possible to say that the increased rate of surplus food recovery and the consequent reduction of food waste are linked both to the commitment of players (food business operators and Non Profit Organizations) and the effectiveness of public policies at national and European level.

3. The evolution of European legislation

There is no doubt that European institutions are currently aware of the magnitude of the issue of food waste and are proposing initiatives to tackle it. However, it should be taken into account that this topic is relatively new and therefore it is difficult to provide a comprehensive and definitive overview of this argument.

As limited data was available to effectively estimate the problem of food waste, in 2010 the DG Environment (DG ENV) of the European Commission commissioned a study to identify the causes of food waste across the EU27, to quantify the amount and environmental impacts of food waste, and to propose policy options to reduce food wastage in the EU. The causes of food waste were “common to households and businesses, and involve portion size, labelling, packaging and storage issues on the one hand, and awareness, preferences, planning and socio-economic factors on the other” (European Commission, 2010); the amount of food waste was estimated at about 89 million tonnes, i.e. 179 kg/capita/year, divided as follows: households (42%), manufacturing sector (39%), retail/wholesale (5%) and food service/catering (14%). In terms of GHG emissions, the study estimated the overall impact of food waste at 170 million tonnes CO2 eq./year, i.e. 3% of total EU27 emissions in 2008.

Then in 2011 the European Commission published a Communication entitled *Roadmap to a Resource Efficient Europe* and identified food as a key sector where resource efficiency should be improved and called for ambitious action to tackle food waste. In this roadmap the Commission

> *looked at how to achieve growth based on the kind of efficient resource consumption essential for future welfare and prosperity. It also identified those economic sectors that consume more resources and proposed instruments and indicators that could help shape actions both in European and internationally. Among the roadmap’s objectives were competitiveness and growth by using fewer resources in production*

> *and consumption as well as creating businesses and job opportunities on the basis of activities such as recycling, the improvement of product redesign, the substitution of materials and ecological engineering* (González Vaqué, 2015).

In addition, in this roadmap the European Commission set the target to halve the disposal of edible food in the European Union by 2020 and agreed to continue assessing "how best to limit waste throughout the food supply chain, and consider ways to lower the environmental impact of food production and consumption patterns" (European Commission, 2011). At that stage the European Commission also promised a Communication on Sustainable Food, which was due to be published by the end of 2014. A public consultation on the topic was held in summer 2013 and a summary of the responses was subsequently published. In the contributions to the public consultation clearly emerged that the EU plays an important EU role in preventing and reducing food waste. However, this Communication on Sustainable Food has not been published yet.

In January 2012 the European Parliament adopted a resolution on *How to avoid food wastage: strategies for a more efficient food chain in the EU* in which "the Commission, Council and Member States must draw up practical strategies and measures to halve food waste along the entire supply chain by 2025, to improve the efficiency of the industry and to raise the public's awareness of an issue that is unknown in many respects" (European Parliament, 2012). This resolution is important because "apart from presenting a wealth of information it also makes some interesting proposals" (González Vaqué, 2015). For instance, it

> *welcomes the initiatives already taken in various Member States aimed at recovering, locally, unsold and discarded agricultural products throughout the food supply chain in order to redistribute them to groups of citizens below the minimum income threshold who lack purchasing power; stresses the importance of the exchange of best practices in this connection between Member States, as also of initiatives at local level; points out in this regard the valuable contribution made, on the one hand, by volunteers in sorting and distributing such products and, on the other, by professional companies that are developing anti-waste systems and measures* (European Parliament, 2012).

The European Parliament puts forward different actions, activities and initiatives addressed to distribute surplus food to the most deprived: for example, it proposes to adopt legislative measures related to "the retargeting of support measures at EU level regarding the distribution of food products to the Union's least-favoured citizens, Community aid for the supply of milk and dairy products to schoolchildren, and the programme for the consumption of fruit in schools, with a view to preventing food waste" (European Parliament, 2012), to amend "the public procurement rules on catering and hospitality services so that, all other conditions being equal, when contracts are awarded, priority is given to undertakings that guarantee that they will redistribute free of charge any unallocated (unsold) items to group of citizens who lack purchasing power" (European Parliament, 2012). Finally, retailers are expected to take part in "food redistribution programmes for citizens who lack purchasing power and to implement measures allowing for products nearing expiry to be discounted" (European Parliament, 2012).

