

Preprint

Food waste reduction in school canteens: evidence from an Italian case

Alexandra Lagorio^a, Roberto Pinto^a, Ruggero Golini^a

^a*Department of Management, Information and Production Engineering, Via Pasubio, 7, 24044, Dalmine (BG), Italy*

Cite as:

Lagorio, A., Pinto, R., & Golini, R. (2018). Food waste reduction in school canteens: Evidence from an Italian case. *Journal of Cleaner Production*, 199, 77–84. <https://doi.org/10.1016/J.JCLEPRO.2018.07.077>.

Abstract

The issue of food waste is increasingly attracting interest within the public and academic communities: this is due to the magnitude of the problem (in terms of quantity and worldwide spread) and to the increasing attention to the issues related to healthy and sustainable food. As a consequence, it is possible to observe an increasing number of initiatives that are intended to reduce the food discarded during the different stages of the supply chain: from the first steps in the production and storage up to the product cooked and ready to be consumed by humans. Still, food waste remains an unsolved issue, and many initiatives struggle to move from the design to the full-scale implementation. This research paper focuses on a successful food waste reduction project in a school canteen in the north of Italy. The case study illustrated in this paper shows how it is possible to implement an effective initiative for the reduction of food waste in a school canteen with a limited investment, leveraging on stakeholders' involvement.

Keywords: food waste, waste reduction, school canteens, stakeholder management

1. Introduction

In recent years, the problem of food waste has become an important subject worldwide, reclaiming the attention of policy makers, associations, industries and academics. Indeed, according to the Food and Agriculture Organization (FAO), annually 1.3 billion tonnes of food are being lost or wasted, about one third of the total mass of food produced (FAO, 2011). The magnitude of this problem has led the leading organizations and institutions worldwide to address the current situation. The European Union has proposed a directive aimed at the reduction of food waste (European Union, 2015) and launched a platform on Food Losses and Food Waste (European Union, 2016) to define measures to prevent food waste, share best practices, and evaluate progress over

time. The United States, especially through the Department of Agriculture (USDA), promoted the dissemination of best practices aimed at reducing food waste at home, school and work (U.S. Food Loss and Waste 2030 Champions) with the target of reducing food loss and waste by 50 percent by the year 2030 (ReFed, 2016). Other notable initiatives include the Food Waste Reduction Alliance (FWRA, 2015) in the United States, jointly promoted by the Grocery Manufacturers Association (representing food and beverage companies), the Food Marketing Institute (representing food retailers), and the National Restaurant Association (representing the foodservice industry) (FWRA, 2017), and the “Joint Ambition” project by Unilever and Hubbub aimed at tackling the issue of food waste at a consumer, business and policy level (Unilever, 2013). The term “food losses” or “food lost” defines loss or damaged food no longer suitable for human consumption and then thrown away before it reaches the final consumers (i.e., production and distribution stages of the supply chain). On the other side, “food waste” refers to food ready for human consumption, but not consumed and then discarded (i.e. processed foods or meals wasted in retail, catering or in the consumer households) (Aschemann-Witzel et al., 2016). The majority of food waste in Europe originates from private households (61%), followed by restaurants and canteens (17%) and supermarkets (5%) (Blanke, 2015). To decrease losses of food, it is possible to process and reuse it: for example, transforming food losses in food for animals (Wen et al., 2016), in fertilizers (Kim et al., 2012) or in an organic energy source (Browne and Murphy, 2013). Instead, to reduce food waste, most of initiatives tend to focus on influencing people's behaviour in the cooking process, consumption and waste management (Lundie and Peters, 2005) or increasing their awareness of healthier diets, which are also related to a reduction of waste (Tagtow et al., 2015). Other strategies address private citizens with sensitizing initiatives and restrictive measures inherent waste policies (Secondi et al., 2015). The initiatives that have aimed to increase customer satisfaction have proven particularly effective (Ferreira et al., 2013).

Food waste and losses reduction initiatives have been proven effective also when applied by large retailers and their suppliers which can implement solutions aiming to reduce waste such as lean stock policies (Haijema & Minner, 2016), increasing food shelf life (Eriksson et al., 2016) or using packages that allow the food to be preserved better and longer (Beitzen-Heineke et al., 2017; Brancoli et al., 2017). Even initiatives that involved all stakeholders acting in the process of food waste by private citizens: in particular, a study in Shanghai showed that in forming groups of citizens supported by members of the waste managing company and of the municipality food waste reduction have been significant results (Xu et al., 2016). From the restaurants and canteens

perspective, greater control can be exerted on reducing food waste in those activities directly managed (usually through an intermediate service provider), such as meal planning and leftovers re-use (Caputo et al., 2017). However, in this sector there are many restrictions regarding compliance with sanitation standards. These regulations, although necessary to protect the health of people, often constitute a huge constraint with regard to the application of solutions that reduce food waste. Other studies are needed to understand how these constraints can be overcome in accordance with the sanitary standards.

