

Analysis and Models for the Reduction of Waste in Organized Large-Scale Retail Distribution: “The Tomato”

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Abstract

Food waste is one of the major global paradoxes of our century and raises quite a few questions from the economic and social point of view. The causes of food loss and waste are many and differ according to the various phases of the agro-food chain. The problem of food waste prompted the European Parliament to proclaim in 2014 “the European Year against Food Waste” and to adopt a resolution that would lead to a 50% reduction in waste by 2025. This work proposes possible Corrective actions, to be adopted by the Organized Large-Scale Retail Distribution, aimed at consumers, to reach the goal of reducing food waste. Therefore, the objective of the study is to identify and analyse the loss and waste within the complex agri-food chain, by analysing the tomato chain in the Organized Large-Scale Retail Distribution.

Keywords: food waste, food supply chain, tomato, food loss.

1. Introduction

Food is wasted at every stage in the agri-food chain from its production to its sale to reach domestic consumption. Waste generation in the global production and distribution phases is, in most cases, inevitable (Onofri and Boatto, 2014). Many scraps are unrecoverable and are the result of incorrect stock management, overproduction, deformed or damaged products. Within the same agri-food chain, it is possible to identify and separate the different phases in which the waste is formed. In this context it is necessary to indicate the terminological differences between the terms “loss”, “waste” and “squander” (Bernstad *et al.*, 2017. Montanari *et al.*, 2014). Food loss means the unintended reduction of food intended for human consumption (Palma *et al.*, 2013. Schimmenti *et al.*, 2013). This unintended reduction results from a series of inefficiencies along the food supply chain, such as lack of infrastructures and logistics, lack of technology, competence or managerial skills. Food loss occurs mainly during post-harvest production and processing, i.e. when products remain on the field or when they are discarded during processing, storage and transportation (Thornsbury *et al.*, 2000) The term food waste, on the other hand, refers to the intentional waste of food (destined for human consumption) and still perfectly edible (Khan *et al.*, 2011. Porretta *et al.*, 2009). The waste, in this case, is due to the behaviour held by companies and individuals, especially by end-users and consumers (D’Amico *et al.*, 2003). The word “food waste” or squander, finally, indicates the combination of loss + waste. Looking at the consumer, it is necessary to recall the changes in consumer lifestyles, most surely attributable to socio-economic variables, but also to cultural changes. Reducing waste requires changes in consumer behaviour ((Lanfranchi *et al.*, 2014a). Mahamud and Manisah, 2007). The waste is correlated to the awareness and attitudes of individuals, and the ability to manage food with logic, such as planning, portioning, and conservation (Salvo *et al.*,

2016. Riggi and Avola, 2008). Causes of waste may vary according to socio-economic status and culture, for example, the habit of generously preparing more food than what can be consumed and having leftover food (Garofalo *et al.*, 2017. Ilic *et al.*, 2017. Marotta *et al.*, 2014).

2. Objective of the research

The aim of this research has been to identify and analyse the loss and waste within the complex agri-food chain, particularly in the Organized Large-Scale Retail Distribution. Efforts have been made to identify possible actions aimed at reducing the phenomenon, also in accordance with the Resolution of the European Parliament of 2011, which aims to reduce waste by 50% by 2025. For this purpose, in this paper, the concept of “food loss” is identified as the food spill linked to the processed product before being exposed on the sales shelf, identifying the “scrap” exclusively as the unsold product. The study therefore aims to analyse the strategies implemented by the Organized Large-Scale Retail Distribution to reduce the waste caused by bad habits of consumers and to identify potential solutions by examining, in particular, the wasted or discarded tomato in order to improve its potential reuse (Lanfranchi *et al.*, 2015).