In 2014, "the European Commission adopted a Circular Economy Package, including a "chapeau" Communication "Towards a circular economy: zero waste programme for Europe", accompanied by communications on sustainable buildings, green employment, SMEs, and a legislative proposal for the review of waste legislation" (European Commission, 2015). In this Communication the European Commission put forward objectives for food waste reduction in the EU and it included a proposal for Member States to develop national food waste prevention strategies with the

aim of reducing food waste by at least 30 per cent by 2025. However, “in its 2015 Work Programme, the Commission announced the intention to withdraw the 2014 proposal on Waste Review (the withdrawal was finalised on 25/02/2015) and to replace it with a new, more ambitious proposal by end 2015 to promote the circular economy” (European Commission, 2015). On 2 December 2015 the European Commission adopted an ambitious new Circular Economy Package to stimulate Europe's transition towards a circular economy in order to boost global competitiveness, foster sustainable economic growth and generate new jobs. This Circular Economy Package gives a clear signal to economic operators that the EU is using all the tools available to transform its economy, opening the way to new business opportunities and boosting competitiveness. The broad measures for changing the full product lifecycle go beyond a narrow focus on the end-of-life stage and underline the Commission's clear ambition to transform the EU economy and deliver results. Innovative and more efficient ways of producing and consuming should increasingly emerge as a result of the incentives we are putting in place. The circular economy has the potential to create many jobs in Europe, while preserving precious and increasingly scarce resources, reducing environmental impacts of resource use and injecting new value into waste products. Sectoral measures are also set out, for instance related to food: actions to reduce food waste including a common measurement methodology, improved date marking, and tools to meet the global Sustainable Development Goal to halve food waste by 2030. In particular, the Communication from the Commission “Closing the loop – An EU action plan for the Circular Economy” clearly states that

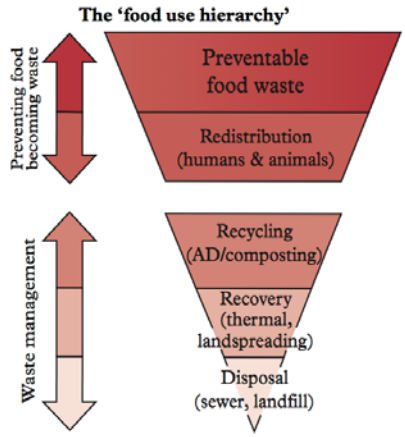
> *food waste is an increasing concern in Europe. The production, distribution and storage of food use natural resources and generate environmental impacts. Discarding food that is still edible increases these impacts, and causes financial loss for consumers and the economy. Food waste also has an important social angle: donation of food that is still edible but that for logistic or marketing reasons cannot be commercialised should be facilitated* (European Commission, 2015).

Within the framework of the Circular Economy Package on 16 May 2017 the plenary session of the European Parliament adopted an own-initiative resolution on resource efficiency: reducing food waste, improving food safety (European Parliament, 2017), proposed by MEP Biljana Borzan, calling for integrated and coordinated policy action by all key players in order to combat food waste effectively throughout the EU.

Within the European Commission, the DG Health and Food Safety (DG SANTE) has been contributing to this topic and now is leading the debate. The DG SANTE created a website with the aim of providing information on EU actions to tackle food waste, a repository of good practices in food waste prevention and reduction initiatives, communications materials in all EU languages to help raise awareness and a food waste resources library (e.g. a video on food waste, a leaflet with *10 tips to reduce food waste* and a leaflet on *“Best before” and “Use By” dates on food packaging*). The European Commission, and in particular the DG SANTE, is analysing in close cooperation with Member States, food industry, consumers’ associations, NGOs, and food sector experts how to reduce food waste without compromising food safety and is discussing for possible EU actions. Cooperation is facilitated through the EU Platform on Food Losses and Food Waste which supports the achievement of the Sustainable Development Goal 12.3 target on food waste, contributing to the implementation of the Circular Economy Package, and maximizing the contribution of all actors in the food supply chain. One of the first results of this Platform was the publication of “EU guidelines on food donation (European Commission, 2017), which aim to clarify relevant provision in EU legislation and help to lift barriers to food redistribution within the current EU regulatory framework. These guidelines are an essential tool because in the European and national debate, a wide range of approaches and policies have been submitted, and also partially implemented, to encourage the different players of the food supply chain to a responsible

