

1222·2022
800
ANNI



UNIVERSITÀ
DEGLI STUDI
DI PADOVA

Università degli Studi di Padova

Dipartimento di Scienze Storiche, Geografiche e dell'Antichità

Department of Philosophy, Sociology, Education & Applied Psychology (FISPPA)
Section of Sociology

Corso di Laurea Magistrale in Local Development

Active learning toward food-waste prevention: an
educational program for college students

Supervisor: Prof. Francesca Gambarotto

Candidate: Beatrice Fontana

Registr. number: 2022571

ACADEMIC YEAR 2021/2022

INDEX

Abstract.....	5
1. PREFACE: the predicament of mankind and system dynamics	7
1.1 Limits to growth.....	7
1.2 The challenge to feed a growing population	9
2. THEORY	12
2.1 Sustainability literacy	12
2.2 Food Production and Food Systems.....	16
2.2.1 Food Production.....	16
2.2.2 Food Systems	19
2.3. Food loss & waste: drivers and solutions.....	20
2.3.1 Food Loss and Waste.....	20
2.3.2. Drivers and solutions	23
2.4 The need of a change in consumers' behavior	28
2.5 Conclusions	34
3. LITERATURE BACKGROUND on households' food waste	35
3.1 Consumers' awareness about food waste, and academic literature.....	35
3.2 The household's food waste: the state of the analysis.....	38
3.3 Have institutions and organizations effectively engaged in the fight against household food waste?	41
3.3.1. International Level	43
3.3.2 Country Level.....	45
3.3.3 Local level	48
3.3.4 Present or future?	50
3.4 Conclusions	51
4. PROJECT PROPOSAL	53
4.1 Interventions and Active Learning	54
4.2 Project Proposal & Methodology	56
4.2.1 Theoretical interventions	60
4.2.2. Practical interventions.....	67
5. CONCLUSIONS	72
5.1 Past, present, and future of a worldwide challenge	72
Bibliography and sitography	76
Annex 1	83
Annex 2	87

Abstract

According to the World Bank and FAO, almost 30% of the total amount of food produced is lost or wasted along the food supply chain (FSC), meaning that around 1.3 billion tonnes of food per year do not reach the final consumers.

These data denote the need for immediate and resolute interventions. Food waste implies numerous consequences, such as diffused hunger, unfair food distribution, or elevated GHG emissions, affecting our society in every aspect of sustainability.

Despite being a worldwide issue, data are often ambiguous, due to their complexity and a diffused lack of knowledge. Developed countries (i.e. North America and Europe) generally observe a higher amount of food waste, which notably occurs at a micro level within households. Studies have tried to understand the causes of such approaches toward food, and despite the lack of shared definitions, the reasons lay usually in wrong habits, lack of awareness, lack of culinary skills, etc.

Consequently, reasonable solutions are interventions to spur behavioral change and a higher level of awareness toward this issue. This work will focus, therefore, on the design of a project proposal to support university students in reducing and preventing their food waste practices.

Secondo quanto riportato dalla Banca Mondiale e dalla FAO, circa il 30% di tutto il cibo che viene prodotto finisce per essere perso o sprecato lungo i diversi step della filiera alimentare, ciò significa che circa 1.3 milioni di tonnellate di cibo ogni anno non raggiungono i consumatori finali.

Questi dati sottolineano il bisogno di un aiuto immediato e di interventi decisi.

Lo spreco alimentare infatti genera una serie di conseguenze, come possono essere la fame diffusa, una distribuzione del cibo non egualitaria, ma anche elevate emissioni di gas serra che vanno ad impattare la nostra società in ogni aspetto della sostenibilità.

Nonostante la sua importanza a livello globale, i dati in merito sono spesso incerti, per lo più a causa della complessità che li caratterizza e della mancanza di una conoscenza diffusa e condivisa del tema. Nei paesi sviluppati come possono essere l'Europa o gli Stati Uniti, si osserva in genere una maggiore quantità di spreco alimentare che si registra, per la maggior parte, a livello micro e quindi all'interno delle singole abitazioni.

Diversi studi hanno provato a capire le cause e i motivi di questo approccio inappropriato verso il cibo, e nonostante la mancanza di definizioni condivise le ragioni maggiormente citate risultano essere abitudini sbagliate, mancanza di consapevolezza, insufficienti doti culinarie, etc.

Di conseguenza, le possibili soluzioni che vengono considerate per combattere questo problema coinvolgono interventi per indurre un cambiamento comportamentale e per generare una maggior consapevolezza sul tema. L'attenzione di questo lavoro verrà focalizzata quindi sul design di una proposta di intervento per supportare gli studenti universitari nel ridurre e prevenire le attività che generano maggior spreco.

1. Preface: the predicament of mankind and system dynamics

1.1 Limits to growth

The Earth we live in can be considered as a system and as such, it is made up of inputs and outputs.

Inputs can be described as the resources necessary to protract and advance the society, outputs as the results of the activities necessary. However, the resources we have been relying on for centuries, are not limitless and an uncontrolled growth, that has been many times wished for in the past, is not sustainable¹.

Sustainability is a very diffused and overused term nowadays, however, within its framework already moved in 1968 (Leone, 2018) Aurelio Peccei, an Italian industrialist that, together with Alexander King the OECD Head of Science at that time, funded the Club of Rome. This association, still active nowadays, was a gathering of scientists, driven by the aim to shed light and develop solutions to some of the most impelling “predicament of mankind” (Club of Rome, n.d.).

Their first meetings, held in Rome exactly 50 years ago in 1972, unfold the book entitled “The Limits to Growth” which created “media controversy and also impetus for the global sustainability movement” (Club of Rome, n.d.). In this report, which is incredibly actual, they highlighted “five major trends of global concern” namely “accelerating industrialization, rapid population growth, widespread malnutrition, depletion of non-reusable resources and deteriorating environment” (Meadows et al., 1972, p. 21). Despite in the ‘70s the concept of sustainable development was at its glare (Sustainability for all, n.d.), these issues were considered as the most relevant to be addressed in order to develop a better world under the environmental, social, and economic aspects which would have become the main pillars of sustainability as known today.

In defining them, Meadows et al. (1972) also introduced the concept of exponential growth. The description given to this measure in the book refers to a quantity that “increases by a constant percentage of the whole in a constant time period” (*Ibidem*, p. 27) and it can be identified as a common process of many different systems, e.g. biological, financial, etc. In social sciences, however, it has mainly been related to the “second concern” of those listed by the Club of Rome, namely, population growth. Indeed, after a slow start, it registered a very

¹ The definition of sustainability and all its implications, used in this work is the one given in the UN Report Our Common Future, also known as the Brundtland Report, which was also concerned with the continuous growth of population and the need of resources (1987) and reported hereafter: “sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs”, (Our Common Future, 1987. UN. p. 15)

rapid increase. Meadows et al. (1972) in defining the process of exponential growth also introduced the concept of “doubling time” (p. 29), meaning that, the world population which, in 1650 grew by 0.3% per year would have doubled in 250 years. At the same pace, it reached, in 1970, a growing percentage of 2.1, meaning 3.6 billion people on earth and a doubling time of 33 years. (Meadows et al., 1972). This trend has not stopped since, and according to the UN, current estimates project an ever-smaller doubling time which would bring the world population up to 11 billion by 2100 (UN, 2022).

This extreme, and relatively sudden, increase in population has brought and undoubtedly will bring many consequences along.

The Earth, we have seen, develops from a sophisticated mix of elements, and a deep understanding of the various intercurrent dynamics, generating many different challenges to be faced at the same time, is extremely complicated.

During the ‘50s, the work of the engineer and scientist Jay Forrester at MIT (Yearworth, 2014), established a new modeling system, which would have been able to help in describing and “understanding the dynamic behavior of complex systems” (Meadows et al., 1972, p. 31), the so-called System Dynamics.

According to this method, everything is interrelated, and the structure of a system must be considered as important as the single components. Changes are usually considered in relation to the positive or negative feedback loops. The firsts are “chain of cause-and-effect relationships” (Meadows et al., 1972, p. 31) that close on themselves meaning that an increase in one element will cause cascade effects on other elements ending up in a further increase of the original element (Meadows et al., 1972). On the other hand, there are negative feedback loops that are necessary to “regulate and hold a system stable” (Meadows et al. 1972, p. 35).

In this manner, it appears straightforward how important is it to have a holistic perspective and an open mindset to truly get the complexity of our world and be able to develop a long-term sustainable future.

1.2 The challenge to feed a growing population

As perceivable by the trends identified in the book “The Limits to Growth” (Meadows et al., 1972), feeding an ever-growing population was already considered as one of the most challenging dilemmas of the society of that time.

Food, indeed, is crucial for any individual to “lead active and healthy lives” (McDonald, Food Security, 2010, p. 1), thus since the switch from being hunter-gatherers to being agriculture and livestock producers, men have always tried to control and use natural resources to satisfy this

need. The role played by food within the society, however, has changed over the centuries, and now, in many places, especially in developed and industrialized countries, it has shifted toward “consumption beyond mere subsistence” (Higgs, 2021, para. 5).

Still, food insecurity, defined by FAO as a situation in which “A person [...] lack regular access to enough safe and nutritious food for normal growth and an active and healthy life” suggesting the reasons for this to happen may vary from the “unavailability of food and/or lack of resources to obtain food”, remains in various parts of the world an unsolved challenge which needs to be addressed by current political agendas.

In 2000, with the ratification of the Millennium Declarations, the UN set eight development goals to be achieved by 2015 with the objective to support a sustainable development and improve living conditions for many. Among the declared targets there was, according to the WHO (2018) the eradication of “extreme poverty and hunger”. According to the data reported, between 1990 and 2013, the “proportion of underweight children in developing countries has declined from 28% to 17%” (WHO, 2018), despite these improvements much still needs to be done. Afterward, the objective of defeating hunger was also set as a goal among the 17 Sustainable Development Goals established during the UN General Assembly in 2015 as part of the bigger project 2030 Agenda for Sustainable Development.

Besides SDG number 2, specifically battling famine and undernourishment (No Hunger), several other goals have the intention and contribute to ending food insecurity (1, 3, 10, 12, 13, 16). However, the path toward the achievement of these objectives set for 2030 still seems as long and complex.

Until recently, the main practices to assure food for everyone have involved an increase in productivity, a “solution” which however has only contributed to enhancing the pressure on the environment and natural resources (according to the World Resources Institute (n.d.) the intensive production of food to feed the world population accounts for 25% of global greenhouse gas emissions), not to mention the related social and economic issues.

As reported in FAO Statistical Yearbook (2021), with reference to the period from 2000 to 2019, production of food commodities has increased steadily, with primary crop production registering an increase of 53%, meat production of 44%, and vegetable oils of 118%.

The belief that an increase in food supply cannot represent the solution to end famines and starvation all over the world should however be shared knowledge since the ‘80s, at least among the scientific community. Indeed, it was already in 1981 that Nobel Prize Amartya Sen

suggested an alternative conception of starvation seen as “a function of entitlements² and not of food availability as such.” (Sen, 1981, p. 7).

Therefore, in accordance with Sen’s assumption, the condition of starvation is due to “entitlements” and their relationships and exchanges.

“ [...] the latter 'legitimizes' one set of ownership by reference to another, or to some basic entitlement in the form of enjoying the fruits of one's own labour.” (Sen, 1981, p. 2). In this framework, subjects more prone to suffer starvation are those whose entitlement sets do not directly include food.

Therefore, says Sen, it could not be enough to earn money from labour, because it is deeply influenced by price fluctuations. To this, however, must be added the complexity of the fact that we live in a system functioning through economic market structures and positions, often generating inequalities. As a consequence, people who, as above-mentioned, do not own entitlements directly linked to food, need to exchange something for it and these exchanges’ conditions may become unbearable due to external factors.

Related to this, it is also interesting to notice that starvation does not usually take place in developed and rich countries. This does not mean, however, that there are no poor people in those countries, but more easily that they (developed nations) have developed a security system in which the State intervenes to assure people with “minimum values of exchange entitlements” (Sen, 1981, p. 7), assuring them the opportunity, at least, of feeding themselves and their families.

This concept of starvation and the definition given by Sen, according to which it does not derive from an absolute absence of food though to the entitlements owned by people, support another issue hounding society for many years, the concept of relative and absolute poverty. Indeed, poverty cannot be considered as the same everywhere in the world. According to Foster, two elements are used in describing poverty namely the “threshold”, and the “equivalence scale” (Foster, 1998, p. 336). The most commonly known is the first which identifies a level under which people are considered to be poor. According to this standard, poverty can be absolute or relative. In the first case, it is a fixed level defining the absolute poverty, however, this measure as suggested by the term does not adapt to the changes in economy and society, or to different geographical and demographical contexts possibly generating, therefore, misguided interpretation of social conditions. The second concept refers instead to a mobile standard developed through the use of “current data” (Foster, 1998, p. 336), which of course is more adaptive and enables a more accurate identification of poverty within specific situations.

² “In institutional economics, a relationship, such as ownership or leasehold, to an asset or a stream of income, as distinct from the income or asset itself.” OECD, 2005 (updated 2013, accessed 25/06/2022)

That being said, other evidence that increasing production cannot be the answer to a growing population in need of food is given by the fact that “nearly 40% of all food produced never makes it into mouths that need it” (Hensel, 2022, para.2). Thus, as also expected and reported by FAO already in 1981 (as cited in Munesue et al. 2014, p. 45) “reducing postharvest losses” could represent an alternative as it “requires fewer resources and applies less pressure to the environment in maintaining the quantity and quality of food than through increased production to offset postharvest”.

The issue of food loss and waste appears, therefore, more crucial than ever, highlighting the need to actively address the problem of an overproduction resulting in being not effectively useful in tackling the problem of global food insecurity.

Despite its importance, only recently have social sciences started to pay attention to this problem and its related consequences which, indeed, affect all the three pillars of sustainability, namely, economic, environmental, and societal. In 2013 Evans, Campbell and Murcott still defined food waste as a “compelling and yet hugely under-researched area of interest for social scientists” (2013, p. 5).

The reasons for this neglect may stem from various cultural, sociological but also economic causes as well as from “negative connotations” (Evans et al., 2013, p. 7) that have been associated with the practice of food waste in the past.

In these circumstances, this work will have the aim to produce a deeper analysis of how food production and food systems are structured paying specific attention to the topic of food waste, within the broader framework of sustainability. An analysis of the actors involved, and the food-related behaviors implied in the food waste issue will then constitute the theoretical basis for the design of a concrete intervention proposal dedicated to the students of the university of Padua to increase their awareness and prevent wasteful practices.

2. Theory

2.1 Sustainability literacy

As hard as it may be for us to think of a past in which the word sustainability was not the commonplace, that was a matter of fact until quite recently.

Mankind has been developing for centuries with one goal, to survive and flourish. To do this, natural resources have been exploited without restraint for centuries, up to when evidence started to reveal that with such rhythms, we (as a species) would not have survived for long.