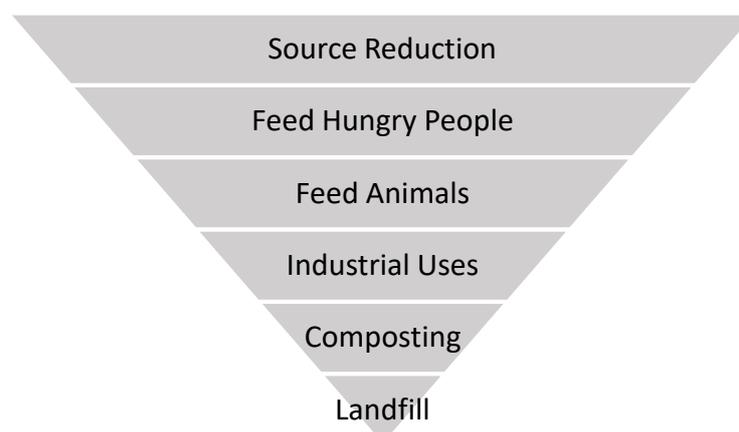
Among these different streams, this research focuses on school canteens, for which it is important to both reduce food waste and increase the level of awareness of students with regard to healthy eating and sustainable practices. In addition, since most of the schools in Italy are public and controlled by the municipality, the social aspects and the creation of an effective circular economy on the territory, as suggested by the European Union guidelines (European Commission, 2011), have a key role.

The main goal of this paper is to illustrate an effective and reliable strategy for the reduction of food waste in canteens that can be put in operation with a relatively small effort in terms of investments and a high level of stakeholder involvement.

In the next section a theoretical background on food waste in school canteen is presented. Section 3 illustrates in detail the single case study methodology that was used for this study, while in section 4 the case study is presented. In section 5 the case study is discussed. Finally, conclusions provide key insights for organizations willing to implement similar projects and for future research in the field.

2. Theoretical background

Even though the scientific literature on food waste in school canteens is quite limited, some studies have addressed this problem in the past from different perspectives, illustrating different solutions



for food waste reduction. Among them, Li et al. (2016) suggest the transformation of food into energy through biofuels or biogas (Ratanatamskul and Saleart, 2016; Othuman Mydin et al., 2014). However, this solution can be applied when there is no other possibility to use the food for human consumption. When the food leftovers from school canteens can be reused, its transformation into energy can be considered a less attractive option (Figure 1).

Figure 1 – Food Recovery Hierarchy (Source: adapted from United States Environmental Protection Agency)

Other studies such as Jungbluth et al. (2016) and Toth et al. (2017) analyse the supply chain operations of companies dealing with the canteens management. Indeed, not only final consumers produce waste: during the preparation and storage, a great amount of food could be wasted, mainly due to inadequate staff training. Therefore, with a greater awareness on food preparation and preservation techniques, a 10% reduction of food waste can be achieved (Toth et al., 2017). Even the earlier stages of food process (i.e. selection of raw materials and suppliers, preparation and storage) may influence the quality of food, the choice of the menus by consumers and consequently the amount of waste (Jungbluth et al., 2016).

Several studies suggest two types of solutions: the reduction of the size of the serving, and a greater attention to the composition and presentation of menus and dishes from the point of view of content and appearance (Martins et al., 2014; Rodriguez et al., 2014).

Silvennoinen et al. (2015) performed a study on different Swedish companies operating in the catering sector and provisioning canteen service in schools. This study, in addition to the previously described solutions, suggests to reduce the self-service and buffet solutions, and to give a greater attention to the education of schoolchildren towards a healthier diet. On this last point, Byker (2014) analyses the meals leftovers in an American school cafeteria. This study shows that after the introduction of a new regulation for canteens which require the presence of a greater amount of healthy foods, the food waste has increased. Therefore, it is necessary to teach students the importance of a healthy diet.