handling of food, the reduction of food waste, and the recovery of surplus food. They are different – "persuasive, cooperative, regulatory, economic, organisational, and technical measures" (STOA – Science and Technology Options Assessment, 2013) – and can involve several stages of the food supply chain. However, in the European Union there is not a common legislation applying in the different Member States: "policy frameworks in different Member States vary, facilitating donation to a greater or lesser degrees some being stricter than others" (Bio by Deloitte,2014). First of all the waste legislation plays an essential role in promoting or preventing food donation; then hygiene and food safety, and tax legislation have been identified as the main legal areas impacting the scale of donation. Other obstacles to food donation can be related to legal and economic factors. As demand for donated food rises sharply and pressure on the prevention and reduction of food waste increases, "a clear, harmonised European legislative framework would facilitate straightforward access to food resources and offer significant joint benefits in terms of resource efficiency and food security" (Bio by Deloitte, 2014). First of all, it is essential to clarify how and to which extent food donation is inserted within with the EU legislative waste framework, in particular Directive 2008/98/EC, the EU Waste Framework Directive (European Commission, 1998). This clarification is provided with the "EU guidelines on food donation (European Commission, 2017) and is essential in order to define the general context and then to address all the other legal, economic and logistics barriers that hurdle food donation.

The principles behind the waste hierarchy were introduced for the first time into European policy in the EU Waste Framework Directive of 1975 (Directive 75/442/EEC). It emphasizes the importance of waste minimization, the protection of the environment and human health as priorities. Then EU legislation has aligned to the principles of the waste hierarchy, which was clearly defined in the Community Strategy for Waste Management in 1989. The Directive 2008/98/EC, the EU Waste Framework Directive, was adopted by the Environment Council on 20 October 2008, signed on behalf of the European Parliament and the Council on 19 November 2008 and published in the Official Journal of the European Union on 22 November as Directive 2008/98/EC. It entered into force on 12 December 2008. The Directive 2008/98/EC sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, and recovery. It also explains when waste ceases to be waste and becomes a secondary raw material, and how to make the distinction between waste and by-products. The Directive lays down some basic waste management principles and introduces a five-step waste hierarchy, which Members States shall apply in their National Prevention Programmes. Member States shall apply a waste management hierarchy as a priority order: waste prevention, as the most favourable option; preparing for re-use; recycling; other recovery, including energy recovery; and disposal, as the least favourable option. Since the approval of Directive 2008/98/EC, the waste hierarchy has been adopted worldwide as the principal waste management framework and it has two main characteristics: firstly, it is about waste in general and there is not a specific reference to food waste; secondly, it is based on an environmental perspective. In effect, the aim of the 'waste hierarchy' is to identify the options most likely to deliver the best overall environmental outcome: the most favourable option is prevention and the less favourable is disposal, at the bottom of the pyramid. As legislative framework the EU Waste Framework Directive through the waste hierarchy primarily focuses on delivering the best environmental option, even if it advises the Member States to consider not only the environmental aspect but also the social and economic ones. The waste hierarchy generally lays down a priority order of what constitutes the best overall environmental option in waste legislation and the proper application of this hierarchy has several benefits: it prevents the emissions of greenhouse



gases, reduces pollutants, saves energy, conserves resources, creates jobs and stimulates the development of green technologies.

With reference to the waste hierarchy the "Comparative Study on EU Member States' legislation and practices on food donation" carried out by *Bio by Deloitte* on behalf of the European Economic and Social Committee affirms:

> *According to the Waste Framework Directive, MS shall apply as a priority order the following waste management hierarchy: prevention, preparing for re-use, recycling, recovery and disposal. There is not specific EU guidance on a food waste or food use hierarchy, prioritising food redistribution to humans over feeding animals, energy or nutrient recovery via treatment methods such as anaerobic digestion (AD), in-vessel composting, land spreading, and landfilling* (Bio by Deloitte, 2014).

In addition, the same study says:

> *There is currently no EU legislation or specific guidance on how to apply the EU waste hierarchy to food. National approaches adapting the hierarchy to food were identified in the UK and Belgium, with the following order of preference: prevention, redistribution to humans, feeding to animals, energy or nutrient recovery through methods such as anaerobic digestion (AD), composting, and landfilling. Although in principle such a food waste hierarchy priorities food donation and redistribution, in practice, is still more expensive in many Member States, including the UK to donate food surpluses than to send them it to AD. The recent report published by the House of Lords acknowledge that AD should remain an option for unavoidable food waste and that more efforts should be made to redistribute food before being used for energy* (Bio by Deloitte, 2014).

And it concludes:

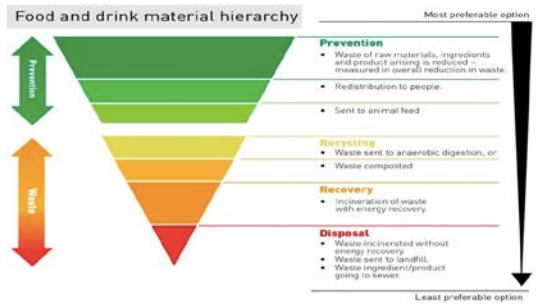
> *It is recommended that the EU publish guidance on a food use hierarchy that clearly prioritises feeding humans, through food waste prevention and donation to charities of unsaleable foods, over waste management options such as composting, anaerobic digestion and landfilling. This hierarchy would provide further clarification on the existing EU waste hierarchy in the context of food and send a clear signal to businesses and governments that economic incentives, investment in infrastructure, and communication activities should prioritise food redistribution* (Bio by Deloitte, 2014).