Nowadays, terms such as sustainability and/or sustainable development have become part of our everyday lives. Despite they have first come to the fore of the public opinion between the end of the '70s and the beginning of the '80s, it was only in the early '90s that, international organizations and governments started to consider these issues in their policy agendas; and, especially after the Earth Summit held in Rio de Janeiro in 1992, where “ [...] governments agreed on that human development aspirations and the capacity of the environment to support them were on a collision course” (Parkin et al., 2004, p. 5). Results of the summit pointed out the necessity of a shift in the mindset and attitude of men toward the natural resources.

It was within this framework that developed the concept according to which people should not only pursue their own needs but, in doing so they should also think about the needs of the future generations assuring them, therefore, with livable conditions.

Yet, we had to wait until the first years of the new century to witness the first attempts of sharing competencies and knowledge on the topic.

As suggested by Caradonna (2014) “Nearly all definitions of sustainability that have circulated in recent years emphasize an ecological point of view [...]” (p. 8), however, the model which became the most established among the different institutions and organizations, “is a tripartite Venn diagram that illustrates the interconnectedness of the ‘three Es’: environment, economy and equity or social equality” (Caradonna, 2014, p. 8).

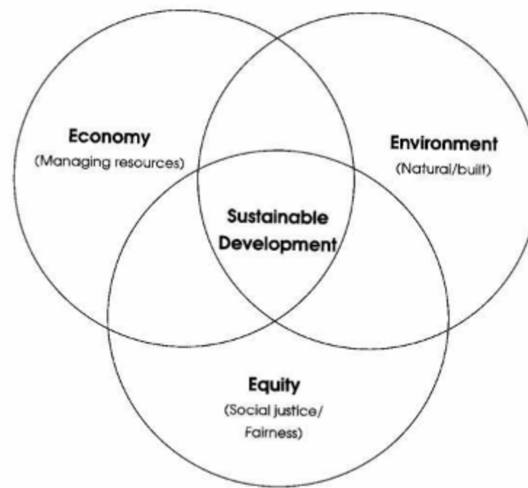


Figure 1: Venn diagram of sustainability/ sustainable development. Source: Salite and Pipere, 2006, p. 16

This tripartition and interconnection among different spheres, sometimes even contrasting with each other, is typical of the Anthropocene³ and did characterize the evolution of human activities. However, as stated by Parkin et al. we as humankind developed “pursuing our economic, social and environmental goals separately”, peculiarity “that has resulted in repeated tradeoffs between goals” (Parkin, et al., 2004, p. 5)

Yet, still nowadays it seems to be extremely arduous for the majority of us to understand the need for a holistic perspective, considering all these aspects together in order to effectively face the challenges of our world.

Hence, what do we consider as a sustainable society?

Firstly, when referring to a sustainable society, a long-term perspective must be embraced. As cited in Caradonna, indeed, “The idea that a society should plan for the future - that it should not ‘mortgage its future’ or create undue burdens on future humans – is part of the ethical consciousness of sustainability” (2014, p. 15). Besides, Van de Kerk and Manuel stated that a sustainable society, also in accordance with the Brundtland report, must enable present generations to meet their needs without compromising the future generations to do the same since everyone must have “the opportunity to develop itself in freedom, within a well-balanced society and in harmony with its surroundings.” (Van de Kerk & Manuel, 2008, p.229).

What has been said highlights how sustainable development should represent more than the mere environmentalist concern, aiming instead at the creation of a new society with actors more aware of their role within this global complexity. Indeed, as reported by Asatani et al. (2020),

³ “ [...] unofficial unit of geologic time, used to describe the most recent period in Earth’s history when human activity started to have a significant impact on the planet’s climate and ecosystems” (National Geographic Society, 2022, accessed on 18/06/2022)

other considerations to be taken into account when referring to a sustainable society attain to the complexity of the topic. As emerged in their meta-analysis the most diverse subjects can be involved and “scientists in various research fields have paid attention to sustainability” (Asatani, et al., 2020, p. 5. See *Fig. 2*).

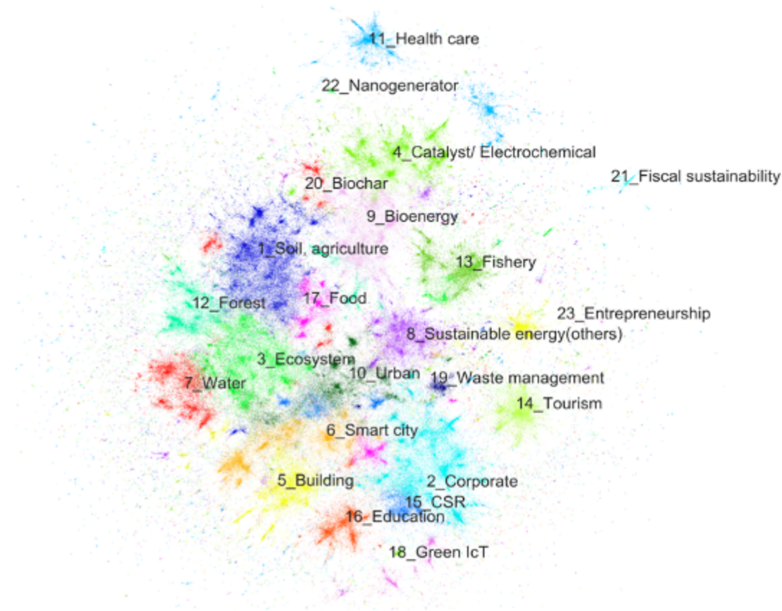


Figure 2: Clusters of papers in which sustainable/ sustainability terms have been found. Source Asatani, et al., 2020, p.6

Complexity is therefore a crucial point when dealing with sustainability and the development of sustainable society.

In the last decades the general level of attention toward these convoluted, though revolutionary, concepts has drastically increased, a trend easily tracked by the numbers of citations reported of the term sustainability in books, reports, and more recently on the web.

To this concern, Caradonna (2014) states that before 1976 any book had this term within the title, a statement furtherly confirmed by the article, already mentioned, by Asatani et al. (2020). The authors, in fact, sure of the central role played by scientific research in the achievement of a sustainable society have “analyzed over 300,000 publications concerned with sustainability by using citation network analysis and natural language processing” (Asatani, et al., 2020, p.1). Results of their research that focused on the papers “that explicitly used the terms “sustainability” or “sustainable”” (Idem), showed a drastic increase in the last decades of the number of publications containing, and therefore, dealing with this concept. Data are reported in *Fig. 3*.

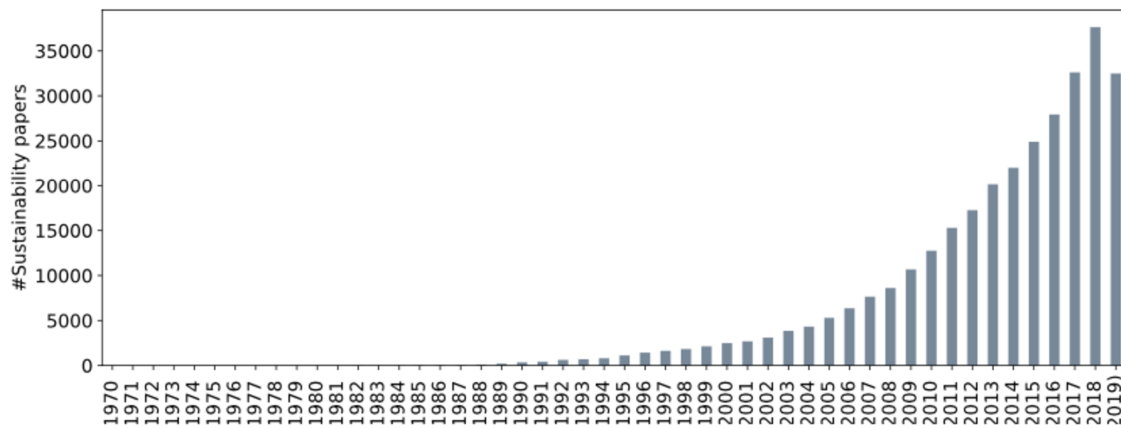


Figure 3 Number of papers including the term sustainable or sustainability. Source Asatani, et al., 2020, p. 3

This indicates the great concern grown around the concept, which does not only involve the international organizations and governments but also private firms and economic sectors. However, despite such a diffusion, not many professionals are truly aware of its deep and holistic meaning, nor of the imperative multidisciplinary approach to deal with it.

In relation to this, another concept known as ‘sustainability literacy’, has recently been introduced in the political agendas of both public and private stakeholders. According to the definition given by the UN it can be interpreted as the “knowledge, skills and mindsets that allow individuals to become deeply committed to building a sustainable future and assisting in making informed and effective decisions to this end” (UN, n.d.).

Parkin et al. explained it through three points reporting the characteristics that a sustainability literate person is expected to have (2004, p. 9):

1. Understand the need for change to a sustainable way of doing things, individually and collectively
2. Have sufficient knowledge and skills to decide and act in a way that favours sustainable development
3. Be able to recognise and reward other people’s decisions and actions that favour sustainable development.

First references to this term and concept date back to the beginning of the 2000s, since when several procedures have been undertaken toward the achievement of a more concrete and deeper understanding of sustainability, whatever the context.

Sustainability literacy must be noted, as the aforementioned points suggest, is not strictly related to one specific scope or generation.

Indeed, the current youth that will be an active part of the future society must be aware of the world's complexity and of the necessity to have a multidisciplinary approach, nevertheless, it is also decisive, to this scope, that current decision makers are knowledgeable and prepared on the topic too.

To this end have been moving, for years, international organizations, governments, and institutions. Among the others, the UN has been playing a crucial role. Immediately after the Rio+20 Summit (also known as the United Nations Conference on Sustainable Development), where it was decided “to launch a process to develop a set of Sustainable Development Goals (SDGs), which will build upon the Millennium Development Goals and converge with the post-2015 development agenda” (UN, n.d., para. 2), the UN supported the creation of the Sulitest platform, a tool generated by the “need to develop tools to help organizations raise awareness, assess and improve global knowledge on Sustainable Development and Corporate Social Responsibility” (Sulitest, n.d., para. 1). and which aim was and still is to deliver “an easy to use, online, multiple-choice assessment platform, consisting of a set of questions identical for all users throughout the world, and other specialized modules that consider national, regional and cultural realities” (UN, n.d., para. 2).

It is not devoted to just one type of public, instead, it has the aim to “empower engaged and responsible global citizens” (Sulitest, n.d., para. 2) from decision makers down to students, so that they can make informed choices. The tools provided to raise awareness are various and adaptable to different fields and contexts (test, quiz, looping, premium) (Sulitest, n.d.).

This is only a very explicative example of the alternative means that have been developed over the years to improve the knowledge on sustainability issues, with the hope to grow a sense of community among the society toward a more equal future.

2.2 Food Production and Food Systems

2.2.1 Food Production

As already said in the introduction, food is the power of life. Without the correct nutriment, people would not be able to live and perform the activities that allowed our society to flourish along the centuries. Food plays therefore a central role in human development, both in a physical and in a more abstract sense. In the following analysis, a more socio-economic and anthropological perspective will be undertaken, upon the certainty that the relationship of men with food not only is determined by physical needs but also by cultural, economic, and behavioral aspects (Fischler, 1988) highlighting, therefore, a certain level of complexity.

Shortages and undernutrition have always accompanied the relationship between men and food, however, in the last centuries this link has become harsher with an ever-growing population and natural resources essential to the production of food starting to burn out consequently making daily food availability a privilege for few.

Along the years, many terms have been related to the above-mentioned conditions, leading, however, to confusion and a reduced level of knowledge among the public opinion, which is often pelted by manifold, and frequently misused, definitions such those of hunger, undernourishment, food insecurity, etc.

These terms, indeed, refer to different concepts (FAO, n.d.):

Hunger has been defined as “an uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy. It becomes chronic when the person does not consume a sufficient amount of calories (dietary energy) on a regular basis to lead a normal, active and healthy life”. Given that “FAO has used the Prevalence of Undernourishment indicator to measure the extent of hunger in the world, [...]”, the problem of undernourishment has often been used as a synonym for hunger, although not indicating the same conditions.

Food insecurity, in turn, is a broader concept stemming from a number of different elements, defining a condition in which people “lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life [...]”, “[...] This may be due to unavailability of food and/or lack of resources to obtain food. Food insecurity can be experienced at different levels of severity” (FAO, n.d., para 3,4). This situation is measured through the Food Insecurity Experience Scale (FIES), which assesses the four essential elements defining food security, namely, availability, access, utilization, and stability. Still, according to FAO, it can be classified as severe or moderate.

Despite only recently did FAO start to collect FIES data, according to the report “The State of Food Security and Nutrition in the World 2021”, from 2014 (first measurements) to 2020, food insecurity has grown worldwide depicting serious conditions all around the world, and especially in the African countries (*Fig.4*).

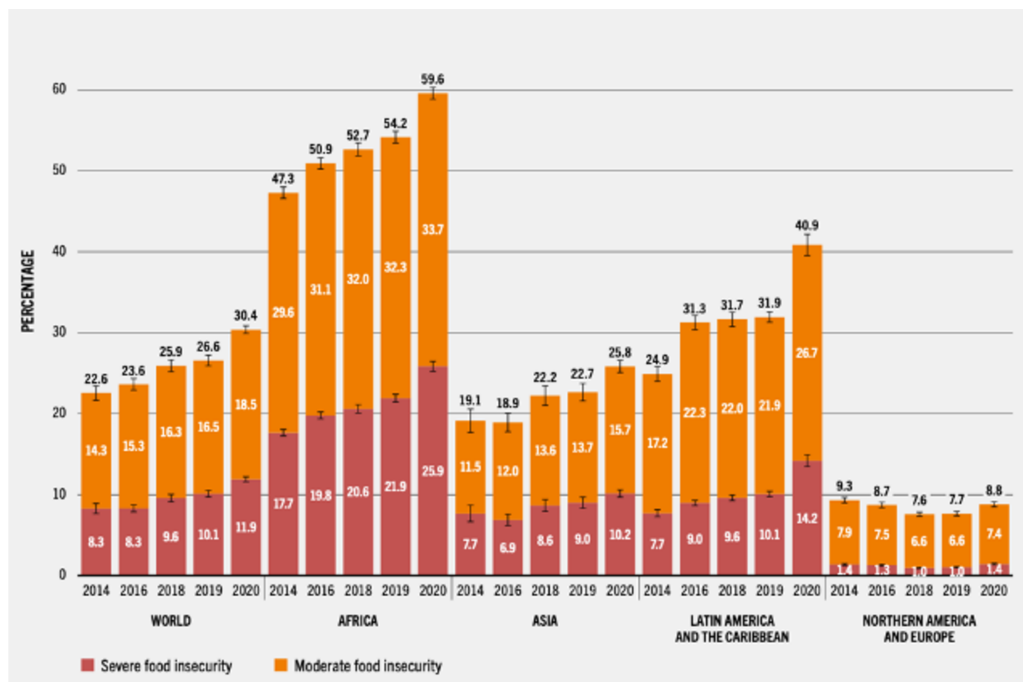


Figure 4 Moderate and severe food insecurity Source: FAO, IFAD, UNICEF, WFP and WHO. 2021 *The State of Food Security and Nutrition in the world*, p.19

Being the need to feed a growing population one of the greater concerns of the last century, international organizations and institutions have tried to implement measures to fulfill it, however, often addressing the problem from the wrong angle.