In Italy, where the case study presented in this paper is based, there are very strict regulations on both the amount of the portions to serve and on the menu compositions in school canteens (Linee di indirizzo nazionale per la ristorazione scolastica, 2010). These regulations were created with the intention of providing adequate, proper and sustainable meals (with a particular attention on serving seasonal and locally produced food). However, as already noticed, these regulations often

constitute a constraint for the implementation of food waste. To fill this gap, Falasconi et al. (2015) propose the reduction of snacks to consume during recreation, whereas Bonomi et al. (2016) propose the re-use of cooked-but-not-served food to help indigent families with the involvement of a set of stakeholders operating in the field: students along with their families, teachers, public authorities, Non-Governmental Organizations and operators of canteens. To support this kind of initiatives, in 2003 the “Legge del Buon Samaritano” (also known as the “Disciplina della Distribuzione dei prodotti alimentari a fini di solidarietà sociale”) was enacted (Legge 155/2003). This law allowed the no-profit associations to make the redistribution of food to the needy families easier and faster, eliminating all those bureaucratic procedures related to the storage conditions of food and the restrictive laws on food hygiene regulations.

In table 1, the main suggested solutions for food waste reduction in school canteen are summarized.

Authors	Suggested food waste reduction strategy
Bonomi et al., 2016	<ul style="list-style-type: none"> • Re-use unsold and/or unused food for charity • Stakeholders network including school, municipality and supermarket
Byker et al., 2014	<ul style="list-style-type: none"> • Reduce portions size • Encouraging nourishing food choices
Falasconi et al., 2015	<ul style="list-style-type: none"> • Less packaged sweet and salty snacks • Greater attention on menu composition • Less rigidity of the procurement specifications • Training catering staff to better presenting food
Jungbluth et al., 2016	<ul style="list-style-type: none"> • Applied measures to improve all the canteen operations and supply chain • Greater attention on menu composition
Martins et al., 2014	<ul style="list-style-type: none"> • Reduce portions size • Training catering staff to better presenting food
Rodriguez-Tadeo et al., 2014	<ul style="list-style-type: none"> • Reduce portions size • Training catering staff to better presenting food
Silvennoinen et al., 2015	<ul style="list-style-type: none"> • Minimizing buffet service • Reduce portions size • Greater attention on menu composition • Educational aspect
Toth et al., 2017	<ul style="list-style-type: none"> • Increase training of catering staff

Table 1 – Main food waste reduction strategy in school canteens

3. Research Methods

To illustrate an effective and reliable strategy for the reduction of food waste in school canteens, we present in this paper a very unique case, yet very informative for other organisations willing to undertake a similar endeavour.

The case chosen is the so called “Buon Samaritano” project, which is still in operations. Promoted by the municipality at a local school, it represents a zero-cost solution for the municipality, as it achieved effective and satisfactory results and it involved all the different stakeholders in the area. The case attracted the attention of the media at the local and regional level, and has become a flagship project for many other schools.

Given the multitude of stakeholders involved, the various phases of the project and the tight relationship between the school and the local territory, we deemed that a single case study was the right approach to study the phenomenon within its real-life context leveraging on multiple sources of evidence to understand its key success factors (Yin, 2002, Eisenhardt, 1989). Moreover, the single case study research method is particularly appropriate for exploratory studies discovering relevant constructs in areas where theory building is at the formative stages and for studies where the experiences of participants and context of actions are critical (Bhattacharjee, 2012), such as food waste management. Like other methodologies, the analysis of a single case study has its limitations. In particular, single case study methodology is less generalizable and it is more complex to verify the external validity than other methodologies, such as multiple case studies. However, these limitations are also positive factors because this methodology “sacrifices generalizability in favour of more in-depth analysis” (Lopes et al., 2017).

For this research, we have followed the case study guidelines proposed by Eisenhardt (1989). First, we defined the ultimate goal of the analysis: *understanding how it has been possible to put in operation an effective food waste reduction strategy without investments and involving all the stakeholders in the context.*

Second, respondents were selected. We have conducted several retrospective interviews with the municipalities’ members that originated and managed the project in order to identify how the project has developed over time.

Next, we collected additional quantitative data (e.g., amount of wasted food before and after implementation of the waste containment strategy) and qualitative evidence from other secondary sources (i.e., presentations, documents, news, conferences extracts) in order to triangulate the information and enhance validity and reliability of findings (Yin, 2009).

Afterwards, we identified the challenges encountered at the different stages of the project, the relationships with the internal and external context, and the approaches used to solve the challenges.

4. The case study description

This paper presents and discusses the “Buon Samaritano” project, implemented at a school canteen in the municipality of Brusaporto, a town of about 5,000 inhabitants in the north of Italy. The information necessary for the case study were obtained through two meetings with the commissioners of the municipality of Brusaporto, viewing the data, reports, and minutes of the meetings related to the project. Additional data include the speeches and interviews to the various stakeholders involved in the project gathered from secondary sources and especially on the proceedings of the National SIMeVeP conference "The food that does not nourish any" held in October 28, 2016 in Bergamo, which is very close to Brusaporto. The school canteen serves primary and secondary school with an average of 800 meals per week, with peaks of about 280 meals on days of maximum flow. The project was initiated in response to the notification of teachers worried about the huge amount of food leftovers at the school canteen. Later, the issue was discussed by the School Canteen Commission, composed of two teachers, the municipal Councillor of the education, a member of the company providing the school canteen service and parents of the students.