3. Definition of the context of analysis

In Italy, the areas intended for tomato cultivation by the industry in 2015 were up 6.2% on the previous year. From the elaboration of the collected data and information it is possible to have a first projection on the tomato conserve cultivated areas. In 2015 in Italy it was around 72,000 hectares. If productivity estimates per hectare are confirmed, production would have increased by about 11% compared to 2014. As far as the

product type is concerned, round tomatoes account for about 80% of the tomatoes planted for industry, the long tomato for about 20%, while a residual share, just over 1%, is invested in cherry tomatoes. Sicily, according to the data provided by the Regional Coldiretti in November 2016, is the first region in Italy to produce tomatoes in a greenhouse with 314 thousand hectares and 200,000 tons of harvested product. Only Lazio keeps up with 167 thousand 800 hectares of cultivated area and 110,000 tons of tomato harvested. In this sector, thanks to Sicily, Italy is ranked second in the world, just behind the United States with China third. The 2016 campaign, despite the overtaking of China, has marked other results. In the North, in fact, the favourable climate conditions led to 2.8 million tons of production; The situation in the Centre-South is different, where production levels have fallen to 2.3 million tons. As for domestic consumption, tomato puree (55%) prevails, followed by pulp (24%), peeled (16%), cherry tomatoes (3%) and concentrate (2%) (Anicav data). The tomato industry gives rise to a multitude of products such as concentrates, puree, peeled, pulp, shredded, cubed, tomato juices, but also powders, flakes, juices and sauces. Processing by-products can be obtained in different quantities depending on the processes. In fact, much depends on their final moisture, e.g. for refinery waste after hot-break treatment, 50% moisture is detected, while in the waste obtained by the pulper after the cold-break treatment, the percentage is around 85% (Leoni, 1997). In fact, the solid waste obtained from the production of juice, puree and tomato concentrate accounts for 2.2% by weight, of the raw product. This fraction is referred to a humidity of 70%, but it is obvious that the more we concentrate the product, the more the fraction of waste is reduced in weight (e.g. 1.5% for a humidity of 50%). From peeled, whole or cut tomatoes, however, about 0.6% by weight of solid waste is obtained for a humidity of 70%, or 0.4% at 50% humidity. Although the fraction that can be obtained is minimal, the waste obtained from the production of peeled tomatoes is a secondary raw material. In fact, it is part of the production process because the residual juice extracted has the function of liquid control in the derivatives (Leoni, 1997). At the end of what has been said so far, the tomato industry generates considerable quantities of waste; For example from 10 million tons of fresh tomatoes, up to 200,000 tons of by-products such as seeds and peels can be obtained during the processing process. Analysing the sales, the Research and Study Office of Fondosviluppo S.p.A for Confcooperative has produced a report explaining their findings in the period they analysed 2010/2015. The Italian market (total not just Organized Large-Scale Retail Distribution) of puree and tomato concentrates has shown a downward trend in retail sales volumes but a growing trend in the total value of sales. The first were down from 333.7k tons to 312.4k tons (-6.4%); the second increased from € 607.3 million to nearly € 650 million (+7%). This increase in the total value of sales is due to an increase in unit prices, due to increased attention by Italian consumers towards higher quality products (e.g. puree and concentrates made using IGP tomatoes). The report also explains that in the term 2015/2020, retail sales volumes are expected to continue, with a slight downturn from 312.4k tons to 310.6k tons (-0.6%). Similarly, the total value of sales is expected to decrease from nearly 650 million euros in 2015 to 642 million euros in 2020 (-1.2%). The world market for fresh vegetables, from 2010 to 2015, recorded a significant growth in per capita sales volumes. In 2010, per capita consumption amounted to 119.7 Kg per year. In 2015 they went up to 126.1 kg a year. Prospects for the European markets are, however, not very encouraging. In fact, an annual growth rate of not more than 0.5% is expected in the next five years. From 2010 to 2015, the Italian fresh vegetables market showed little performance. In particular, total sales volumes dropped from 3,842,000 tons to 3.713k tons (-3.4%). In 2015, in terms of market share on total volumes of fresh vegetables, tomatoes, with 20%, were the most popular category. From 2010 to 2015,