The UN has repeatedly put the end of hunger among the declared objectives of the MDGs first and of the SDGs after, nonetheless, the undertaken path toward these achievements has been misleading, and data suggest that what had been forecasted for 2030 will unlikely be accomplished.

As reported by Da Silva (2012, para. 7), “According to estimates compiled by the Food and Agriculture Organization (FAO), by 2050 we will need to produce 60 per cent more food to feed a world population of 9.3 billion”, however, this could not be sustainable with the actual production practices. Agriculture, together with livestock, are indeed cause of huge impacts on the environment.

Already in 1999, within his article “Global environmental impacts of agriculture expansion: the need for sustainable and efficient practices” David Tilman, was shedding light on this issue, reporting that an increase in grain production had already taken place.

Wheat, rice, and maize, occupied in 1999 “67 million hectares, 140 million hectares, 151 million hectares, and 230 million hectares, each, worldwide, which is 39.8% of global cropland” (Tilman, 1999, p. 5995). Hence, it was already difficult to imagine a further increase in production without considering the compromise of the global environment and “non-agricultural ecosystems” (*Idem*).

According to Ritchie and Roser (Our World in Data, 2020), the most diffused impacts related to an additional increase in food production, would be greenhouse gas emissions, land use, freshwater withdrawals, ocean, and freshwater eutrophication, and biodiversity loss.

With these premises, it appears straightforward, that even in the framework of a green revolution, as supported by the UN and other organizations, an increase in production would not be sustainable for our planet and our society.

From these developmental patterns emerged the question whether it exists an alternative way to feed people without the necessity to increase the agricultural production with all the implications or not.

The answer would of course entail a complex and crooked path, however, through a drastic change in the food system, and consumption patterns characterizing our society, more sustainable and equal conditions could be achieved.

2.2.2 Food Systems

When dealing with food systems we should be aware of the complexity of the topic in discussion.

“A system is a set of things – people, cells, molecules, or whatever – interconnected in such a way that they produce their own pattern of behavior over time. The system may be buffeted, constricted, triggered, or driven by outside forces. But the system’s response to these forces is characteristic of itself, and that response is seldom simple in real world.” (Meadows, 2008, p. 2).

As suggested by Parsons et al. (2019) the definitions given to the concept of food system have been various, perhaps by reason of their presence “at different scales: global, regional, national and local” (von Braun et al., 2021, p. 1).

The most diffused definition, however, describes it as not only including “[...] the basic elements of how we get our food from farm to fork, but also all of the processes and infrastructure involved in feeding a population.” (University of Oxford, n.d.).

Still, according to Parsons et al. food systems are influenced by drivers, which “push or pull the chain.” (2019, p. 1), these can include different spheres of our society, “[...] from technology to demography, soil health, to urbanization, policy frameworks to people’s incomes.” (*Idem*) which, as easily conceivable, are linked to sustainability in all its pillars (economic, environmental and societal).

Indeed, a sustainable food system is depicted by FAO as the “[...] one that contributes to food security and nutrition for all in such a way that the economic, social, cultural, and environmental

bases to generate food security and nutrition for future generations are safeguarded.” (Von Braun et al., 2021, p. 4).

Food systems have been changing over the centuries following the habits and needs of an evolving society, however, in the last decades a new “worldwide momentum” has been registered to drive “[...] consumption and production patterns together to achieve a sustainable development.” (Von Braun et al., 2021, p. 2).

Given these premises, the next section will assign particular attention to the growing issue of food waste, its reasons, consequences, and possible alternatives.

2.3. Food loss & waste: drivers and solutions

2.3.1 Food Loss and Waste

To achieve a sustainable food system, as described above, increasing the production is not the most preferable solution. Instead, what is needed is a deep change within the current economic and food systems patterns. As suggested by the renowned Ellen MacArthur Foundation, to achieve a more sustainable society, we should shift from the actual linear consumption model to a circular one. In relation to food systems, this means a better waste management and the prevention of tons of food getting lost or wasted along the food supply chain (FSC).

This concern about the extent of food waste comes from numbers. Indeed, as firstly published by FAO in 2011, in the report *Global Food Losses and Waste*, data showed a diffused critical situation where almost 1/3 of the total amount of food produced is lost or wasted along the supply chain, a condition furtherly confirmed by the latest UNEP report (2021) which sets the percentage of food that doesn't reach the table of consumers to 14%.

According to the IPES (2019, as cited in Teigiserova et al. (2020)) only in Europe, food produced and wasted accounts for the 20%, of the total production, with an overall cost for the society of 143 billion euros per year. This situation undoubtedly brings along many consequences, not only related to food security but also to the misuse of natural resources and the unnecessary consumption of production inputs, such as land or water. Stemming costs, therefore, are related not only to the economic sphere with direct income losses for farmers or excessive expenses for consumers, but also to negative externalities for which the entire society must pay, linked therefore to the environmental and societal spheres, such as the waste of natural resources or the environmental impacts.

Despite the relevance of this issue, related research interest is only at the beginning with confusion and lack of knowledge still predominant, not only among the public opinion but also at higher scales among decision-makers.

This situation may stem from various reasons, one of the most reliable is the lack of precise data which in turn depends on confusion about the terms.

Indeed, referring to food waste, more attention must be paid to the several definitions that have been used to describe sometimes the same action and some others different ones.

A very important, though, sometimes underrated distinction must be done already between edible and non-edible food. Indeed, there are some foods, or parts of them which for nature are not good for human consumption, e.g., bones, some seeds or peels, etc., and are, therefore “bound to become waste” (Teigiserova et al., 2020, p. 5). With the difference between edible and non-edible in mind, a further subdivision among surplus food, food loss, and waste can be performed.

Huang et al., define surplus food as a problem of “post-harvest oversupply” (2020, p. 3). The reasons behind this may be manifold, among others the authors suggest overproduction, excessive import, weather conditions, and also market prices (Huang et al., 2020).

The deriving redundancy generally ends up becoming waste, both because most of the food is highly perishable, meaning it gets rotten very easily if not well stored, and because it does not even reach the consumers.

Despite playing a role in the amount of food that is produced and not consumed, surplus food is not very commonly known.

Food waste and loss (FWL), on the other hand, are more common terms, also among the public opinion. Nevertheless, there is still much confusion about their meanings as well which often end up being misused as they were synonyms.

Shared definitions of food loss refer to the food “that is wasted during post-harvest processing or transportation of agricultural products at an early stage of the food supply chain” (Huang et al. 2020, p.3), not reaching the final phase of selling and consumption, while food waste is, according to the definition given by FAO, the “wholesome edible material intended for human consumption, arising at any point in the FSC that is instead discarded, lost, degraded or consumed by pests” (FAO 1981, as cited in Papargyropoulou et al. 2014, p. 108). For clarity, within this thesis the reference will be done to food waste.

Teigiserova et al. (2020) adopted the concept of “waste hierarchy” (*Fig.5*), to better subdivide the abovementioned classification and the related possible alternative practices.

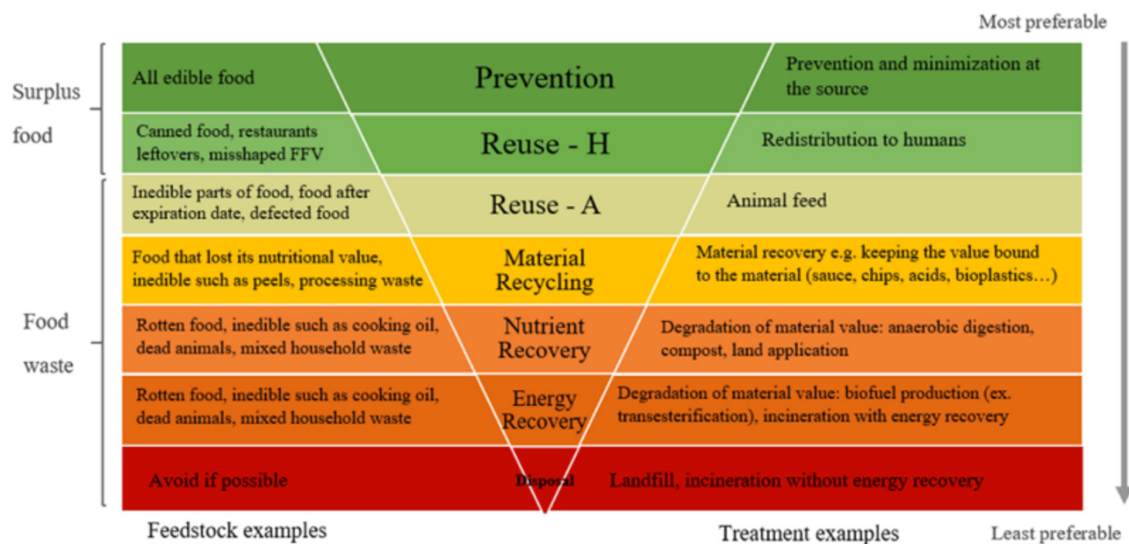


Figure 5 Waste Hierarchy. Source; Teigiserova et al. 2020, p. 5

According to this graph, the amount of alternative uses for food wastes diverse from the disposal, which above all is the least preferable, appears evident. In general terms on top of the pyramid can be seen the option “prevention”, which is deeply conditional to the level of knowledge and awareness. Besides, it appears clear that in a circular economics perspective also food wastes can be reused in different ways, from charity to animal pasture, but also in terms of energy production. Complexities however involve the whole chain, making it more difficult for many to adopt certain sustainable practices rather than others, less sustainable though more profitable. An example can be found in the paper “A theory-based evaluation of food waste policy: Evidence from Italy” written by Simone Buseti, where the author explained the intricacy of laws concerning donations, that led many supermarkets and the food industry in general, toward the waste rather than alternative uses of food still edible, though not good to be sold. In this framework, Buseti introduced the example of the law 166/2016 which streamlined the bureaucratic procedures and the possibility of “donating food after the BBD” (Busetti, 2019, p.3). Indeed, before this law, donation procedures implied several practices, such as the communication to the fiscal authority five days in advance of what should be donated, which made this action particularly expensive, driving many retailers toward the disposal or recycling of food surplus, which became wasted.

Despite the studies conducted on these issues in the last decades, a definitive compliance on the definitions is not shared yet and many authors still give different, even if slightly, descriptions of the abovementioned situations, contributing to the difficulty of gathering effective data on the subject.

It might be hard to believe but it is at consumer level of the food supply chain where most of the food waste takes place. In her article, citing UNEP Food Waste Index Report 2021, Hensel reports that of the “931 million tons of global food waste that was generated in 2019, 61% came from households, 26% from foodservice, and 13% from retail” (Hensel, 2022, para. 11).

Thus, the focus of this thesis will be on the micro level of food waste, “identified by the Committee on World Food Security’s High Panel of Experts investigating FW and losses” as that “directly resulting from individual actions at each particular FSC segment” (Canali et al., 2016, p. 22).

It appears evident at this point that to better address this crisis we should consider consumers and their habits. Why does so much food gets wasted in private households? What and how can consumer habits be addressed to develop more sustainable practices?

2.3.2. Drivers and solutions

Before looking for alternative food-related behaviors and solutions to waste prevention, it is important to analyze the context and understand the causes leading to such a wasteful approach. Despite, as previously stated, food is lost and wasted throughout the whole FSC it is also true that it is in households that most of the edible food is discarded before time. More specifically reference will be to the definition given by Gaiani et al. who describe household food waste as that “occurring between acquisition (house-gate) and food preparation, food preparation and food serving and after food serving (plate waste)” (2017, p.17).

To have a better understanding and develop more specific and customized strategies to reduce or prevent these wastes, an ever-growing branch of literature is focusing on what lies behind these waste practices, trying to identify the most relevant drivers that cause food waste among consumers.

Sure thing, food is a very particular good, and related activities are deeply rooted within the local cultures, but also very much dependent on individuals’ preferences, making it difficult sometimes to find a general rule to identify what is a waste or not, e.g., for someone fruits or vegetable peels are considered a part to discard, while for someone else they are edible and eat them. Therefore, to have a comprehensive view of food-related practices, a broad multidisciplinary approach is needed, considering not only economic reasons for specific approaches to food but also cultural and behavioral motives.

The intricacy, characterizing the drivers of food waste is also a reason accountable for the lack of “reliable quantitative data” (Gaiani et al., 2017, p.18). Indeed, a quantification of the amount

of food that gets lost or wasted, especially if considering private households, is very complex, stemming as previously stated not from a “single” practice but from a multitude of reasons instead.

According to Canali et al. (2016) the drivers of food waste, being related to different aspects, can change along the FSC. Indeed, in their article, they suggested a classification based on the context, with reference to *technological drivers*, as those related to the “misuse, failures and limits of current FSC technologies” (Canali et al., 2016, p. 5), more common in LDCs, *institutional drivers*, related to the “organizational aspects of food production and consumption” (*Idem*) and *social drivers* related instead to “consumer behaviors and lifestyles” (*Idem*), and more easily identified in developed countries, characterized by a consumerist consumption approach. Perfectly aware of the necessity of a holistic perspective to develop effective countermeasures in such a delicate context our research will focus on the latter. In doing so, the main reasons driving people to waste food at the household level and the implications of these approaches, will be analyzed.

The reference scale when dealing with households is generally small; behaviors, lifestyles, and routinized activities related to food habits play, in this context, a crucial role in defining the reasons leading to food waste.

As already said, measuring food waste, especially at such a small and scattered level, may be very complicated. Gaiani et al., as suggested in their paper, find some reasons for this complexity in three aspects. Firstly, must be considered that activities regarding food within households (such as doing groceries or cooking) are very habitual, meaning that “people are often unaware of the quantity of food they throw away and they tend to forget how much food they waste” (Gaiani et al. 2017, p. 18), approach resulting in often inaccurate and underestimated data.

Secondly, food is disposed in different ways, meaning that to quantify it, several disposal routes must be measured. Lastly, data gathering performed by a third party (“door-to-door data collection, compositional analysis, installation of ‘bin cameras’” (Gaiani et al., 2017, p. 18)) although being more accurate are usually very expensive methods, thus not very diffused.

This lack of information on such an important issue has contributed to higher unawareness on the topic among society and uncertainty among institutions on how to manage this growing problem.