The School Canteen Commission used to meet on a quarterly basis to discuss management issues related to the canteen, but following the report by teachers on food waste, the Commission started to meet every month. In addition, it was decided that on a rotating basis, each day a member of the Commission would have been in the school canteen to check the food quality and the behaviour of children in the cafeteria. After these first actions, the Committee understood that the aim of the reduction of food waste was twofold: making the students eating better, and raising awareness among children and families on the issue of food waste.

To this end, the local health department (Azienda Sanitaria Locale, ASL) was involved to implement actions aimed at recovery the uneaten food. According to the revised national guidelines of the Italian Ministry of Health (Ministero della Salute, 2010) and to the Lombardy regional law (Antonioli et al., 1998), it was not possible to produce smaller portions of food. Given this constraint, The School Canteen Commission, started to study the best practices to reduce food waste in alternative ways. Following the same logic of the Food Recovery Hierarchy (Figure 1), the second-best solution was to transform the amount of food prepared and not consumed into a resource for all indigent families through the help of charitable and social associations of the territory. Thus, the School Canteen Commission, along with the municipal Councillor of social services and a member of the local health department decided to organize a meeting with the municipality of Calusco, a nearby

town that was experiencing a pilot project on the redistribution of school canteen leftovers. The meeting made clear to the members of the Committee and representatives of the Municipality the necessity to create a working group involving the local health authorities, the company providing the catering service, and the non-profit organizations operating in the area, already dealing with food distribution to the needy families. The main problems encountered in the town of Calusco were in fact related to misunderstandings among the company providing the canteen service and the non-profit organization managing the service. To avoid such misunderstandings, the School Canteen Committee and the Councillor for social policies of Brusaporto decided to involve in the project also the local health authorities' representatives, the representatives of the parents' committee, and the representatives of a non-profit organization that deals with local initiatives of food banking.

The first action that the local health department suggested was the monitoring of wasted food. The monitoring of food waste at the school canteen was performed for two weeks at the end of every lunch: with the active collaboration of teachers, the leftover food was weighed directly into the refectory by students, in order to understand the extent of the waste. School teachers also monitored snacks consumption (type and quantity) in each class during lessons break in the midmorning. The results of the monitoring are summarised in the Table 2: the need to implement corrective actions appeared more than evident.

	Food discarded (portions)	Food discarded (kg)
First dishes	351	72
Main courses	363	28
Side dish (vegetables)	631	63
Bread	328	16
Fruit	160	31
Total wasted food	1833	210

Average of food waste per day	153	18
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Table 2 – Results of the monitoring on food waste (10-21 November 2014)

Then, the extended stakeholder group proposed the solution which was then adopted. The opted solution prescribed to serve half portion meals with the possibility for having the other half at a second time. In this way, the food not served remains in trays without being touched. This solution allows to quantitatively reduce the portions served by continuing to respect national and regional laws on the amount of food to be served in school canteen. Moreover, this makes sure that children, at a visual level, do not feel forced to finish a large amount of food. The leftover food from the plates (i.e. already served and not consumed) instead is discarded. After lunch, canteen operators and non-profit organization volunteers organize food boxes for needy families using the unserved and still edible food.

Before starting with the implementation of the pilot project, meetings were held with the entire teaching staff to illustrate the hypothesized solution. The monitoring results and the proposed solution were then presented to the parents of the students: the major concern of the parents' committee was to guarantee children a quality service without increasing the cost of school canteen service. Students' parents have been reassured that the contractor was not gaining on the meal (parents were worried about pay for a whole meal and then having served only half the portion). To avoid misunderstandings and create awareness about the extent of the problem of food waste in the school canteen, in January 2015 several information meetings were organized to better explain the project.

Later, it was necessary to draft two new agreements between the local health department, the catering company, and the parents. At this stage, in fact, the catering company had several meetings with the local health authorities to be sure that the meals coming out of the canteen and distributed to needy families complied with the law from a sanitary point of view. The local health department support was important and decisive at this stage to resolve the bureaucratic and administrative matters guaranteeing unchanged cost for families.

In this phase of the project, the local health department also trained the volunteers of the partner association on the distribution of the food recovered from the canteen and put into food boxes. Needy families were selected by the voluntary association based on the guidance provided by the

Department for Social Policies of the municipality. Moreover, a sharing protocol on food withdrawal and delivery was signed: the volunteers need to sign a document when they withdraw a box and a recipient family member need to sign a document when the box is delivered.