Some countries decided to consider food as a particular typology of waste and to take into consideration not only the environmental but also the social aspect. They adopted a new more specific hierarchy for food translating the 'waste hierarchy' into a 'food use hierarchy', which follows the following priority order: prevention, redistribution for human consumption, feeding to animals, energy or nutrient recovery by methods such as AD and in-vessel composting (IVC) and finally landfill or incineration (House of Lords, 2014). The United States were among the first countries to adopt a 'food recovery hierarchy' of preferred uses for available food that goes uneaten by consumers. In the 'food recovery hierarchy' developed by the U.S. Environmental Protection Agency (EPA) the ideal situation would be to prevent the production of food waste at the source. Then,

> *when food waste is generated, the first preference is to recover wholesome food from all points in the food production, marketing, and consumption chain to feed*

people who are food insecure. Providing food for livestock, zoo animals, and pets would be the second best option, followed by recycling food and food waste for industrial disposal costs. These three options would help conserve resources and reduce food waste disposal costs (Buzby, Wells, Hyman, 2014).

In the Netherlands the 'food use hierarchy' "is referred to as the 'Ladder van Moerman', where each successive step down the hierarchy from waste prevention down towards treatment and disposal represents a loss in food value and a less desirable option" (House of Lords, 2014). The House of Lords published a report on *Counting the Cost of Food Waste: EU Food Waste Prevention*, which argues that when applying to food, the waste hierarchy should be most effectively represented as a 'food use hierarchy' focused on priorities: first of all prevention, followed by redistribution for human consumption and then for feeding animals, wherever possible. In 2014, the European Food and Waste recommendation in the context of the "food use-not-loss-or-waste" hierarchy FAO and UNEP developed a food and drink material hierarchy.



The study carried out by the Politecnico di Milano in 2015 shows that the declination of the hierarchy of use of surplus food in a company primarily involves the construction of a system for monitoring the phenomenon, with specific indicators (e.g. the amount of surplus food generated in a week or in a different timeframe). Monitoring is necessary not only for internal accounting purposes but also to support the decision making process. The monitoring must be carried out with such a frequency as to allow "corrective" actions and with a detail that reflects the causes of the surplus generation. Secondly, it is necessary to define a priori the alternatives actually practicable by the companies for waste prevention. As also highlighted by a research conducted by ECR Italy – Efficient Consumer Response, the criteria that guide the choice of alternative uses can be many: quantity of surplus generated, state of conservation of the product, costs of options, time available for activation. It is also necessary to associate a budget with each alternative, especially if, for instance, the greater economic advantage of an option could preclude the conferment in another channel that is preferable for different reasons. The activation of various management options involves more functions, depending on the size of the company. For instance, in a processing company, the commercial function plays an important role since it can offer promotions that increase sales, thus reducing surpluses, while the "management control" function intervenes on the allocation and control of the budget for the different alternatives. The logistic function has a key role, also in operative terms, for which very often it coordinates the whole process, being the enabling engine of the donation. The legal and administrative functions play a fundamental role both in the decision and in the operational phase. Lastly, it should be noted that in the decisions that go through the process, and in particular in the decisions on the timing and quantities destined for the various alternative channels, there are not only economic, but also strategic and ethical/solidary considerations. The recovery of surplus food through donation implies logistical and administrative activities by the companies and non-profit organizations involved. The administrative activities are specific to donations, while the logistics activities are partly shared with other processes commonly carried out by the company. For instance, in a large-scale retail outlet, the supply ship shelves periodically check the deadlines and collect products due to expire. However, it is necessary to subdivide the withdrawn products that can be donates and prepare them for delivery to the NPO. The company cost for the recovery of surpluses depends on the need to carry out additional activities, from the cause of generation, from the characteristics of the products and from the organization of the conferment process. As an order of magnitude, the cost of surplus recovery is estimated to vary between 0.05 and 0.1