In the last years and decades, more interest has been shown toward the understanding of the leading causes of these approaches to food, and different studies have been submitting

questionnaires to population samples trying to understand the roots of these wasteful behaviors (e.g. Gaiani et al. 2017, Stancu et al. 2015). Despite some obvious differences, the reasons leading most people to waste food have resulted similar to one another.

According to different researches conducted all over the world, but especially in Europe and North America, since as already said it is in the developed countries that food waste at household level mostly occurs, “[...] the lack of food-related knowledge (i.e. lack of understanding of food labels); suboptimal storage; certain retailer practices (e.g. special offers); poor cooking skills; perceived social norms, personal values, and financial resources; and elements related to different geographical and cultural contexts” (Gaiani et al. 2017, p. 17) have resulted among the most commonly reported causes for food to get wasted.

With similar intentions, Gaiani et al. (2017) conducted a research, which data are reported in the article “Food wasters: Profiling consumers’ attitude to waste food waste in Italy”, to develop a deeper understanding of why food gets discarded before time or is bought and ends up uneaten, and who are those people more prone on this kind of behavior.

A questionnaire consisting of 49 questions was submitted to a population sample, covering 5 aspects considered as possibly influencing the attitude of people toward food waste: 1. Demographic area; 2. Consumption habits; 3. Consumption attitudes; 4. Food waste behavior; 5. Solutions to prevent or reduce food waste.

According to the answers gathered Gaiani and her colleagues were able to identify 7 different types of consumers characterized by different approaches toward food, more or less aware and thus generating variable quantities of waste (Gaiani et al., 2017, p. 23). The different types are reported below:

1. **Conscious-fussy**: uses its senses (smell and taste usually) to define whether a food is good or not. They are usually quite aware of food waste as a global concern and seems agree on countermeasures.
2. **Frugal consumer**: they are usually older and tend to consume less in general terms, leading to a minor quantity of waste production.
3. **Exaggerating cook**: they are huge wasters, mainly due to their lack of organization they tend to buy and cook too much.

4. **Conscious- forgetful type:** these individuals waste food they forgot to have. They are quite aware of the issue and usually able to read in the proper way the labels, though they might be better organized. Also, they show availability and interest in getting more information on the problem.
5. **Unskilled cook:** the reason for the waste of these type might be underrated, though many individuals do waste food because they have not the knowledge to use it in the proper way, or they commit some errors during the preparation process that make the food not good to be eaten.
6. **Confused type:** represent those individuals who are not really aware of the real meanings of the labels and being unsure between “best before” and “use by” may bring them to waste higher quantities of food.
7. **Exaggerated shopper:** similarly to number 3 these individuals tend to overbuy. According to the questionnaire responses, however, it appears clear that this situation might also be due to the composition of the households. Indeed, these individuals often live alone and are “obliged” to buy larger quantities of food as packages in supermarkets tend to contain large portions.

Despite the abovementioned categorizations being related to an Italian research, and thus not presenting shared definitions valid for all the research on this subject, the basic conditions mostly reported as drivers for people toward an irresponsible purchase and consumption of food, are generally similar.

Indeed, also van Geffen et al. (2020) identify shopping, storing, preparing, and consumption among the most relevant causes for food waste at household level.

These categorizations, highlight the intricacy related to the food waste debate revealing the central role of personal and social behaviors and the need for organizations and institutions to understand it before developing more efficient counteracting strategies.

Indeed, to reduce the negative externalities of human activities on the world system (food waste among the others), it is necessary, as already said, to change mindsets and consumption patterns.

Within this framework, do Paço and Laurett make reference to the term, “environmental behavior” to describe the action of “adopting attitudes and behaviors aiming to minimize any adverse effects on natural environment” (2019, p.1). Despite the shared consciousness that a switch toward a sustainable consumption pattern is needed, environmental behavior is many times promoted but rarely effectively implemented.

This is also true with specific reference to food waste at household level, where indeed many are aware of the benefits that could come from the change of individual behaviors though still hesitate to actualize it. Why does this happen is a crucial question to improve actions enhancing sustainability.

Van Geffen et al. describe behavioral change as a “multiphase (iterative) process.” (2020, p. 31), meaning that various factors can influence someone’s behavior and consequently the motives to act upon it and change it.

In general terms, the motives or forces that can participate in the defining of diverse behavior patterns have been illustrated by do Paço and Laurett (2019), within the table reported below (Fig. 6).

Factors	Description
Motivational factors	Weighing costs and benefits: Related to the alternatives that may offer greater benefits and lower costs (Steg and Vlek 2009)
	Moral and normative concerns: Moral factors are more closely related to prosocial values, altruistic values and people’s beliefs, moral obligations over acting pro-environmentally. The normative concerns relate to compulsory and descriptive norms (Steg and Vlek 2009)
	Affect: Affects influence environmental behaviours; for example, in the case of car usage with affection for cars relevant to some people (Steg and Vlek 2009)
Contextual factors	This reinforces how contextual factors also influence human behaviour. For example, contextual factors such as infrastructures, technical facilities, product availability and the characteristics of the product and/or service. Persons may choose to use public transportation instead of their own cars, however this requires transportation options and the entire infrastructure necessary to facilitating the exchange (Steg and Vlek 2009)
Habitual behaviour	Behaviour can often be considered as habitual and driven by automatic processes. Thus, carrying out interventions in habits needs to take into account how they are formed, reinforced and sustained (Steg and Vlek 2009)
Demographic characteristics	Demographic characteristics such as: Gender (Stern et al. 1993; Schultz et al. 1995), income, schooling, age and urban living area (Schultz et al. 1995). This also considers variables able to influence environmental behaviours
Internal factors	Among the internal factors identified by Blok et al. (2015), there are: General values, personal norms, social norms, perceived behavioural control, attitude towards pro-environmental behaviour, environmental awareness, and environmental values
External factors	Among the internal factors identified by Blok et al. (2015), there are: Situational factors, leadership support, leadership boss

Figure 6 Factors influencing behavior, Source:, do Paço & Laurett, 2019, p.

Still related to the different factors that can lead to behavioral changes, was the article of Lindenberg and Steg (2007). Within their study, they focused on the so-called “goal framing theory” according to which “goals ‘frame’ the way people process information and act upon it” (Lindenberg, Steg, 2007, p. 117). In this perspective, the types of goals considered are the *gain*, *hedonic* and *normative*.

Normally, when one goal is activated, the others are pushed in the “cognitive background” (Lindenberg, Steg, 2007, p. 120), in this way people prioritize one over the others.

A brief definition describes the hedonic goals as those pursued to “feel better right now”, the gain goals as those to “guard and improve one’s resources” and lastly the normative goals as those to pursue to act “properly” in terms of what is right or wrong (Lindenberg, Steg, 2007, pp.119,120). Sometimes, however, norms are not easy to be understood and people need further knowledge and information to interpret them in the right way. This complexity may also end up in a selfish attitude, with individuals more prone to following gain or hedonic goals rather than normative. In this sense we should enhance the awareness of people toward the issue of food waste, making them able to deal with it, by setting and striving goals toward a change for the better.

This being said, it is evident that a waste-preventing behavior may also do not stem from environmental concerns, or from a real interest in the issue at stake, but from other needs felt as essential for a subject in its life.

In addition to the abovementioned complexities, van Geffen et al. (2020) stated that food is a very particular good and therefore it is characterized by different types of goals at the same time. To achieve a real behavioral change toward a less wasting approach, people should be able to tackle this issue together with other goals considered by the individuals more important, such as feeding the family or assuring safe and nutritious food. In this sense, van Geffen et al. (2020) suggest that what makes a goal relevant for someone, is the attitude, problem awareness, behavioral influence and responsibility, and social norms.

2.4 The need of a change in consumers’ behavior

Most of the academic world has nowadays recognized the manifold consequences originated by the unprecedented productive and economic growth that has characterized recent human history, both on the environment, economic and social spheres.

Despite the most evident damages have become prominent in the last decades, growth and the consumerist habits that have led to the actual situation, have a longer history behind.

According to Higgs (2014), first references of production and economic increase can already be linked to the early European colonial expansion, then growth was characterized by the coal-based industrialization and the most recent change occurred with the oil revolution.

Together with the economic growth, what started at the beginning of the modern era and was spurred by the European colonialism was, as above-mentioned, the consumer culture (Magaudda, 2015). In line with what stated by Magaudda it can be said that this new trend accompanied the rise of modern capitalism, with some characteristic features such as the “growth of a materialistic attitude, a tendency to develop forms of social competition through

goods, and also an increase in the meaningfulness of these goods to express identity and social belonging.” (Magaudda, 2015, p. 1).

Indeed, as stated by Arnould in his article (Arnould, et al. 2011, p.1), this tendency can be defined as the ““social arrangement in which the relations between the [lived cultural experience of everyday life] and social resources, between meaningful [valued] ways of life and the symbolic and material resources on which they depend, is mediated through markets.””.

The consumption patterns that have derived, eventually becoming distinctive of our markets’ structures and everyday lives, have generated multiple consequences not only in an economic perspective and not only in a positive way. Indeed, the unprecedented growth registered in the last centuries has led to an overproduction which is endangering the environment and “man-nature relationship” (Kostadinova, 2016, p.224).

On this issue converges now “global consensus that urgent changes in human behavior and cultural practices” (*Idem*) capable of spurring a shift toward a more sustainable consumption are required.

From this need has developed a branch of research focusing on consumption habits and behavioral changes, however it is quite new and many of the results that have been achieved by different studies, concentrating on the drivers and barriers of sustainable consumption, are still conflicting with each other. Nonetheless it has become clear that, to deepen the analysis and knowledge on this issue, as consumer behavior involves a multitude of interacting stages and variables, a systemic approach and “multilevel perspective” is needed (Milfont, Markowitz, 2016).

Consumer behavior has been, since many years now, focal point of numerous studies underpinned from both the academic world as well as from marketing professionals. Indeed, understanding how consumers take their decisions in terms of purchase preferences is of crucial importance for businessmen. Within this framework, concordance has been achieved on the fact that consumer behaviors are defined by a multitude of variables, generally attributable to several groups of factors. Inside these groups, a wider range of elements potentially influencing consumers’ attitudes toward purchase are gathered. Stávková et al. (2008, p. 277) define these groups as represented by personal factors, where we can find socio-demographic conditions such as age, sex, or occupation and therefore income, psychological factors, including motivation, or skills and knowledge, and lastly situational factors where characteristics of the environment in which the consumer is located are defined.

These groups can determine, both in a conscious and unconscious way, the decisions taken by consumers.

Despite what one might think, when dealing with sustainable consumption, behavioral aspects are not extremely different. In relation to this topic, namely what drives a consumer toward more sustainable choices, Gregory and Di Leo conducted a research related to households' water consumption and conservation issues and behaviors. According to the methodology and results achieved within their study we considered it could be possible to regard the same aspects as relevant also in the context of our interest in relation therefore to the household food waste generation and management. The model used by Gregory and Di Leo to describe the sustainable consumption, and reported in *Fig. 7*, can be referred to as an environmental behavior model and it's composed by different variables, such as "cognitive psychology, applied behavior analysis, and behavioral decision theory" (Gregory, Di Leo, 2003, p.1263), which indeed are not new but were already studied, although in different fields of research.

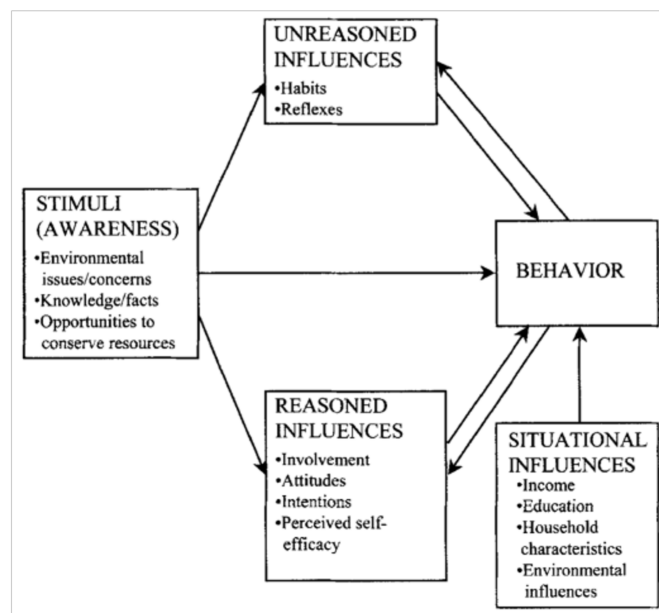


Figure 7 Environmental Behavior Model. Source: Gregory and Di Leo, 2003, p. 1264

The main purpose of this model is, according to the authors, to describe the effects of psychological factors on individuals' consumption behavior.

It developed on the idea that someone's behavior, especially in resource consumption contexts is, as above-mentioned, the result of several elements such as situational influences (namely the context in which people are), external stimuli, i.e. knowledge, environmental issues/ concerns, opportunities, unreasoned influences and reasoned influences (see *Fig. 7*).

It appears evident therefore, that also in a sustainable framework, a multitude of elements potentially interact at generating the final behavior of an individual. This complexity is what might worsen the barriers toward a sustainable consumption and production. The latter, defined at the Oslo Symposium (1994, as cited by the UN, n.d) as "the use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the

use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of further generations” (para. 2) and part of the agenda 2030 in the SDG number 12 is, as mentioned in the previous chapters, a growing trend answering the needs of a world increasingly under pressure. However, the impelling need to change lifestyles and consumption habits is still not fully understood by many still anchored to the actual linear production-consumption system. To implement these changes, a deeper knowledge of the causes, drivers, or barriers spurring or limiting pro-environmental behaviors, are needed to further implement strategies to improve these kinds of approaches among people.

To this end, from the early 2000s academic research has started to focus more on subjects such as “decision-making perspective, [...], consumers’ motivations and other psychological factors” (Trudel, 2019, p. 87), to highlight and understand the causes and barriers of certain behaviors and/or attitudes.

Within this framework, four areas of investigation have become prominent in understanding the “psychology of sustainable consumer behavior” (Trudel, 2019, p. 87), that have been classified as (1) cognitive barriers to sustainability, (2) the role of the self, (3) social influence and social norms, and (4) product characteristics and sustainable behavior. These are all important elements participating at the achievement of a more sustainable behavior, however, the first three areas are of particular interest to the design of effective interventions aiming at the achievement of a change in behavior.

The first area of investigation is of notable importance as it involves the system of cognition and decision-making processes, essential elements to be considered to understand and change consumption habits. In psychology and neuroscience cognitive system has been traditionally considered as agent-relative, meaning that it is strictly related to the individuals performing the actions. “According to this ‘top-down’ approach, a cognitive agent is decomposable into different cognitive systems” (De Brigard, 2017, p.224).