Moreover, a Memorandum of Understanding was signed between the municipality, the catering company and the non-profit organization to ensure that the expectations and obligations of each party were correctly set and understood. The withdrawal operation and distribution takes place immediately at the end of the canteen service, between 14.00 and 14.30. The containers, purchased by the non-profit organization, are distributed to the needy families within 24 hours; the families return the containers clean at the time of delivery of the next meal.

It was the task of the non-profit organization to identify a number of families to whom deliver the food, with the supervision of the Councillor for social policies of the municipality. The most critical point, at this stage, was to make the families understanding that the food they got were meals prepared and never been served, not leftovers from students' dishes. Each family had to sign an agreement and commit to follow all the rules (e.g., returning the food boxes washed and cleaned, ensuring the presence of a family member at the time of the withdrawal of the food box).

In March 2015, the pilot project started, deploying half portions for children. In April, the project ramped-up to full scale operation with the distribution of the food leftovers to the needy families. Seven families, for a total of twenty-seven persons were chosen to be supported by the "Buon Samaritano" project. The distribution of the meals takes place every week alternately in order to help a larger number of families. The service is not guaranteed, sometimes there are no leftovers, other times only bread, fruit and vegetables are left. Every week, between 220 and 390 portions of food are recovered and redistributed.

For the second year of the project, the non-profit organization has decided to proceed with the purchase of a chiller to ensure that food could be distributed and consumed beyond 24 hours. The non-profit organization has started monitoring family feedbacks, who have never reported mistakes or problems, while local health authorities recorded the kilogram of food wasted in a two-week pilot testing. Monitoring throughout the year took place on the part of the Canteen Committee. As well, an improvement was included: Wednesday, fruits are distributed during the morning break.

Over the last year, monitoring was performed by weighing what was left in the dishes. Moreover, two more families were added to the network (nine families, thirty people). Given the success of the initiative, the local health department asked to the municipalities to participate in public debate

and meeting to explain to other school institutions and other municipalities the Brusaporto project. Moreover, the municipality collaborated with the researchers involved in this paper in exchange of international dissemination of the project.

Table 3 summarize all the phases of the project “Buon Samaritano”.

Phase	Period	Actions	Stakeholders involved
1	June 2014 - September 2014	<ul style="list-style-type: none"> School Canteen Commission meetings 	School Parents Municipal Councillor of the education Company providing canteen service
2	September 2014 - January 2015	<ul style="list-style-type: none"> Meeting with Calusco Municipality Monitoring wasted food Solution proposed Meeting with Teaching staff Meeting with parents 	School Parents Municipal Councillor of the education and of social policies Company providing canteen service Local health authorities
3	February 2015 - April 2015	<ul style="list-style-type: none"> Agreement protocols drawn up by the local health department with the company managing the school canteen service The local health department formed the association's volunteers Shared protocol on withdrawal of food between no-profit association and indigent families Memorandum of Understanding has been signed between the municipality, the contracting company managing canteen service and the non-profit organization Pilot project starts 	School Parents Municipal Councillor of the education and of social policies Company providing canteen service Local health authorities Non-profit organization and volunteers Needy families
4	April 2015 - June 2015	<ul style="list-style-type: none"> Project fully operational 	Same Phase 3
5	September 2015 - June 2016	<ul style="list-style-type: none"> Purchase of the chiller Monitoring 	Same Phase 3
6	September 2016 - On Going	<ul style="list-style-type: none"> Two more families acceded Public debates Monitoring 	Same Phase 3

Table 3 – Steps of the project

5. Discussion

The case study described in the previous paragraph aims to solve the problem of food waste in a school canteen with a zero-cost solution for the municipality.

There were some peculiar, contingent elements of the project that were an enabling factor for the success of the project. For instance, the presence of the International Exposition in 2015 in Milan (only 90 Km away from Brusaporto) devoted to “Feeding the planet, energy of life”, gave momentum to the debate on food and to the project. Another factor that was important to the success of the project was that the contract between the municipality and the catering company was expiring and needed to be renovated. This favoured the possibility to renegotiate the terms and introduce new practices (e.g., half portions). Still, we do not think that these factors have determined the success of the project, but it is rather how the project was managed and the collaboration of all the stakeholders the real takeaway of this study.