€/kg for manufacturing companies, between 0.4 and 0.8 €/kg for retail stores and between 1.5 and 2 €/kg for food service. The unitary cost decreases when the degree of "recoverability" of products is higher and the average amount of donated surplus is greater. In addition to the costs borne by companies, it should be taken into consideration the cost incurred by Non Profit Organizations which receive the surplus food. These costs depend on the organizational capacity of Non Profit Organizations, but also on highly specific factors such as the presence of volunteers or the use of spaces given for free. If the conditions to implement a "zero km" recovery model are fulfilled (e.g. the company is close to the Non-Profit Organization), costs can amount to less than 0.1 €/kg. If the two players are at a greater distance, the cost rises to 0.5 €/kg. Since the average value of meals recovered from the food service sector is equal to about 6.5 €/kg, and the value of surplus food donated by manufacturing and retail companies to 2.5 €/kg, it can be concluded that the cost of recovery and donation activities amounts to about 10-30% of the recovered value. There is therefore an important "multiplier effect": for 1 € invested in the recovery process it is possible to donate food to people in need for a value between 3 and 10 €. The "multiplier effect" can improve with a better optimization of the process and collaboration between the actors involved. The quality of the surplus food management process depends on the choices made on four key variables:

- the method for measuring surplus food;
- the degree of formalization of the process;
- the level of coordination between the functions;
- logic of setting up the conferment process.

The process can be defined as well structured when the following elements are in place: the measurement of surplus food is systematic, the activities and the decision-making processes are formalized, an explicit mechanism of coordination between the different functions involved in the process, and clear mechanisms of relations with the NPOs. In particular, the periodic and detailed measurement of the volumes of surplus food generated allows the company to be aware of the size and periodicity of the phenomenon. The a priori formalization of the activities makes the intervention quicker when the generation of surplus food occurs. The coordination between the various functions within the company, with a clear division of responsibilities and the adoption of formal coordination tools, is fundamental. Finally, the formalization of the relationship between the donor company and the NPOs, in terms of responsibility for the call and frequency of donations, allows the various subjects to plan their activities in a proper way and to correctly size the resources. Several case studies have shown that a high degree of structuring of the management process has a positive impact on the level of surplus food recovered. For instance, the processing companies in the environmental segment with more structured processes are able to donate up to 80% of the surplus food generated (compared to an average of 42%). Similarly the retail outlets, which have adopted structured processes, are able to donate up to 30% of fresh surplus food (compared to an average of 10%). The increase in surplus food donations and the consequent reduction of food waste are linked to the commitment of the actors in the supply chain, the NPOs, the involvement of local authorities and the effectiveness of public policies. The latter ones are developed along three dimensions: the civil liability of the actors involved in the donation, the hygiene and food safety of donated products, the economic and fiscal convenience with respect to the other options to manage surplus food.

4. The impact of the activity of Food Banks

To complete these reflections, it is necessary to remember that, if today many talk about waste or study it as a phenomenon, it is also due to a character that probably our great-grandchildren will not find in their tablet but that has

certainly triggered, in a world now indifferent to the daily gift of food, a fuse so powerful that even today, fortunately, manages to explode the desire to contribute to the change and improvement of human existence. That's why it's worth telling his story.

Food Banks have been established all over the world for a long time period –the first Food Bank appeared in the United States of America in the late 1960s – and nowadays there are Food Banks represented in most countries of the world. The St. Mary's Food Bank, the first Food Bank, was founded by John Van Hengel in Phoenix (Arizona):

> *he grew up in Los Angeles and moved to Arizona in 1965 where he became volunteer at a soup kitchen for poor people. The refectory had an annual budget of only $ 8,000. This induced Van Hengel to seek out sources for free food products. In the beginning he recovered vegetables left in the fields and fruit remaining on the trees. In so doing, however, he obtained more products than were needed in the soup kitchen where he worked. So he delivered the remaining products to other relief organizations, making it possible for them to offer additional meals. After a while, the need to give structure to this operation led to the creation of the first food network. An old bakery was used as a warehouse. Van Hengel and his colleagues soon began to recover surplus food from many supermarkets, which sometimes sent their vans directly to the warehouse* (Garrone P., Melacini M., and Perego A., 2013).

John Van Hengel died in 2005 and for many years of his life he lived in a small room in the warehouse of the St. Mary's Food Bank, a deposit of about 10,000 square meters. The news about this new kind of Bank went viral and Following the example of the world's first Food Bank in 1967 in Phoenix more food banks were started: in the USA and a few years later also in Canada, as a sort of positive contamination. Everyone who saw the warehouse wanted to replicate it: in Canada with Francis Lopez, in France with Bernard Dandrel in 1984 based on an initiative from five charitable organizations (Armée du Salut, Emmaüs, Entraide d'Auteuil, Entraide Protestante, and Secours Catholique), in Belgium with André Hubert in 1986, in Barcelona with Jordi Peix in 1988. In Italy Fondazione Banco Alimentare Onlus (FBAO), indeed, was established in 1989 thanks to the meeting between Cav. Danilo Fossati, owner of the company Star, and Mons. Luigi Giussani, founder of the Communion and Liberation movement, which then became a member of the European Food Banks Federation (FEBA). By 1990 food banks spread across Europe, with centres set up in Portugal (1992), Ireland (1994), Poland (1994), and Greece (1996). Food Banks have been spreading worldwide and they are currently represented in more than 60 countries around the world, adapting to different political and socio-economic contexts.