Within this framework, thus in close relation with neurological aspects of decision-making processes, crucial has been the work performed by the psychologist and economist Daniel Kahneman. He studied in depth what drives individuals toward certain decisions instead of others entering the fields of behavioral economics, psychology of judgment and decision-making. In his book “Thinking, Fast and Slow” (2011), he stated that individuals usually take decisions according to two different systems.

According to Kahneman, System 1 operates in a quick and automatic way. It is responsible of involuntary actions as knowledge, says the author, “is stored in memory and accessed without intention and without effort” (Kahneman, 2011, p.22). System 2, on the other hand, operates

through longer stages made up by “effortful mental activities” (*Idem*). The two systems usually work simultaneously, although System 2 is more often activated when System 1 cannot answer the question that has emerged. This subdivision is, as reported by Kahneman, “highly efficient” as it “minimizes efforts and optimizes results” (*Ibidem*, p.25).

This duality is considered to stem from one of the “oldest conundrums in psychology”, namely the subdivision of human mind in a double way, with one part conforming to an associationism view and one to an analytical and sequential view (Sloman, 1996, p.3).

Within this framework, as reported by Adnani (2017, *The Economics Review*), neuroeconomics research has highlighted how different regions of the brain are responsible for each system and how decisions are the result of this complexity.

That being said, as human-beings we are characterized by irrationality. This means that, according to a process known as hyperbolic discounting, linked to the mesolimbic pathway of the brain, we tend to favor decisions which imply immediate reward, rather than decisions which may imply bigger rewards though later in time, which in turn are linked to the fronto-parietal system (Adnani, 2017, *The Economics Review*).

This aspect generally becomes evident when people have to make decisions which imply a certain degree of intertemporally, i.e. performing actions today which have results in a far future, such as sustainable actions.

Within this framework inserts the idea presented by Trudel (2019) for whom it is this dichotomy that makes difficult for many to implement sustainable consumption choices. Indeed, the option of renouncing to an immediate gratification to the perspective of long-term benefits, is what prevent many less motivated people from acting sustainably. These attitudes are defined by Trudel as the so-called cognitive myopia and present bias (2019, p.87).

To challenge these behaviors, an important role can be played by governments and organizations, through the development of specific policies and interventions.

Indeed, they have long been trying to convince and inspire people to behave in a sustainable way or toward a definite goal through economic incentives, which indeed have always proven to be a good mean. Nevertheless, in the last decades things have started to change, and an increasing number of institutions have begun to develop and put in practice behavioral strategies instead (Benartzi, et al., 2017). These alternative approaches are generally considered as nudges, meaning that according to the definitions given by Thaler and Sunstein (2008, as cited in Benartzi et al., 2017, p.1041), people’s behaviors are changed “without forbidding any options or significantly changing their economic incentives.”, as nudges should be “easy and cheap to avoid [...] not mandates”.

This “new trend” also highlights a different aspect characterizing societies and decision-making processes implied. As reported in the World Development Report entitled *Mind, Society and Behavior*, and published by the World Bank in 2015, it appears clear that “we are not purely selfish and wealth-maximizing actors, as many economic models and policies assume [...]” (World Bank, 2015, p. 42).

For this reason, the role of the self, social influences and social norms play, as abovementioned, a central part to the achievement or not of sustainable behaviors. However, as reported by the World Bank (2015), this social component and the power social incentives have on achieving behavioral change, have often been underestimated.

It appears clear, at this point, that addressing the issue of food waste at every level of the FSC and in particular at the household level, is not an easy task and to achieve a behavioral change many aspects need to be considered simultaneously. Within this framework, the role played by public but also private institutions gets fundamental.

International organizations, but also governments or educational institutions are crucial in improving food waste prevention through accurate and effective interventions aimed at modifying the drivers and changing the approaches of individuals towards this issue.

To set a goal, in truth, does not mean it will be certainly achieved, therefore van Geffen et al. divide the potential interventions in two groups, those aimed at convincing individuals that “their waste-related behaviors are problematic” (2020, p. 37) and that they should change them, being therefore interventions to set a goal. The others addressed instead to, those individuals that are already aware and willing to change their behaviors, though still find it hard to perform this change by themselves.

In their paper, the authors suggested various alternatives to involve householders into behavioral changes. Among the interventions to help setting the goal of reducing or preventing food-waste van Geffen et al. included “information campaigns, emotional appeal campaigns, social influences, commitment and regulations” (pp.40-41), while the second group includes interventions such “prompts, implementation intention settings, instruction to increase abilities, feedback and making it easy” (pp.43-44).

These interventions have been developed according to what has been defined as the most common barriers to food waste prevention and drivers toward food-waste. It is crucial, indeed, for a third party that designs an intervention, for the latter to be successful and effective, to be deeply informed on the context and targeted population.

2.5 Conclusions

This chapter has cleared up two concepts that has gained relevance in the last decades but still are sometimes unknown, in their essential characteristics, namely sustainability and sustainable behavior. Light has been shed on the tripartition in environmental, economic, and social sustainability and on the need of a holistic perspective to achieve a sustainable society, meaning where everyone must have the means to set goals and strive them. A sustainable society, however, is one where food is available for all, and where there is no space for hunger and food insecurity.

To achieve sustainable food systems, however, does not seem to be an easy task, as many different elements and actors contribute at its creation and functioning. Essential condition has appeared to be a switch from the linear consumption model expecting a never-ending production growth to a circular one, where solutions alternative to disposal are introduced, also referring to food-related practices.

However, the complexity related to food management, stemming from non-homogenic definitions, context and target dependent measurement methods, individuality and routinized practices within households, have made the development of strategies to improve sustainable consumption patterns among final consumers, an intricate field of research and intervention.

3. Literature background on households' food waste

The goal of a fairer and more sustainable food system is now commonly shared among governments, organizations and private companies around the world, e.g. UN Agenda 2030, SDG 12.3 “By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.” (UN, n.d.); EU Farm to Fork Strategy to achieve a “[...] fair, healthy, and environmentally-friendly food system [...]” (lifefoster.eu, n.d.)

Many obstacles, however, are still limiting this intention from becoming reality, above all a market structure yet too firmly linear.

With focus on the micro level of food waste attention will be on households and consumers' practices, we will investigate the current condition of academic research on the theme, focusing on the knowledge that has been produced in the last decades and on what, on the other hand, still needs to be done.

Further in this section significant attention will be devoted to the description of alternative interventions put in place to achieve a concrete reduction and/or prevention of food waste, with the implied goal to understand whether or not they resulted in successful outcomes and the extent to which they are potentially replicable in other contexts.

3.1 Consumers' awareness about food waste, and academic literature

As already emerged, the role of knowledge and awareness on the issue of food waste among the various figures constituting the FSC, and especially among consumers, is crucial to tackle food waste issues in a systematic and therefore effective way.

According to the Capgemini Research Institute (Bridges, et al., 2022), the level of knowledge and awareness on food waste among consumers increased during the Covid-19 pandemics, as stated within the report in fact, “72% of consumers now claim awareness, compared with 33% before the pandemic” (p.11). Nevertheless, as shown in *Fig. 8* reported below, many misconceptions, especially on the consequences and implications of unsustainable practices as food waste, are still common at the consumption stage.

These data show that much work still needs to be done and that a holistic approach must be integrated in the interventions which objective is, by sharing notions and relatable data on the issue, to inform people on the manifold consequences that a practice such as food waste can generate on sustainable development.

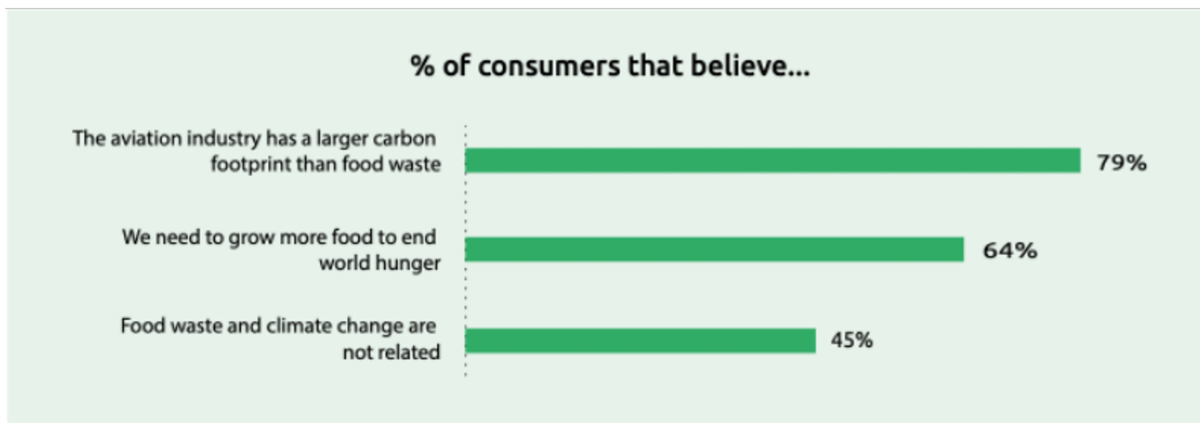


Figure 8: Source: Bridges et al., 2022, *Food Waste Survey, April-May 2022, N=10,000 consumers, p. 11*

Within the same report, other interesting data were displayed. Indeed, the research conducted by the Capgemini Research Institute tried to dig deeper in the consumers' attitudes and consumption behaviors, achieving results showing for example that economic aspects accounted as the most reported motivation potentially leading people toward a reduction of their wastage (56%) followed by, familiar lifestyles (52%), then by the will to contribute alleviating world hunger (52%), up to the concern about climate change (51%) and the concern about environment (50%), (Bridges, et al. 2022, p.11).

Moreover, emerged that, if dealing with emotions and perceptions, consumers associate to the practice of food waste, an interestingly 60% answered that they felt "guilty" when it happens in their houses (Bridges, et al., 2022, p. 15).

What stated and reported until now, is the proof that a systemic attitude is needed when dealing with such an intricate issue. The drivers and causes leading to food waste, as well as those motivating people in reducing it, are the most diverse, requiring therefore equally diverse and reasoned counteractions.

Despite most of the food waste develops at the last stage of the FSC, namely in households, there are also other figures covering influential roles in the inducement of a behavioral change among food related practices. Governments, no-profit organizations as well as other actors constituting the FSC, such as manufacturers and retailers could indeed play a crucial role in helping consumers implementing changes in their consumption practices. On this tendency, the Capgemini Report (Bridges, et al., 2022) observed that many interviewees, who reported to expect this behavior from retailers and other stakeholders, did not feel as enough help was coming from them. This perception, however, resulted to be in contrast with what declared by the organizations working within the food system, highlighting a contradiction negatively affecting the effectiveness of food waste reduction practices proposed.

Indeed, several interventions are reported to be developed along the whole FSC, also with special attention to the last stage implying consumers' actions, such as purchase, storage,

consumption, and post-consumption (Bridges, et al., 2022, p.18), however, not always are consumers able to grasp their effectiveness which remains many times unknown.

Despite the dedication demonstrated in the last decades by several actors, institutional or private, to spread knowledge on the issue of food waste to reduce its impacts, it is important to bear in mind that the main element of this discussion is not a good as many others. Food, indeed, “is not a commodity” (Vivero-Pol, 2015, p.3), or a mere source of sustenance, but it has always been a natural and local resource, pillar of culture (Idem) and therefore core of public “events”, surrounded by “ritualized forms of behavior”, or “wider social norms”, as well as being related to various practices and perceptions (Atkins & Bowler, 2016, p. 296,297). To show how food related practices potentially contribute to consumers’ final decisions, Atkins and Bowler (2016) developed a conceptual model displaying all the interacting factors, see *Fig. 9*.

That being said, it appears straightforward that, to better deal with this complexity when developing interventions to reduce food waste, as many factors as possible must be considered and confronted. Given the relevance food waste has been gaining in the last decades, from institutional as well as private sectors worldwide, increasing work has been done to develop interventions addressing consumers in the attempt of making their consumption and post-consumption behaviors more conscious, with special focus toward this issue.

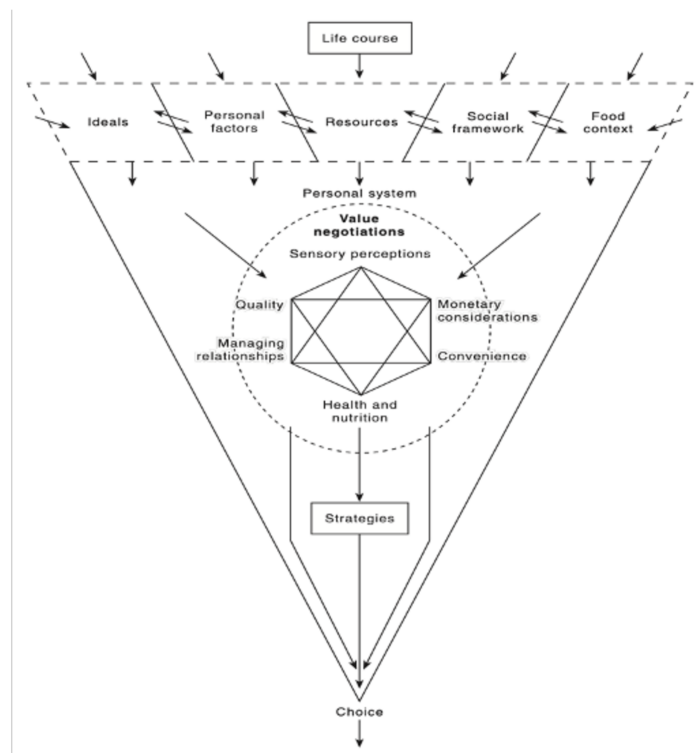


Figure 9: Conceptual model of the food waste choice. Source: Atkins, P., & Bowler, I., 2016, *Food in society*, p.301

Nevertheless, academic literature has been “criticized” for having lagged behind in the analysis of interventions and their effectiveness. In 2018 Stöckli, Niklaus and Dorn published an article on the urge for academics to focus their attention and research on this topic. Indeed, they performed a review by using a framework which categorized interventions according to whether they were antecedent (related to the context ahead of the intervention) or consequence (relative to the results stemming from the intervention), (Stöckli, et al., 2018, p.446) and shed light on the sharp disproportion existing, still a few years ago, among the higher number of interventions developed and implemented on food waste behaviors by practitioners in confront to the not many academic studies focusing on the same issue. Besides this, results of the categorization they did were also useful to identify some key challenges to be tackled from both practitioners and academics, meaning the urgent need for a “1) wider repertoire of intervention types and 2) more systematically evaluated interventions” (Stöckli, et al., 2018, p. 456).

Indeed, the analysis they performed, showed that despite informational interventions being recognized by Osbaldiston & Schott (2012) among the less effective to achieve real behavioral changes, they were enumerated among the most implemented ones (weighted mean effect size, $g = 0,31$).

Moreover, the lack of convergence on measurement methods, definitions and identification of target groups within the framework of food waste, has been impeding systematic categorizations of the interventions, resulting in problematic evaluation and potential replication.