First of all, it can be noted the presence of two simultaneous solutions already encountered in literature: the monitoring of snacks consumed by schoolchildren with its attempt to educate children to consume more healthy snacks (Falasconi et al., 2015), and the decision to use the food cooked and not eaten to help the neediest families (Bonomi et al., 2016). Moreover, from Table 3 it is clear the gradual involvement of all stakeholders in the project, which is a key success factor highlighted in the literature (Xu et al., 2016; Bonomi et al., 2016). In fact, we observed that in the two neighbouring towns, similar projects were not implemented although the same food waste problem was noticed and discussed in the same period. The lack of implementation is due, in one case, to the lack of willingness from the school and, in the other case, to the lack of a non-profit organization in the area able or willing to manage the distribution service to needy families. Also in the municipality of Calusco, the town which had initially supported the Brusaporto administration in the early stages of the project, the project was discontinued because the school was no longer able to support the project. To ensure that the project is successful, each group of stakeholders must understand the motivations that lead to the project. Even in municipalities with few inhabitants where, apparently, it is easier the link and communication among the stakeholders, there may be problems that lead to the closing of a project. A detailed analysis of the case study evidenced that eight different stakeholders were involved.

Analysing the interviews and extracts from conferences, we can observe that despite the involved stakeholders have objectives very different from each other, the secondary interests may coincide,

or rather, those who for a stakeholder are the main objectives, for another is secondary objectives and this facilitates the discussion and the ability to find compromises (Table 4).

Stakeholders	Main Goal	Secondary Goals
Municipality	Raise awareness among children and families on the issue of food waste	Waste reduction Help needy families
School	Find solutions to make sure that children eat and better	Raise awareness among children and families on: <ul style="list-style-type: none"> • food waste and on healthy food • helping needy families
Non-profit organization	Increase the number of people helped	Raising public awareness
Parents	Increase the sense of responsibility of the children regarding food waste	Pay greater attention to the aspect related to solidarity
Local health authorities	Ensure compliance with food safety	Reduce waste by using the already cooked food

Table 4 - Main and secondary objectives of the stakeholders involved in the project

In additions, an appropriate balance between respecting the regulations and fluid approaches is necessary to meet the needs of stakeholders. It should be also underlined that the role of the municipality has given a substantial stimulus to the effective implementation of the project: while not investing monetary resources, it was able to give an administrative and bureaucratic support promoting the discussion and the link between the different stakeholders involved.

Displaying the stakeholders on a power/interest matrix (Figure 2), we can observe that the model proposed by Newcombe (2003) for an effective stakeholder's involvement was actually applied in the Buon Samaritano Project's stakeholders. We can observe that the majority of the stakeholders lies in the high power-high interest part of the matrix, thus highlighting the criticality of the project and the need to work to a satisfactory agreement for all the parties.

Next, the catering company, whose interest was in renovating the contract, is in high interest-low power. The catering company was kept informed, thus limiting its influence in the project. The parents were instead involved in the project as they have limited interest (as long as their children receive the right amount of food at a fair price), but quite high power as they could easily stop the initiative.

Finally, needy families are those with low power and (relatively) low interest. This shows that the final beneficiaries of such initiatives may have little voice in the project, and it was therefore important that these stakeholders were represented by the non-profit organisation.

Beside what is displayed in the matrix, it is also important to remind that, being a small town, many stakeholders knew each other, and the past positive experiences that they had from past collaborations were of great help in the different stages leading to the implementation of the project.

		Level of interest	
		Low	High
Power	Low	Needy families	Canteen Catering Company
	High	Parents Committee	Municipality (Instruction and social policies council member) School Local Health authority No-profit organization volunteers

Figure 2 – Buon Samaritano Project Stakeholders Matrix (Newcombe, 2003)

The strong link established between the stakeholders involved, powered by a proper use of public meetings and debates, also allowed to continue the discussion once the project was implemented. The project is monitored by the School Canteen Commission alerting other stakeholders if there are any feedbacks that interest them. Thanks to this continuous exchange of information, it was discovered that the regulation on social services has to be improved: at present, there is no precise regulation that families must follow to access the service, the system relies on reporting from social services or non-profit organization. It could be necessary a call to access the service, even though this could become a problem in the case of larger municipalities, where the number of needy families is much greater than the available meals.

6. Conclusion

The case study shows the different phases of the implementation of a food waste reduction strategy acting on multiple stakeholders in a school canteen of a small-size town. This project aimed also at addressing the education of students and their families towards a more appropriate food culture and environmental behaviours. Furthermore, the project had a concrete social outcome, directly

supporting needy families. In this way, without any additional investment and without producing waste, school canteen can nowadays serve both students and indigent families.

While the project may seem almost trivial in the proposed approach to food waste, our observations show that the development process, from the idea to the implementation, was actually quite articulated and complex, and the successful outcome is clearly related to how stakeholders and, more broadly, the project ecosystem, were well understood and managed.