Nowadays at the global level it is possible to identify three main networks of Food Banks. In the United States of America, the largest hunger-relief organization is Feeding America which is a national network of more than 200 Food Banks operating within all the 50 states as well as the District of Columbia and Puerto Rico. In 2017 it provided 4.2 billion pounds of food through 60,000 food pantries and meal programs to more than 46 million people facing hunger in the USA, including 12 million children and 7 million seniors. The European Food Banks Federation (FEBA) is a European umbrella non-profit organization and works in collaboration with 24 members and 4 projects in European countries. It represents its membership at European and international level, and support and strengthen food banks in Europe by providing training, sharing best practices, and developing partnerships. FEBA brings together 388 Food Banks and branches which are committed to fight against food waste and to feed the most deprived. In 2017, our members provided 2,7 million meals each day to 6,6 million of the most deprived people through 41,300 charitable organizations and thanks to the professionalism of 16,200 co-workers (86% volunteers). Finally, the Global

FoodBanking Network (GFN) is dedicated to helping existing Food Bank systems and broaden their operations, increase impact, and deliver more food to hungrier people. Moreover, GFN is involved in a number of projects aimed at creating Food Banks where they do not exist. In 2017 Food Banks belonging to GFN, in 32 countries together distributed more than 940 million pounds of food to over 7.11 million people in need.

In Italy, with thanks to a network of 21 Food Banks across the country, FBAO recovers and redistribute surplus food from the food supply chain to 8,035 charitable organizations that help over 1,5 million poor every year, work to raise awareness about food waste and food poverty, and advocate for policies that sustain food poverty. In 2017 the Italian Food Banks redistributed 91,235 tons of safe and quality food (fresh fruit and vegetables, fish and meat, canned and packed food, dairy products, bakery, drinks and prepared meals) from all the stages of the food supply chain: farmers, wholesale markets, manufacturers, distributors, retailers, collective caterings. The redistribution of food supports 8,042 charitable organizations operating in Italy, so that they can concentrate on their mission of assisting almost 1,584,271 people in need.

For 30 years the mission of Banco Alimentare has been to raise awareness and make the most of the contribution that agriculture, the food industry, organized distribution and catering, because everything that exceeds can be recovered in favor of thousands of charitable organizations that through the reception in canteens, communities and cooperatives can fill in the stomach and restore humble and poor people, "discarded people" as Pope Francis often reminds us, giving them a hope. In fact, Pope Francis clearly states:

> *In this way people are thrown aside as if they were trash.*
> *This "culture of waste" tends to become a common mentality that infects everyone. Human life, the person, are no longer seen as a primary value to be respected and safeguarded, especially if they are poor or disabled, if they are not yet useful — like the unborn child — or are no longer of any use — like the elderly person. This culture of waste has also made us insensitive to wasting and throwing out excess foodstuffs, which is especially condemnable when, in every part of the world, unfortunately, many people and families suffer hunger and malnutrition* (Pope Francis, 2013).

In this perspective, the recovery and redistribution of surplus food to disadvantaged people is essential not only in view of food security but also in order to improve the sustainability of food systems and to reduce the impact of food waste on the environment. Last but not least, this activity contributing to address a basic need gives a new value to food, rediscovers the culture of gift, enhances the social commitment within the community as an integral part of the life of every citizen.

The activity of Banco Alimentare has evolved and improved over the years. For instance, since 1997 it has been evident that the lack of an adequate regulatory framework could not foster the daily activity but it was only in 2003, with the entry into force of Law No 155/2003, the so-called Good Samaritan Law, that both food business operators and Food Banks had the chance to foster food donation and change mentality moving from the fight against food waste to the promotion of food recovery. Over time, it became necessary to have tools for the measurement of the phenomenon of food poverty and waste and increase the skill of Food Banks. Several collaborations con the academia allowed to develop a more scientific knowledge and to train food bankers to better face new challenges. It was essential to work together with dozens of students, PhD candidates, and researchers, attend conferences and lectures, and finally collaborate in the drafting of 3 studies both on the topic of food poverty and on the management of surplus food for social purposes. The combination of experience and theory allowed to have more strength with the media, public