Despite these suggestions, the situation does not seem to have evolved in recent years.

Indeed, as already seen within the Theory, indeed, in 2020 Van Geffen et al. (2020) presented a work where they suggested a wider range of interventions that were potentially context dependent, target population oriented and final objective focused. Nevertheless, the authors still found it necessary to underline the importance and the need of working towards the development of more practical interventions to be added/ combined to merely informational ones, as well as on the need to foster the study and development of commonly agreed monitoring and measurement methods to evaluate the effectiveness of interventions themselves (Van Geffen, et al., 2020, p. 46).

3.2 The household’s food waste: the state of the analysis

From the lack of shared definitions and measurement methods for food waste, has originated relevant uncertainty and characterized this topic. As already stated in this work and reported from various studies i.e. Capgemini Report (2022, *Fig.10*), UNEP Food Waste Index Report (2021), most of the total amount of food waste is produced at the final stage of the FSC, namely

by customers' consumption and disposal practices. Despite the potential effects of a cultural and behavioral shift within households' food waste production could be revolutionary, the lack of data on the precise amounts and reasons behind its generation has proved to be an essential tile impeding the above-mentioned result.

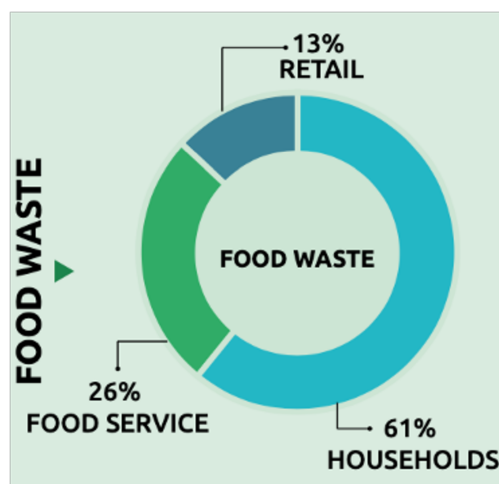


Figure 10 Source: Bridges et al, 2022, with data from UNEP, FAO, WFF, p. 9

Only in recent years, the academic world has started to search for alternative solutions to gather quantitative data and other information on the food waste practices within households. Attention has also been addressed to the development of shared methodology enabling scholars and practitioners to perform comparisons among different countries.

Collecting data on such an intricate process is indeed a challenge, as the factors intervening at the production of food waste are, as already stated, manifold and stemming from the most diverse causes, e.g. socio-demographic and economic factors, unevenness of domestic nuclei, poor reliability of self-collected data, etc.

In the Italian context the first national wide survey on this topic was conducted only in 2018 by GFK Italia within a European framework. Indeed, according to Scalvedi & Rossi (2021) this study was part of an innovative experiment aiming at overcoming the above-mentioned obstacles providing a “harmonized European approach” (Scalvedi & Rossi, 2021, p. 4) on household food waste (HFW) measurements. It was not the first survey on HFW implemented in Italy, however, it was the first time that a national representative sample was implied. The study was divided in two phases, the first one involving a questionnaire to select the sample and the second another questionnaire where “respondents were asked to report the amount of food wasted in the previous week” (Scalvedi & Rossi, 2021, p.5). In this framework, food waste was defined in relation to the edible parts. Despite relevant similarities and some discrepancies

that emerged in comparison with the other European countries, the most relevant elements, with attention to our research topic, arose in comparison with other surveys conducted in Italy.

Indeed, as reported by Gaiani et al. (2017, see *Fig. 11*), in recent years several inquests have been conducted on this issue in our country, still, comparisons have been difficult to be implemented as only a few of them were integrated by quantifications, while with reference to research foci and methodologies they were multiple as well as the definitions used to identify the issue of food waste to the respondents, making thus the results achieved hard to be confronted. Nevertheless, some correspondence emerged among these studies too.

Source	Year	Methodology	Focus
Lanfranchi, M., Calabrò, G., De Pascale, A., Fazio, A., Giannetto, C.; Household food waste and eating behaviour: empirical survey	2016	Survey on a sample of 500 consumers of the Province of Messina	Deeper insights into consumers' wasting behaviours. No quantification
Setti M., Falasconi L., Segrè A., Cusano I., Vittuari M.; Italian consumers' income and food waste behaviour	2016	Survey on a sample of 1,403 Italian consumers	Insights on the relationships between consumers' income and household food waste behaviours No quantification
Mondéjar-Jiménez, JA., Ferrari G., Secondi, L., Principato, L.; From the table to waste: An exploratory study on behaviour towards food waste of Spanish and Italian youths	2016	Exploratory study, based on a survey involving 380 youths residing in Italy and Spain	Investigating the complexities of food waste behaviour within the framework of the Theory of Planned Behaviour. No quantification
Giordano, C.; Assessing Household Food Waste in Italy: A Methodology for Detecting Drivers and Quantities	2016	Mixed methodology based on the use of questionnaire, diary and waste sorting	Development of a mixed methodology to overcome the limitations of single methods
Principato, L., Secondi, L., Pratesi, C.A.; Reducing food waste: an investigation on the behaviour of Italian youths	2015	Survey on a sample of 233 students at Roma-Tre University	Explore youth's knowledge, attitudes and behaviour towards food waste from an individual behavioural perspective
SIMA (Italian Society of Environmental Medicine); Survey on food waste	2015	Survey on a sample of 765 individuals	Household food waste quantification. 70% of the sample wastes less than 300g food of the week, and only 31% of them wastes between 300 and 500g
Last Minute Market (with SWG); Observatory of Italian household food waste	2013, 2014, 2015, 2016	Survey on a sample of about 2,000 households	Household behaviour and food waste quantification. Every year Italian households throw away food for an average value of 360 euro per week. On average, every week a family throws away 213g of food
Garrone, P., Melacini, M., Perego, A.; Feed the hungry. Surplus food as an opportunity	2012	Survey on a sample of 6,000 Italian households, stratified in terms of geographical location, income, composition and other characteristics	Household food waste quantification. Household waste food is estimated at 5.5 million tons/year (surplus food reaches 8% of the purchased food)
Save the children; Without fame e sprechi: il paradosso della scarsità nell'abbondanza	2012	Survey on a sample of 478 individuals stratified in terms of geographical location, income, composition and other characteristics (CAWI methodology)	Household food waste quantification. Household waste food is estimated to 343.2 euro per year
ADOC (Italian Association for consumers' protection and orientation); Report on food waste	2009	Survey on a sample of 600 individuals	Household waste food quantification. Household waste food is estimated to 454 euro per year, equal to the 8% of the food purchased

Fig. 11 Source: Gaiani et al., 2017, p. 19. Major surveys on household food waste within the Italian context, p.

19

Despite these differences, indeed, in more than one research results converged on the types of food that most often get discarded, namely fruits, vegetables and dairy products (Scalvedi & Rossi, 2021; Giordano, et al. 2019; Lanfranchi, et al. 2016), as well as on the correlation occurring between socio-demographic characteristics and amounts of food wasted (Scalvedi & Rossi, 2021, *Fig. 12*), namely the bigger the size of the family/household the higher the amount of food discarded.

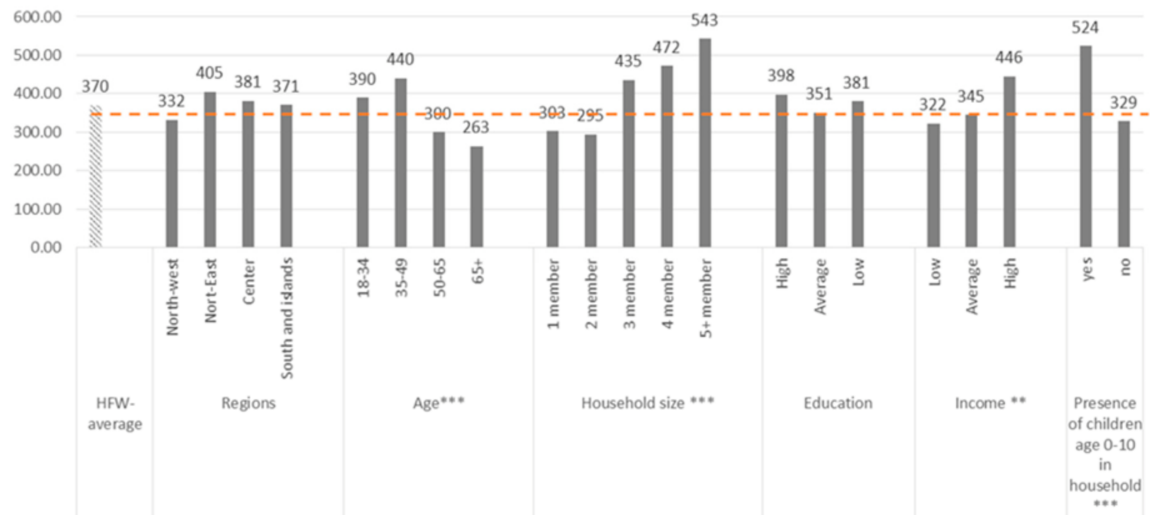


Fig. 12 Source: Scalvedi & Rossi, 2021, Average FW measured in g/week in relation to sociodemographic characteristics, p. 7.

However, concordance was also on the fact that, proportionally, most wasteful households were surprisingly those composed by fewer people, as well as results showed that the older the people the less the waste (Scalvedi & Rossi, 2021; Giordano, et al. 2019; Gaiani, et al. 2017).

In addition to socio-demographic aspects food waste has been reported to stem from other routinized practices, potentially involving moments from purchase, storage, preparation, or consumption, and therefore connecting consumers to additional and different elements of the FSC as retail or food services.

To tackle this intricacy in the most effective way, policies and intervention strategies must be appropriately designed, developed and implemented.

Indeed, paraphrasing the place-based theory for regional interventions (Barca, 2009), in the food waste sector in order to be effective reduction or prevention strategies must be target-based, developed therefore in accordance with the need and habits of the interested subjects.

With these assumptions the next section will be devoted to the analysis, with general reference to our country, of what has been and is done to spread reduction and prevention strategies in the framework of household food waste, highlighting if possible whether or not has the goal been achieved.

3.3 Have institutions and organizations effectively engaged in the fight against household food waste?

As we have repeatedly said in this work, being related to a multitude of consequences, the issue of food waste has gained relevance in the last decades, and the urge to reduce the numbers of this problem is becoming a worldwide battle.

Additional complexity in its contrast is given by a multitude of factors. As unexpected as it might be, it has been shown that the most impacting stage of the FSC on the generation of food waste in developed countries is the last one, involving therefore consumers' purchase choices, storage, and consumption practices, and making it even harder to tackle the problem. Indeed, when dealing with food waste at household level, families, personal habits, and traditions, as well as income or neighborhood must be considered since, as already declared, when related to food these aspects might be very rooted and therefore hard to be changed. Moreover, Aschemann-Witzle et al. (2017) affirm that further reasons for household food waste production may also derive from elements external from the households themselves and implied instead to the relations with other actors of the FSC such as retailers and/or food services, e.g. "products packages and food marketing, [...] regulations and standards, [...] societal trends [...]" (p. 2). As a consequence of the intricacy of elements intervening to the production of the final amount of household food waste, concerning both actors and practices, it appears evident that a clear and easy solution is difficult to be reached.

The goal on which strategies should focus is clear, a reduction of the amount of food that get discarded by families each day, week, month, and year, however, the best way to implement this change is still under construction.

The reason for this backwardness is to be found in the overall complexity of this issue. Indeed, as above-mentioned just like the drivers, also the agents intervening within this framework are various, from public institutions and organizations, to governments, to the academic world, and the private sector, and likewise numerous are the levels of governance at which strategies aimed at the reduction of the household food waste production have tried to be developed and implemented. In addition, the lack within the literature on this topic of shared definitions or commonly agreed measurement methods, increment the hindrances to the design of interventions.

For instance, the number of studies on food waste in domestic environments has been growing in the last decades, however those presenting concrete interventions to reduce it are limited. Moreover, when strategies were suggested their effectiveness, has rarely been measured in a systemic way which could make them potentially replicated.

What still seems to lack within this framework limiting the effectiveness of food waste reduction or prevention interventions is, therefore, a harmonized and structured work.

Trying to fulfill this gap and perform a review of academic studies and interventions put in place on this theme, Reynolds et al. (2019) underwent the analysis of 292 articles published between 2006 (year in which academic world started to pay attention to this issue) and 2017. However, as a confirm to what stated above only 17 articles, namely 5% of the total, were

featured by concrete examples describing the implementation of the food waste reduction interventions suggested.

To these examples stemming from academic literature, Reynolds et al. (2019) suggested, to add also other real-world interventions implemented instead by political institutions or private sectors. However, despite these were more numerous and could undoubtedly contribute to the formation of a grey literature on the topic, helping toward the achievement of a shared final objective, not being featured by the academic details such as a theoretical framework, they could not be included in a comprehensive literature on the topic, leaving the gap on the effectiveness of interventions still open.

3.3.1. International Level

It has been since some years that the international and communitarian levels of governance have started to consider the issue of food waste generation as relevant and worthy of strategies and research.

The European Union, in particular, has started to work on this topic since 2012. According to what stated by Laaninen and Calasso in the European Parliament Briefing (PE 659.376 – December 2020), in that year (2012) the “Commission established a Working Group on Food Losses/Food Waste” (Laaninen & Calasso, 2020, p. 4). However, major steps have been undertaken only from 2015, when the Circular Economy Action Plan was established. Indeed, among its priorities were included “Food waste prevention and the need to adopt a more sustainable production and consumption model” (*Ibidem*, p. 5). The following step was implemented in 2016, when the EU Platform on Food Losses and Food Waste was created. On this platform in 2019 key recommendations were published addressing all the stakeholders involved in the FSC “to accelerate the EU's progress towards the reduction of food loss and waste” (Laaninen & Calasso, 2020, p.5). However, despite consumers were included, they were not considered within the household framework. One of the most recent step dates back to May 2020 when the Farm to Fork Strategy has been presented as part of the European Green Deal, again with the broad aim of making food systems more sustainable.

Another strategy implemented within the European framework in the same temporal span is the Strefowa Strategy (2019) (<https://www.interreg-central.eu/Content.Node/STREFOWA.html>, accessed on 11/09/2022).

This Strategy to Reduce Food Waste in Central Europe, was part of the Interreg Central Europe Programme, it lasted three years (2017-2019) and was aimed at finding solutions to the issue of food waste along the whole FSC.

Among the suggested actions, Strefowa, also involved the implementation of more practical interventions such as “pilot actions”.

Defined as “experiments to try out new methods to reduce and manage food waste” (<http://www.reducefoodwaste.eu/pilot-actions.html>, accessed on 11/09/2022) they were implemented to evaluate the effectiveness of some practices and to further support the creation of broader interventions such as guidelines, recommendations, and training materials, where useful information and tips to help reducing food waste are listed.