In particular, we have observed that it is possible to implement a zero-cost solution for the municipality aiming to reduce food waste in school canteen. However, to achieve an effective solution, it is fundamental the involvement of all the different stakeholder that play a key role in the project. Moreover, involving all the stakeholders and making them satisfied it is not enough to explain the proposed solution clearly taking into account the different goals; it is necessary to involve them from the beginning with several dedicated and public meeting so that all doubts and misunderstandings can be addressed. Involving stakeholders on a continuous base also ensures that municipality can monitor and share possible future improvements at any time.

As a consequence, while this solution to canteen food waste may be applied to other realities in principle, the implementation process should be carefully managed with full awareness of the sets of interests at stake. Future development of the research could focus on how to extend the model to other school canteens and to the case of company canteens where a private-public partnership could be required.

Bibliography

- Antonioli, L., Bianchi, M. A., Castaldi, F., Cremona, R., Di Prampero, M., Donghi & Messina, A. M. (1998). Linee Guida della Regione Lombardia per la ristorazione scolastica.
- Aschemann-Witzel, J., de Hooge, I. E., Rohm, H., Normann, A., Bossle, M. B., Grønhøj, A., & Oostindjer, M., 2016. Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste – A multiple case study. *J.Clean. Prod.* ARTICLE IN PRESS
- Beitzen-Heineke, E. F., Balta-Ozkan, N., & Reefke, H., 2017. The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain. *J. Clean. Prod.* 140, 1528-1541.

- Blanke, M., 2015. Challenges of Reducing Fresh Produce Waste in Europe—From Farm to Fork. *Agric.* 5(3), 389-399.
- Bhattacharjee, A. 2012. *Social science research: principles, methods, and practices.*
- Bonomi, S., Moggi, S., & Ricciardi, F., 2016. Innovation for Sustainable Development by Educating the Local Community. The Case of an Italian Project of Food Waste Prevention. In *International Conference on Exploring Services Science* (pp. 705-716). Springer International Publishing.
- Brancoli, P., Roustia, K., & Bolton, K., 2017. Life cycle assessment of supermarket food waste. *Res., Conserv. Recycl.* 118, 39-46.
- Browne, J.D., Murphy, J.D., 2013. Assessment of the resource associated with biomethane from food waste. *Appl. Energy* 104, 170e177.
- Byker, C. J., Farris, A. R., Marcenelle, M., Davis, G. C., & Serrano, E. L., 2014. Food waste in a school nutrition program after implementation of new lunch program guidelines. *J. nutr. educ. behave.* 46(5), 406-411.
- Caputo, P., Clementi, M., Ducoli, C., Corsi, S., & Scudo, G., 2017. Food Chain Evaluator, a tool for analyzing the impacts and designing scenarios for the institutional catering in Lombardy (Italy). *J. Clean. Prod.* 140, 1014–1026.
- Eisenhardt, K. M., 1989. Building theories from case study research. *Acad. manag. rev.* 14(4), 532-550.
- Eriksson, M., Strid, I., & Hansson, P. A. , 2016. Food waste reduction in supermarkets—Net costs and benefits of reduced storage temperature. *Res. Conserv. Recyc.* 107, 73-81.
- European Commission (2011) “Guidelines on the preparation of food waste prevention programmes”
http://ec.europa.eu/environment/waste/prevention/pdf/prevention_guidelines.pdf accessed on 14 January 2017.
- European Commission (2015) “Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive 2008/98/EC on waste” <http://eur->

lex.europa.eu/resource.html?uri=cellar:c2b5929d-999e-11e5-b3b7-01aa75ed71a1.0018.02/DOC_1&format=PDF accessed on 14 January 2017.

European Commission (2016) "EU Platform on Food Losses and Food Waste Terms of Reference (ToR)" https://ec.europa.eu/food/sites/food/files/safety/docs/fw_eu-actions_flw-platform_tor.pdf accessed on 14 January 2017.

Falasconi, L., Vittuari, M., Politano, A., & Segrè, A., 2015. Food waste in school catering: An Italian case study. *Sustain.* 7(11), 14745-14760.

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

Ferreira, M., Liz Martins, M., & Rocha, A., 2013. Food waste as an index of foodservice quality. *Br. Food J.* 115(11), 1628-1637.

FWRA (2015) "Best practices and emerging solutions guide" http://www.foodwastealliance.org/wp-content/uploads/2013/05/2015FWRAToolkit_Web_FINAL.pdf accessed on 14 January 2017.

Haijema, R., & Minner, S., 2016. Stock-level dependent ordering of perishables: A comparison of hybrid base-stock and constant order policies. *Int. J. Prod. Econ.* 181, 215-225.