among the different types of fresh vegetables, the sales volumes of tomatoes decreased by -6.4% over the five years. The distribution of fresh vegetables prevalently refers to the retail channel (supermarkets, hypermarkets, traditional shops, etc.) with a market share of 70.7%. In 2015, the consumption of fresh organic vegetables reached 4.8% of the total sales volume (the share was 4.2% in 2012). The standard category, however, keeps the lead with 95.2% of total sales volumes. As for the distribution of bulk and packaged volumes, the largest share, 82%, refers to the category of unpackaged fresh vegetables, which in recent years has consolidated leadership. The remaining 18% refers, instead, to the packaged category. In the term 2015/2020, a substantial further decline in sales volumes is expected. Overall, the total volume of fresh vegetables sales in 2020 will amount to about 3,659.7 thousand tons, with a decrease of -1.4% compared to 2015. The tomatoes and the all other vegetables will mark a decline in sales volumes, of -0.7% and -1.3% respectively (ISTAT data 2016).

4. Materials and methods used in the research

A survey was conducted on a sample of 14 retail outlets in order to identify for each of them:

- the impact of tomato waste on sales over a period of five years;
- which retail outlets contributed most to waste / squander in both economic and quantitative terms;
- potential policies and management strategies to reduce waste.

The first step in the methodology has allowed us to verify the existence of food waste and to quantify the impact on sales in the 14 commercial points analysed and to identify the amount of tomato waste (*Table 1*) in the 2012-2016 period. The first results have allowed us to concentrate on and further perfect the analysis of the identified sector (Lanfranchi *et al.*, 2016a). Through careful monitoring, it was possible to carry out a quantitative analysis of tomato waste, showing a high level of waste in relation to the quantities ordered by the individual outlets (*Table 2*).

Table 1. Impact of waste on sales (2012-2016)

Year	2012	2013	2014	2015	2016
Economic loss due to waste	€ 3,744.73	€ 2,754.87	€ 2,880.12	€ 2,820.33	€ 4,878.63
Percentage of influence	9%	10%	13%	8%	13%

Source: own elaboration

Table 2. Quantitative analysis in terms of tomato waste

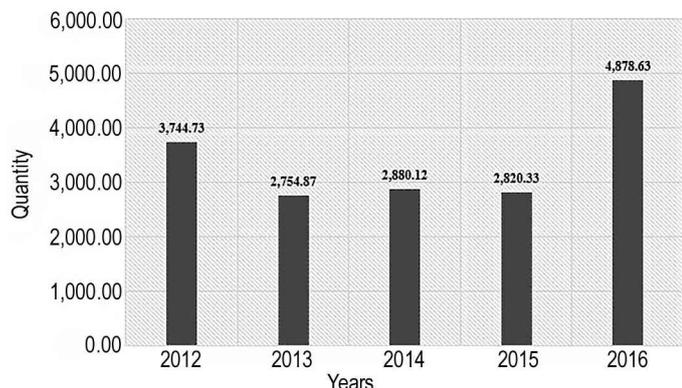
Refuse (kg)	Value of loss in economic terms	Ordered Quantities (kg)	Estimated value of ordered quantities	Influence of waste / quantities ordered (%)	Average for all outlets (per capita)
17,078.68	€ 16,639.77	168,109,918	€ 158,061,027	10.2	0.006

Source: own elaboration

5. Results and discussion of the research: analysis of tomato waste and possible intervention strategies

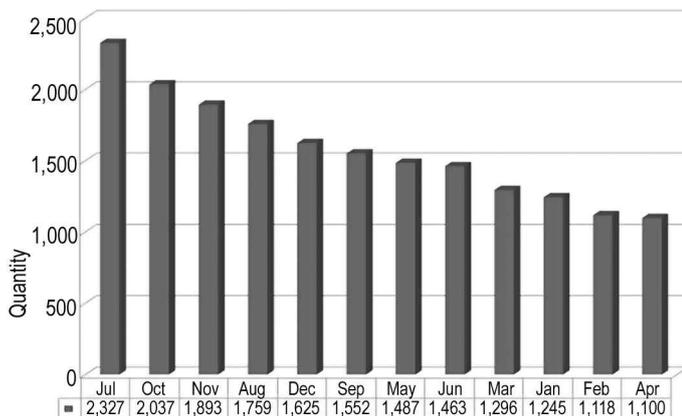
From the analysis of the data collected during the survey period followed by its processing, it was possible to carry out some assessments that made it possible to further distinguish between waste of energy (loss + waste) and simple waste. This has allowed us to propose policies for the distribution and