The pilot actions were 16 and they were put in action in five countries of central Europe (Austria, Hungary, Poland, Italy and the Czech Republic) (<http://www.reducefoodwaste.eu/pilot-actions.html>, accessed on 11/09/2022).

The declared aims were to (Idem)

- Raise awareness in schools and amongst consumers
- Prevent food waste through donations and re-use
- Optimize separate collection of food waste

Four of these experiments were implemented in our country, and they focused on “food donation from Hospitals to the territory; food waste prevention in tourism and food preparation; pilot activities with primary schools in Italy; and food waste prevention in households in Italy) (Idem).

For the sake of our research topic, the last one resulted the most compelling.

This experiment aimed at the creation of “experimental procedure or tailored awareness campaigns” (<http://www.reducefoodwaste.eu/pa13-food-waste-prevention-in-households.html>, accessed on 11/09/2022) to reduce food waste within families. To develop these procedures or campaigns, a sample of 32 families from the Province of Rimini was involved. They were initially submitted a questionnaire on their eating habits in general, as well as on the preparation and eating phases of their meals, to enable the practitioners to analyze and select the most adapt good practices for food waste prevention. The families were then asked to perform the best practices they had been suggested for two weeks and after that they were asked to measure and quantify the reduction of food waste obtained through the implementation of the above-mentioned recommendations. Results from this experiment, besides being used to develop the general consumer guidelines, were not shared in a systematic and scientific way, making it difficult to see how the implementation of best practices could have reduced or not HFW.

In general terms we can state that the European level has started to move, and to design interventions to address the issue of food waste, however most of the bigger strategies reported here were limited to suggestions and referring to the broad context of food system sustainability.

Others, more focused and effectively implemented, also at household level, were not featured by a relevant theoretical background enabling systematic organization, measurement, evaluation, and possible replication. Neither academics nor practitioners covered a relevant role in the food waste battle within this framework, where institutions instead, despite with often generic actions, have proven their presence.

3.3.2 Country Level

At country level, as reported by Giannetti and Livi (2021) the situation is slightly different. Yet, also the Italian government started, from 2013, to think about strategies to be developed and implemented in order to tackle the issue of food waste which, indeed, was recognized as urgent. Our country, however, has devoted its institutional efforts to the simplifications of bureaucratic procedures to enable the donation of food by retailers and/or food services. Despite being an undoubtedly praiseworthy venture, it is more focused on actors of the FSC different from the final consumers.

The main steps undertaken by the Italian government within the framework are represented by the Programma Nazionale di Prevenzione dei Rifiuti, in which can be found a section to develop potential measures to reduce the food waste, implemented in 2013, followed by the Piano Nazionale di Prevenzione degli Sprechi Alimentari (PINPAS) implemented in 2014 while a crucial shift occurred in relation to this topic in the Italian legislation two years later in 2016, namely the “Legge anti spreco” (or Gadda).

Indeed, L. 19 Agosto 2016, n° 166 was devoted to lessening the limits from manufacturers to retailers and/ or food services to donate the unsold food avoiding it to get wasted.

Despite the relevance of this intervention, again, it was not intended to tackle the situation of food waste within households, which as renowned is the most impacting and core of the present work.

However, still referring to the country level other actors, different from governmental ones, have emerged within this framework.

Indeed, in the last decades, an increasing number of private firms have started, sometimes to obtain personal benefits or for CSR objectives, other times upon request or in partnership with public political institutions, to devote efforts and economic resources to the fight against food waste as well as to the spread of knowledge with specific focus on final consumers and citizens. The effort spent by these actors is, in respect to the actions implemented by governmental bodies, more concrete, becoming an essential element to the achievement of effective behavioral changes.

Among the others Barilla Group has emerged within the theme of research on sustainability. The company has created a dedicated section, Fondazione Barilla (<https://www.fondazionebarilla.com/chi-siamo/>, accessed on 12/09/2022) focused on research and distribution of knowledge and awareness on topics such as sustainable behaviors and consumption choices. Beside the dedication to scientific research on the theme of sustainable food systems, the group has also developed some interventions to enable consumers, with a particular attention to younger generations, in changing their behaviors.

From the above-mentioned goal has been created a book, available also online, 100 Food Facts - Piccola Guida per Grandi Cambiamenti (<https://www.fondazionebarilla.com/i-food-facts/>, accessed on 12/09/2022), which includes many hints and practical hacks to perform a more sustainable lifestyle. It is divided in 6 sections, dedicated to likewise themes where readers can find and read interesting facts related to food and associated to a potential solution (food fact > action). The first section is focused on saving tips, since as previously seen money is one of the most effective levers for food waste prevention (Bridges, et al. 2022, Van Geffen, et al. 2020), therefore in these pages readers can find useful information and related tips to save money while simultaneously avoid waste, e.g. “Food Fact 2: the resources necessary to produce food which gets discarded generate greenhouse gases. At global level, if the food waste were a country, it would be the third accounting for emissions after US and China. Reducing waste would make us save up to 3,3 billion tons of CO₂. Action 2: The less you waste, the more you save: Italian families waste in average 15% of the fresh fruit they buy. When you peel the vegetables don't throw them away but reuse them for always new recipes! For example: the trunk and external leaves of the cauliflower, as well as the stems of artichokes are excellent to prepare a vegetable broth”⁴.

Beside this informational work addressing final consumers who, however, should be already aware of the problem and should have already, autonomously, set their goal of becoming more conscious of their choices and practices, other two educational programs have been developed by the foundation, also in partnership with other institutions, namely, *We, the Food, the Planet* and *Skilled Through Food*. These two additional interventions are targeting a more precise group of consumers, the young, using more interactive and engaging tools and methodologies.

⁴ Traduction personally elaborated from:

Food Fact 2: Le risorse necessarie a produrre il cibo che poi viene sprecato generano emissioni di gas serra. A livello globale, se lo spreco fosse un paese sarebbe il terzo per emissioni dopo gli Stati Uniti e la Cina. Ridurre lo spreco ci farebbe risparmiare sulle emissioni fino a 3,3 miliardi di tonnellate di anidride carbonica (CO₂).

Action 2: Meno sprechi, più risparmi: in media, le famiglie italiane buttano il 15% della verdura fresca che acquistano. Quando peli le verdure, non gettare gli scarti ma riusali per ricette sempre nuove! Ad esempio, il tronco e le foglie esterne del cavolfiore o i gambi dei carciofi sono ottimi per preparare del brodo vegetale. Original version at (Fondazione Barilla, Piccola Guida per grandi cambiamenti, il tuo cibo la tua terra, p. 7.)

However, these projects do not precisely focus on food waste issue, but on a more general concept of reaching a higher sustainability through food.

In the first case, *We, The Food, The Planet*, the program consists in a digital game, through which the young can dialogue with Planet Earth. It explains them, through a guided chat the most urgent problems of our society, tests their awareness through a quiz and suggests possible solutions. It is more engaging but again, it does not seem to be supported by any specific strategy and needs the young to be already involved with the theme.

On the other hand, the second program, is more intricate and is developed in partnership with Erasmus +. It is a didactic project involving schools from different countries with the wider objective of increasing the effectiveness of the effort of schools towards the teaching of food sustainability issues.

As reported on the official page of the project (<https://www.skilled4food.net/skilled-il-progetto/>, accessed on 12/09/2022) it involves 5 schools, 35 teachers and 250 students from secondary schools. The activities to be performed are 5 and include (Idem):

- *Intellectual products:*

1. *Report on the state of the art of education for sustainability through food in schools;*
2. *“Skills framework” for teaching sustainability through food;*
3. *Guidelines for teachers to educate in about sustainability through food;*
4. *“Meet & Learn” web platform;*
5. *Didactic Certification “Sustainability through Food”*

- *Project meeting*

- *Dissemination events*

- *Mobility for training (for teachers)*

- *Mobility for training (for students)*

Potential results and impacts expected from the implementation of this project are reported to be an increased ability of critical thinking by the students as well as a higher interest and teaching effectiveness on the theme of sustainability through food.

Nevertheless, none of the above-mentioned projects does focus expressly on the issue of food waste, dealing more in general on how to achieve sustainability through food, and moreover they do not provide measuring or evaluation methods to effectively assess the results of implemented actions.

Remaining within the private realm, another relevant project was developed and launched at the beginning of 2021 by the Danish company Too Good To Go, one of the most relevant App against the food waste. This campaign, the “Patto contro lo spreco alimentare”, defined by the company as a “virtuous alliance” against wastes, involves many relevant stakeholders from the

retailer sector, as well as consumers associations and is developed with the partnership of the Italian Red Cross (<https://toogoodtogo.it/it/press/releases/combattere-lo-spreco-alimentare-lapp-too-good-to-go-in-italia>, accessed on 13/09/2022, para. 5).

As reported on the website, the pact lies on five main actions, 1. Conscious labels; 2. Conscious firms; 3. Conscious consumers; 4. Supermarket against waste; 5. Firm against waste.

Number three is what interests us the most in relation to our research topic. To make consumers more aware of the consequences of food waste in terms of economic, environmental and social impacts, firms, with the support of Too Good To Go, and through their communication channels are invited to share with their clients information, tips and advice on how to concretely implement actions to reduce the waste (<https://toogoodtogo.it/it/campaign/commitment/commitments>, accessed on 13/09/2022).

In occasion of the first anniversary of this pact, an impact report was published where data for each partner showed the results that had been achieved (1° Anniversario Patto contro lo spreco alimentare - Impact Report 2021). Despite the information shared within the document, little data concerned the structure of concrete strategies or interventions implemented among final consumers at household level.

These results highlight once again how, despite the efforts put in place by different actors against food waste, final consumers and their wasting habits within households are still not considered as relevant figures to tackle the problem. In addition, the interventions implemented, especially by the private sector, are most of the time limited to top-down initiatives of knowledge spread, ignoring theoretical backgrounds, suggesting that to achieve a behavioral change, other elements should be introduced, and that quantifications and measurements are still lacking most of the time.

3.3.3 Local level

Evidence proves how crucial it is to effectively tackle the regional and local level within this framework. Despite being “small” in fact, it is at this level, and especially within households, that most of the food waste takes place.

If at national level governance seems to be exceeded by private companies in reaching consumers in a domestic environment, at a more local level public institutions regain relevance through municipalities which, according to Coste et al. (2021, p. 2), represent the “level of governance which is closer to citizens and local businesses”. Yet, the actors that can play a role and being involved are manifold, and it is not unusual to see collaborations between different players.

Indeed, also civil associations are particularly active in this sense, Slow Food for instance provides support to public entities in embarking new projects and activities towards a more sustainable food system.

In December 2021, the no-profit organization, published a guide to help municipalities to implement “concrete measures on the ground” (Coste, et al. 2021, p.2).

The document focused on five goals to which municipalities should dedicate their efforts to support the shift towards a more sustainable food system, namely (Coste, et al., 2021, p. 5)

1. *Plan and strategies in order to prepare and adopt a holistic plan that aims to reduce food waste within the frame of a wider transition to a sustainable food system;*
2. *Stimulate the local food system through community-supported agriculture and initiatives that reduce food loss at the primary level;*
3. *Create a local food environment that encourages a wide-range of public and private actors to develop food waste prevention activities;*
4. *Raise awareness and educate about the value of food through educational program or impacting campaigns stimulating citizens to reduce food waste;*
5. *Develop a proper bio-waste management system to ensure food waste is valorised into fertiliser in the case it cannot be prevented.*

Also, in this case we can find one point from the total, dedicated to the engagement of final consumers (n.4). For each point, best practices and examples of potential interventions were reported, however, some refer to citizens’ awareness of non-Italian countries and cities, becoming therefore not unhelpful to our analysis of the situation in our country. For instance, the best practices reported below and addressing food waste are not implemented in Italy.

“Really Healthy School and its comprehensive approach to educate about the value of food” and *“Raise your voice against food waste”* campaign are the two project presented with focus on food waste prevention. The first involves 300 cities in Czechia, it has recently been activated and aims at making a more sustainable food system in public kindergartens and primary schools while the second was implemented in Ljubljana (Slovenia) in 2013 and is an educational campaign to share knowledge against food waste through diverse communication channels. Both of them, however, are not featured by any results, or measurements methods.

From the same assumption that municipalities, whatever the dimension, should support “awareness raising activities” and “encourage the exchange of best practices” (Coste, et al. 2021, p. 23), developed, in 2015, the Milan Food Policy Pact (MFPP).

This project was launched by the municipality of Milan as a heritage form the Expo 2015 *“Feeding the Planet, Energy for Life”* and involves nowadays more than 220 cities all over the world (<https://www.milanurbanfoodpolicypact.org/resources/mufpp-policy-brief-2022/#>,

accessed on 13/09/2022). It has the aim, with the support of international partners, to provide the signing cities with “strategic options [...] to achieve more sustainable food systems [...]” (15 October 2015, Milan Urban Food Policy Pact, p. 3). These options are clustered in 6 thematic areas to which a number of recommended actions are linked. The areas refer to 1. Governance, 2. Sustainable Diets and Nutrition, 3. Social and Economic Equality, 4. Food Production, 5. Food Supply and Distribution, and finally also 6. Food Waste.

To the ends of our research, area number six related to food waste is what interests us the most. To this area four recommended actions are devoted, among which, one (n.35) is exclusively dedicated to “Raise awareness of food loss and waste through targeted events and campaigns; identify focal points such as educational institutions, community markets, company shops and other solidarity or circular economy initiatives” (15 October 2015, Milan Urban Food Policy Pact, p. 6).

Together with the recommendations, in this case “specific indicators to monitor processes in implementing the Pact” (<https://www.milanurbanfoodpolicypact.org/the-milan-pact/#>, accessed on 13/09/2022) are also provided to the actors involved, helping them measuring the situation while creating a shared methodology.

For recommendations included in cluster number six, the indicators to measure improvements according to the Pact are the Total annual volume of food losses and waste, and the Annual number of events and campaigns aimed at decreasing food losses and waste (<https://www.milanurbanfoodpolicypact.org/the-milan-pact/#>, accessed on 13/09/2022, see Annexes for further details).

The provision, in this case, of dedicated indicators intended to help in measuring the results of the intervention implemented is indeed a great step forward in the creation of shared data on the issue. However, too little interventions are implemented with such a structured framework.

3.3.4 Present or future?

In the last years thanks to an undeniable technological innovation concerning also the diffusion of smartphones, and the subsequent development of applications, new tools have been introduced in the framework of food waste reduction and prevention. Indeed, an increasing number of applications have been devoted to help consumers in making more conscious purchase choices, or to suggest them on how to better store food to make it last longer, as well as to give them hints on how to cook a meal from leftovers. With similar goals though in a different way, other apps were developed in order to put in contact final consumers and retailers or food services helping the latter to avoid wasting bigger quantities of unsold food (Too Good To Go, MyFoody, BestBefore, Regusto, Svutafrigo; Garrone, *ecologica*, 08/08/2022, para. 3).