Jungbluth, N., Keller, R., & König, A., 2016. ONE TWO WE—life cycle management in canteens together with suppliers, customers and guests. *Int. J. Life Cycle Assess.* 21(5), 646-653.

Kim, Y. S., Yoon, Y. M., Kim, C. H., & Giersdorf, J., 2012. Status of biogas technologies and policies in South Korea. *Renew. Sustain. En. Rev.* 16(5), 3430-3438.

Legge 25 giugno 2003, n. 155, "Disciplina della distribuzione dei prodotti alimentari a fini di solidarietà sociale" <http://www.parlamento.it/parlam/leggi/031551.htm> accessed on 14 January 2017.

Li, H., Tian, Y., Zuo, W., Zhang, J., Pan, X., Li, L., & Su, X., 2016. Electricity generation from food wastes and characteristics of organic matters in microbial fuel cell. *Biores. tech.* 205, 104-110.

Lundie, S., & Peters, G. M., 2005. Life cycle assessment of food waste management options. *J. Clean. Prod.*, 13(3), 275–286.

Martins, M. L., Cunha, L. M., Rodrigues, S. S., & Rocha, A., 2014. Determination of plate waste in primary school lunches by weighing and visual estimation methods: A validation study. *Waste manag.* 34(8), 1362-1368.

Ministero della salute (2010), Linee di indirizzo nazionale per la ristorazione scolastica. http://www.salute.gov.it/imgs/C_17_pubblicazioni_1248_allegato.pdf accessed on 14 January 2017.

Newcombe, R., 2003. From client to project stakeholders: a stakeholder mapping approach. *Constr. Manag. Econ.*, 21:8, 841-848,

Othuman Mydin, M. A., Nik Abllah, N. F., & Ghazali, N., 2014. Development of environmental friendly mini biogas to generate electricity by means of food waste. *J.Mat. Environ. Sci.* 5(4), 1218–1223.

Ratanatamskul, C., & Saleart, T., 2016. Effects of sludge recirculation rate and mixing time on performance of a prototype single-stage anaerobic digester for conversion of food wastes to biogas and energy recovery. *Environ. Sci. Poll. Res.* 23(8), 7092–7098. <https://doi.org/10.1007/s11356-015-4448-0>

ReFed (2016). “A roadmap to reduce U.S. Food Waste by 20 percent” https://www.refed.com/downloads/ReFED_Report_2016.pdf accessed on 14 January 2017.

Regione Lombardia (2010), “Linee Guida della Regione Lombardia per la ristorazione scolastica” http://www.milanoristorazione.it/files/moduli-milanoristorazione/linee_guida_ristorazione_scolastica.pdf accessed on 14 January 2017.

Rodrigues, J., Oliveira, V., Lopes, P., & Dias-Ferreira, C., 2015. Door-to-door collection of food and kitchen waste in city centers under the framework of multimunicipal waste management systems in Portugal: the case study of Aveiro. *Waste Biomass Valoriz.* 6(5), 647-656.

Secondi, L., Principato, L., & Laureti, T., 2015. Household food waste behaviour in EU-27 countries: A multilevel analysis. *Food Pol.* 56, 25-40.

Silvennoinen, K., Heikkilä, L., Katajajuuri, J. M., & Reinikainen, A., 2015. Food waste volume and origin: Case studies in the Finnish food service sector. *Waste Manag.* 46, 140-145.

- Tagtow, A., Nguyen, J., Johnson-Bailey, D., & Schap, T. E., 2015. Food Waste Reduction Efforts at the USDA. *J. Acad. Nutr. Diet.* 115(12), 1914-1918.
- Tóth, A. J., Koller, Z., Illés, C. B., & Bittsánszky, A., 2017. Development of conscious food handling in Hungarian school cafeterias. *Food Contr.* 73, 644–649.
- Unilever (2013), “Making food go further: a joint ambition for a zero food waste in Britain” https://www.unilever.co.uk/Images/hubbub-unilever-joint-ambition_tcm1252-484757_en.pdf accessed on 14 January 2017.
- Wen, Z., Wang, Y., & De Clercq, D., 2016. What is the true value of food waste? A case study of technology integration in urban food waste treatment in Suzhou City, China. *J. Clean. Prod.* 118, 88–96.
- Xu, D. Y., Lin, Z. Y., Gordon, M. P. R., Robinson, N. K. L., & Harder, M. K., 2016. Perceived key elements of a successful residential food waste sorting program in urban apartments: stakeholder views. *J. Clean. Prod.* 134, 362–370.
- Yin, R.K., 2002., Development of environmental friendly mini biogas to generate electricity by means of food waste. *J. Mat. Environ. Sci.* 5(4), 1218–1223.