institutions both at national and European, and companies. A milestone was the meeting with Ms Maria Chiara Gadda, deputy of the Italian Parliament, and the organization of Expo Milan 2015 in Italy because they allowed to start a systematic collaboration with more and more players. The concrete result was the entry into force of Law No 166/2016, the so-called Gadda Law, which defines "Provisions concerning the donation and distribution of food and pharmaceutical products for purposes of social solidarity and to limit waste", and facilitates the process of food donation and increases the number of sources of supply. Thanks to the entry into force of the Gadda Law, in 2017 Banco Alimentare had a 20% increase in the recovery of surplus food, in particular from the distribution sector. This was accompanied by the first recovery of ready to eat food from cruises in the world, launched as the first implementation of Gadda Law in a completely innovative sector. Then the first recovery of surplus food in Italy from a specialized fast food restaurant: unsold food is collected in special food bags during the day, labeled with information on quantity, type of product, and expiry date. The packaged food is then frozen and stored in the cold rooms inside the restaurant, until the recovery thanks to the volunteers of Banco Alimentare who deliver it to charitable organizations in the area. Moreover, important agreements were signed with the Society of Preventive Medicine Veterinary, which represents professional figures who monitor the safety of the food that we buy and consume; with the Istituto Zooprofilattico of Torino for the recovery of portions of samples of intact and healthy food that remains in the laboratories after the analyses; with the National Order of Food Technologists to promote new projects to extend the shelf life of food products and increase the recovery of surplus food; with the Department of Fisheries of the Sicilian Region and the Fishing District of Mazara del Vallo for the recovery of confiscated and rejected fish, which can be donated to charitable associations. Finally we noticed more often that change of mentality so desired. Furthermore, Banco Alimentare launched together with Federcongressi&eventi, the Italian association of companies and professionals involved in the meetings industry, the project Food for Good for the recovery of surplus food at conferences. Coffee breaks and meals during conferences, congresses or events, are a pleasant opportunity of conviviality, where taste, high quality and abundance are starring. If the food is not completely consumed, it can be donated for the purpose of social solidarity. With simple operations, surplus food can be recovered by volunteers of Banco Alimentare and then delivered to charitable organizations (shelters, soup kitchens and refugee centres) assisting people in need. The project is simple, it does not require great efforts or costs, and complies with Italian Law No 166/2016. The recovery of surplus food is organized under a clearly defined protocol where responsibilities are governed by a shared operating procedure. Banco Alimentare is recovering surplus food also from extraordinary events such as the G7, Milan Food City, Motociclismo di Misano races or at football grounds. Much work remains to be done. In particular, it is possible to develop two innovations: the first, in the short term, is the possibility of transforming and conserving fresh food and cooked food in order to extend the shelf life. The second innovation concerns the start of a task force aimed at validating and testing the hypothesis to develop a cloud computing service model connecting the food supply chain, Banco Alimentare and charitable organizations in order to create a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can increase even more the quantity and the quality of the recovered surplus food. Thanks to these new and innovative projects, the Italian Banco Alimentare has the possibility to contribute to an efficient management of the food supply chain and to provide charitable organizations with tasteful and nutritious food but also deliver a feeling of joy.

5. Conclusion

The recovery and redistribution of surplus food managed by Food Banks and charitable organizations contribute to

the reduction of food waste and the sustainability of the food system. There is evidence of the impacts of their action with respect to ecology, economy and social welfare. This activity provides an ecological benefit preventing the generation of food waste, saving energy and reducing greenhouse gas emissions. Food Banks optimize the value of surplus food produced by the food supply chain, with a subsequent saving of resources. Moreover, food discarded in landfills immediately begins to produce methane gas, a greenhouse gas with over 20 times the heat-trapping capacity of carbon dioxide. Greenhouse gas damages the water supply, land, air and ultimately harms present and future generations. From an economic perspective, the recovery of surplus food has a positive impact because it renews the economic value of food and food donors can reduce storage and disposal fees and put products to good use instead of to waste contributing to the common good of society. Finally, the recovery and redistribution of surplus food provides a benefit to social welfare because they support charitable organizations and allow them to allocate their economic resources for improving their services and to focus on the activities they offer to their beneficiaries. Nevertheless some academics express a severe point of criticism because the existence of Food Banks may represent the inability of the social-economic systems in developed countries to take care of people in need and so "food banks are the signposts of the collapse of the social safety net" (Van Steen, Pellenbarg, 2014). The enormous growth of Food Banks worldwide can be seen as the evidence that the welfare state system is being broken down.