marketing and to outline possible results in terms of reducing the amount of waste. The product examined shows a declining trend of waste in the first four years examined (as a result of the reduction in the sale price in case of excessive ripening or proximity of the expiry date) and then, an upward trend growing in quantities, during the last year (Graph 1).



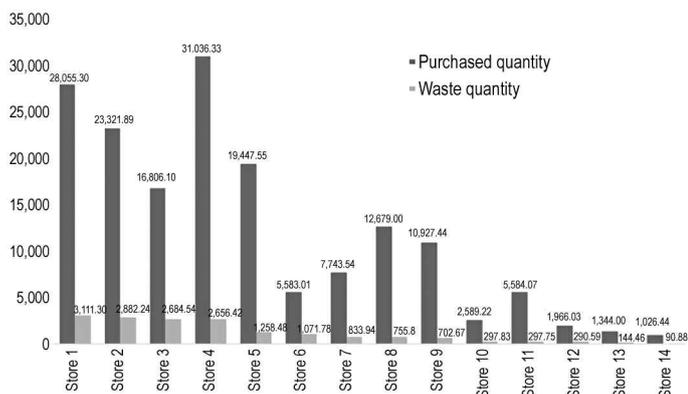
Graph 1. Quantitative scheme of tomato waste (2012-2016) (Kg)
Source: own elaboration

In addition, some peculiarities have been found in regards to the seasonal period of waste / refuse related to the product in question. The analysis showed that the largest amount of waste was produced mainly in July (with a peak of 2,327.6 kg), October and November. While in January, February and April there is a significant reduction in waste, even though there is constant production throughout the year (Graph 2).



Graph 2. Waste quantity distributed for months (2012-2016) (Kg)
Source: own elaboration

Finally, the extent of the waste loss for the 14 sales outlets was analysed. Waste, with the exception of two values exceeding 15%, remains between 12 and 5% (Graph 3).



Graph 3. Purchased quantity / waste quantity (2012-2016)
Source: own elaboration

With reference to the sector analysed in this study, for the period 2012-2016, about 17,078.68 kg of food was wasted, with a loss in economic terms of about 16,639.77 euros (Lanfranchi *et al.*, 2016b).

6. Conclusions

Based on the evaluations carried out, reviewing the topic literature and also reviewing the international literature, the lack of data on tomato waste production was seriously noted. In addition, some field studies have shown that in the retail sector about 25-30% of fruit and vegetables are discarded due to cosmetic defects, such as inadequate size or shape, holes or bruises (Lanfranchi *et al.*, 2014b). In addition, it turned out that the percentage of waste is about 11% in the period considered, which is fairly high and therefore urges for the implementation of targeted policies. In this regard, in order to identify adequate actions to reduce waste and on the basis of similar experiences undertaken at international level, a possible intervention strategy aimed at the reuse of waste from the use of tomato was conceived. An example is the "LoveFood HateWaste" campaign, which proposes the application of a brand to be affixed on highly perishable products, near the expiration date and with non-perfect aesthetic standards (Lanfranchi *et al.*, 2014c). The research team proposes the placing of an extractor machine at each point of sale, located within the fruit and vegetable department. The aim is to get fresh juices, from products that are close to going bad, to be presented to the consumer in order to gain good health benefits. Instead, the waste obtained from the extraction is to be put in special containers to be given to the processing companies. Therefore, in this study, the proposal to reduce waste has only considered the tomato chain to meet the requirements of a product that has experienced a high amount of waste in the last 5 years. This solution could be applied to any product that, at the outlet, presents together or separately the characteristics of high perishability, to be near the expiration date and don't have the desired appearance of perfection.

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