It is an evidence that the model of food recovery redistribution carried out by Food Banks represents "a successful model for synergistic partnerships between civil society, the private sector and governments" (Gentilini, 2013). Furthermore, it is evident "to expect the need for food assistance to keep being high or even slightly rising. It is equally evident that both governments' safety nets and the food bank system are overstretched in terms of capacity to meet current and projected needs" (Gentilini, 2013). These dynamics "call for more policy attention than currently received, as well as for more pragmatic, multi-sectorial, evidence-based and innovative approaches in confronting and navigating the complex trade-offs that the issue involves" (Gentilini, 2013). For these reasons it is essential to encourage the growth of Food Banks and charitable organizations dealing with food redistribution and donation programmes because they can act proficiently, while upholding their social and non-profit motivation, as intermediaries between business and millions of people in need. They provide a solution to the generation of surplus food by the food supply chain and a crucial, last-resort safety net for the most deprived, at the same time.

It is widely recognized that food waste and food poverty are among the greatest challenges of our era and they cannot be solved only by the recovery and redistribution of surplus food. According to Schneider,

> *neither hunger can be solved by the donation of food, nor all edible foodstuff can be distributed to people in need. The goal should be to recover as much edible food as possible by implementing donation. In addition, other prevention measures such as optimisation of food production and processing and raising stakeholder awareness to overcome excessive requirements with respect to freshness have to be implemented and will change conditions in the future* (Schneider, 2013).

Only a combination of different measures and the active involvement of all the players of the food supply chain, in collaboration with public European and national authorities, can contribute to a significant decrease of the amount of food waste and create a sustainable food future, in the perspective of Circular Economy. Nevertheless, the recovery and redistribution of surplus food are a perfect example to generate environmental, health, and development co-benefits and they should be fostered for the common good of society, in particular the most deprived citizens.

REFERENCES

Bio by Deloitte, European Economic and Social Committee 2014. Comparative Study on EU Member States' legislation and practices on food donation.

Buzby J. C., Wells H. F., Hyman J. 2014. The estimated Amount, Value, and Calories of Postharvest Food Losses at the Retail and Consumer Levels in the United States, *Economic Information Bullettin*, No. 121, United States Department of Agriculture.

Campiglio L., Rovati G. 2009. La povertà alimentare in Italia. Prima indagine quantitativa e qualitativa. *Edizioni Guerini e Associati*, Milan.

European Commission 2010. Preparatory Study on Food Waste across EU27, Brussels.

European Commission 2015. Communication from the Commission to the European Parliament, the council, the European Economic and Social Committee and the Committee of the Regions "Closing the loop – An EU action plan for the Circular Economy", COM(2015)0614 final.

European Parliament 2012. Report on how to avoid food wastage: strategies for a more efficient food chain in the EU (2011/2175(INI)), Brussels.

European Parliament 2017. Report on initiative on resource efficiency: reducing food waste, improving food safety (2016/2223(INI)), Brussels.

Eurostat 2016. People at risk of poverty or social exclusion, Brussels.

FAO 2011. Global food losses and food waste – Extent, causes and prevention, Rome.

FAO, IFAD, UNICEF, WFP and WHO 2017. The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security, Rome.

FUSIONS 2016. Estimates of European food waste levels, Stockholm.

Garrone P., Melacini M., and Perego A. 2013. Feed the Hungry: the potential of surplus food recovery, *Edizioni Guerini e Associati*, Milan.

Garrone P., Melacini M., and Perego A. 2015. Surplus Food Management Against Food Waste. Il recupero delle eccedenze alimentari. Dalle parole ai fatti, Milan.

Gentilini U. 2013. Banking on Food: The State of Food Banks in High-income Countries, *IDS Working Paper*, Vol. 2013, No. 415, CPS Working Paper No. 008.

González Vaqué L. 2015. Food Loss and Waste in the European Union: A New Challenge for the Food Law?, *European Food and Feed Law Review*.

House of Lords 2014. Counting the Cost of Food Waste: EU Food Waste Prevention, *HL Paper 154*.

Pope Francis 2013. General Audience, Rome.

Schneider F. 2013. The evolution of food donation with respect to waste prevention, *Waste Management 33*.

STOA – Science and Technology Options Assessment 2013. Technology options for feeding 10 billion people. Options for Cutting Food Waste, Brussels.

Van Steen P. J.M., Pellenbarg P. H. 2014. Food Banks in the Netherlands, *Tijdschrift voor economische en sociale geografie*, Vol. 105, No. 3.

Winne M. 2008. Closing the Food Gap. Resetting the Table in the Land of Plenty, *Beacon Press*, Boston.