These trends have become very “fashionable”, however as stated by Falasconi and reported by Garrone (*ecologica*, 08/08/2022, para. 3) according to data from 2022 less than 10% of people find these tools effectively useful in helping them reducing the amount of food wasted. On this, Garrone reported the words of professor Segrè who said about this artificial intelligence that “[...] remains a precious resource, but if used in a mechanic way it does not stimulate the active effort of consumers from a preventive perspective [...]”⁵.

All the above-mentioned interventions and waste reduction strategies contribute to the development of a grey literature on the issue of food waste. However, the academic literature on the topic is still lacking similar examples, especially with attention to the Italian framework. Most of the studies conducted in our country on household food waste have been focused on the measurement and understanding of the amounts of food waste produced, of the drivers leading to these practices, as well as of the barriers toward the implementation of a more sustainable consumption (Scalvedi & Rossi, 2021, Gaiani, et al. 2017, Giordano, et al. 2019, Lanfranchi, et al. 2016). Few are the studies in which reduction strategies have been proposed, suggestions that in general terms are limited to educational programs (Annunziata, et al. 2022, Pellegrini, et al., 2019), while in little to none these have been implemented and results measured, assessing whether or not the goal has been achieved (no findings).

3.4 Conclusions

We have seen that, although quite recently, the problem of food waste has gained importance worldwide and has earned a place in many political agendas.

Nevertheless, manifold hindrances still hamper the achievement of more sustainable food systems and society.

What emerged in this chapter is the total absence of a shared action plan, necessary to tackle such an intricate issue in the globalized world we find ourselves in.

The examples reported above are a clear representation of what is the current situation and of what needs to be improved.

It cannot be said that tentative to help consumers in changing their behaviors toward more sustainable practices have not been done, however, the working framework were too scattered to be useful.

Indeed, the levels of action are manifold as well as the actors involved. The main problem lies in the absence, still now, of a comprehensive and consistent academic literature. Definitions of

⁵ Traduction personally elaborated from:

«[...] Che resta pur sempre una risorsa preziosa, ma se utilizzata meccanicamente non stimola l’impegno attivo del consumatore in chiave di prevenzione. [...]» (Segrè as cited by Garrone, *Ecologica*, 08/08/2022, para. 3).

the issue are many and they are used, even in scientific journals, in heterogeneous ways. The intricacy of food waste has made that no clear evaluation, quantification, and measurement methods were designed and extendable to varied situations and as a consequence, a divergent academic literature developed on the topic. Moreover, most of the literature focus on the understanding of the drivers and barriers toward and against food related practices, the articles devoted to the design and the implementation of concrete interventions are the minority. However, these are rarely accompanied by measurement and evaluation methods making it difficult to understand the results and replicate or confute the experiment.

Another interesting aspect emerged in this framework, namely the interventions developed by practitioners, e.g, manufacturers and retailers, designed to help their clients in becoming more sustainable-oriented. They are becoming crucial players in this game, producing a rich and useful grey literature on the topic. However, since marketing or CSR goals might be, in some cases, the drivers of these interventions they most of their interventions lack a theoretical framework which is essential, again, to the scientific evaluation and potential replication of the interventions.

Another important limit is given by the target population which is selected for the interventions. Despite being the most impacting part of the FSC households are rarely addressed by specific strategies. When this is the case, the target are generally families. It has been recognized that different factors, from socio-demographic to economic, to size of the household might generate various food-related practices, however, yet little to no attention has been given to the possibility that in the same house might live people with no relations to each other's. In these cases, it must be taken into consideration that most of the habitual food related practices, whether the grocery or the meal preparation, might be deeply diverse from those of a "traditional" family.

Since, according to the Nona Indagine Eurostudent (2021), in the A.A. 2019-2020, 517.941, representing 29.3% of the total of university students lived away from home, meaning not with family members but potentially alone or with other students, the aforementioned research gap represents a huge void that must be filled.

Considering, in addition, that for many it might be the first experience of living on their own, centered interventions should be devoted helping them in preventing those practices mostly related to food waste (poor cooking skills, little knowledge to correctly read labels, little knowledge on how to properly store foods, etc.). Within this framework, developed the present thesis, with the goal to consider these "unseen" as core of the research and help them in achieving more sustainable behaviors. To reach this goal, we consider universities might be the relevant actors implementing these interventions.

4. Project Proposal

It is true, indeed, that many individuals, accordingly to the idealized rational man described in traditional economics, act in a selfish manner, however, several psychological theories have been developed to deepen the understanding of alternative attitudes among citizens and what has emerged is that many individuals tend to act following different precepts, for example according to what is considered good by the society, or according to what they believe their peer's think about them.

This human sociality characterizing us as living individuals is the potential lever for alternative intervention designs, i.e. spurring people “to seek social status” or “to build and maintain social identities” (World Bank, 2015, p. 42).

Potential tools and interventions to act upon these areas of interest and enabling policy makers and organizations to achieve an effective change in consumers' behaviors are manifold. However, as we have seen, to result in effective changes, especially when dealing with resources and sustainable consumption, their design and implementation need to be well structured.

Among the others, education has always been considered a necessary pre-condition for the achievement of a sustainable development and society.

Indeed, international organizations such as the UN or the EU believe, as stated at the beginning of this work, sustainability literacy to be the very first and essential step toward the implementation of more pro-environmental and sustainable behaviors as well as to the creation of a future class of concerned and aware decision makers careful of sustainability issues.

As stated by Boyes and Stanisstreet (2012), the academic world has often investigated the relationship between education, in terms of knowledge, and actions. Indeed, “early models for encouraging environmental behavior” were based on the so-called “information deficit”, meaning that “if people understood more about the environment and the actions that would cause, or avoid, environmental degradation, they would behave in a rational manner and adopt environmentally sympathetic practices” (Boyes & Stainsstreet, 2012, p. 1592).

Still, the results of studies performed on this issue, have many times been inconsistent. The main reason for this is inferable to the fact that, as also previously seen, behavior and consumption behavior, do not result only from knowledge and education, but depend instead on many different factors, even completely unrelated from the preceding. Indeed, as emerged in the previous pages, informational interventions, aiming at rising awareness and knowledge on certain topics among a target population, have rarely revealed effective in changing their actual behaviors.

Education as well as knowledge, remains necessary conditions to achieve a sustainable development, especially if considering the long term, however, their implementation in isolation has many times revealed insufficient to change people's behaviors.

4.1 Interventions and Active Learning

What shown in chapter 4 with the analysis of what has been done at different levels of governance, from the broader communitarian to the smallest local context, helped to frame the current situation of the fight against food waste. What emerged, especially at national level, is that most of the interventions have been implemented by non-governmental actors and those activities addressing the domestic framework are fewer than those referred to retailers and other subjects of the FSC. Most importantly, data showed that when referring to households they address "traditional" families, and the most implemented activities involve informational campaigns. Only some, especially when dealing with schools and younger generations, presented well-structured activities to be concretely put in practice to achieve a behavioral change in an engaging manner and as in accordance with the above-mentioned sociality related levers.

The tendency to engage students in knowledge production to improve their own complies with the concept of active learning, a teaching method, that has been developed since the '80s and has been broadly described by Bonwell and Eison (1991) as those "instructional activities involving students in doing things and thinking about what they are doing" (p.5). According to Brame (2016), this approach grounds on different learning theories. The most important, in our framework is that of Vygotsky, who bestows an important role to the sociocultural situation around the act of learning, indeed according to his sociocultural theory of development "students solve problems beyond their current developmental level with the support of instructors or peers" (Brame, 2016, p. 2).

Active learning, indeed, not only is an "innovative" tool to teach traditional subjects but can also play an important role in sharing and developing values when implementing projects toward sustainability among a target different from students such as the civil society.

Sometimes, the importance of providing a project which combines both the informational side together with a practical one is still hardly recognized. As a consequence, it can happen that projects presenting only one of the two aspects are implemented, not achieving therefore any effective results among the targeted population. As repeatedly stated within this thesis, "real" sustainability results from the interconnection of economic, social and environmental conditions, and a systemic approach is needed to tackle concerning issues. Therefore, schools and higher education institutions, as well as other civil organizations active in the spread of

sustainability literacy should always provide a right balance between an educational basis and practical activities.

However, studies and research conducted on this issue within scholastic frameworks, have highlighted different trends.

Sustainability issues, in fact, especially in universities, not only are often taught as separate subjects but also through formal and traditional ways of learning, missing therefore the important systemic and transdisciplinary perspective and preventing students from deeply understand and personally consider this topic.

What stated, is particularly true with reference to higher education contexts, where knowledge is still too often distributed, considering students as mere recipients, rather than as potential authors of their own culture, with the possibility to learn new approaches toward sustainability through actions.

With specific attention to the Italian case, Sonetti, Barioglio and Campobenedetto (2020) wrote a very explicative article on this debate, in which they highlight that despite an increasing number of universities do implement “sustainability education initiatives” they tend to do so through “top-down actions proposed by university governments (85% of the cases), followed by experiential training for students (7%), and bottom-up initiatives (6%)” (Sonetti, et al., 2020, p. 12), therefore remaining stuck in an old individualistic and ineffective perspective.

In the framework of our research on food waste behaviors and potential reducing interventions among college students, this trend has appeared particularly evident, in contrast to the situation within primary and secondary schools where, even in partnership with external actors, a higher number of engaging interventions focusing on the reduction of food waste has emerged, e.g., Green school (<https://www.green-school.it/pillars/view-restyled/3/cibo-e-spreco>), Progetto “Momenti da non Sprecare” Whirlpool, Last Minute Market and Sprecozero with Progetto REDUCE (<https://www.sprecozero.it/reduce/>), etc.

These projects are developed and implemented by institutional or private companies sharing the aim of producing changes in the approach of younger generations toward sustainability issues, and in general terms, it seemed that in concordance with the above-mentioned criteria, the spread of information and knowledge is usually carried out together with practical lessons and activities, enhancing the engagement of students and their families in the co-production of pro-environmental changes.

Unfortunately, this is not the case for what concern the approach toward university students. So far, in fact, Italian athenea have resulted to be still tied to a very traditional version of top-down knowledge diffusion in which sustainability is still taught as many other subjects, making it certainly useful though not as effective as it could be. The reason behind, might lay in the

belief that university students, being young adults, would already present habits and preferences potentially making it more difficult to change their behaviors. However, human-beings' behavior, is a plastic trait that has enabled evolution and adaptability (Chenard & Duckworth, 2021, p. 301), meaning that even if students already present routinized habits and preferences, if given the right stimuli, they are still potentially prone to a switch toward pro-environmental behaviors and attitudes.

4.2 Project Proposal & Methodology

As anticipated in the conclusions of chapter 4, a huge gap to be filled in order to have more tools to tackle food waste in its various facets is the lack of research and interventions with focus on university students, who should be considered as autonomous householders with all the related duties.

Despite the relevance the issue of food waste covers worldwide, as previously mentioned, little research has been done on this topic with specific reference to college students as young autonomous householders. Even though, university contexts have been addressed with studies and intervention plans, indeed, these were mainly designed to reduce the waste generated in canteens, thus considering food service sectors instead of households where, as now renowned, most of the waste takes place. Therefore, students as food managing subjects, have rarely been considered within this field of research.

In addition to what above-mentioned, current data on the amount of food waste, specifically produced by off-site students, are not satisfying, when not completely absent. Despite a demonstrated lack of data, the problem is of real concern. Within this context universities could, and should, play a role in guiding their students throughout the intricate world of sustainability, not only in a theoretical way but also by means of practical interventions incentivizing them to implement more pro-environmental behaviors.

Given the scarcity of scientific literature on this specific topic, we considered plausible to generalize, at least for the Italian context, the results achieved by the research conducted by Principato et al. (2015) on the behaviors of Italian youths relative to food consumption. In their work, the abovementioned problem was highlighted through a statistical analysis performed on data gathered from a sample of 230 students between 19 and 28 years old and enrolled in different years of Bachelor's Degree at the faculty of Economics at the University "Roma Tre". The respondents were asked to answer a questionnaire composed by 28 questions developed on three set of variables considered as the most impacting on people's behaviors when dealing with food waste and corresponding to the main groups of factors listed by the authors as

influencing consumers' behaviors, namely knowledge, level of concern and demographic and socio-economic conditions (Principato, et al, 2015, p. 733).

Conscious of the limits related to the small number of respondents, making the sample a non-probabilistic one, interesting results have emerged. Data showed that 84% of the total considered themselves already aware of the consequences of food waste, both environmental and economic, still 43.1 % simultaneously “declared that they would probably throw away less if they were more aware” (Principato, et al., 2015, p. 742), highlighting, therefore, how a good educational campaign could definitely favor deeper behavioral changes also among students.

Given the circumstances, thus the lack of projects aiming at the education towards a more sustainable consumption among university students, maybe considered as already “lost” to the “consumerism plague”, arose the idea to develop and present within this work a project proposal focusing on this issue. The aim, stemming from the recognition that only informational campaigns could do little, is to provide both theoretical and practical recommendations and ideas of interventions, to offer students not only the chance to enhance their awareness on food waste issues but also to spur their concrete ability to act upon it, both through knowledge distribution and practical hacks.

Therefore, this strategy was designed on the basis of what has emerged in the previous chapters, namely, the relevance of sociality as a lever to spur people toward more sustainable behavior as well as the importance to address also university students with interventions to teach them how to prevent food waste practices, and especially from the proved overall ineffectiveness of pure informational campaigns.

Indeed, starting from the abovementioned assumptions the declared goal was to develop and suggest a series of theoretical and practical activities to be potentially implemented among young university students, paying special attention to the issue of food waste.

The choice of this target of analysis stems, as previously mentioned, from the gap registered on the topic within the literature as well as on the implemented interventions.

The underlying hypothesis that the combination of awareness raises activities with the provision of practical tips and tools to prevent household food waste would result in a concrete reduction, will not be tested since the context in which the work would develop present for the researcher unavoidable time and budget constraints making it impossible to prove its validity.

Therefore, the project will remain a proposal for now providing, however, the information necessary to potentially implement it to verify or confute the theory.

It will refer to the University of Padua but could be repeated and applied to whichever university is willing to provide its students with an assistance to disentangle the intricacy of adulthood and all the entailed responsibilities.

According to the Portale dei Dati dell'Istruzione Superiore (Ustat Miur, n.d) in the Academic Year 2020/2021 the University of Padua registered 63.032 students, 12.342 of which were new enrolled.

Despite being aware that food waste awareness should be spread among all students, as well as faculty members, the project will be devoted to new enrolled with specific attention to those living alone, in shared apartments or in institutional dormitories. The number identified of students involved in the most time-and-cost-expensive activities is of 150 subjects.

This choice was developed on two main considerations, economic and time constraints limiting the possibility to reach such a high number of people, and the assumption that off-sites students are those most probably facing household duties such as cooking or doing the grocery for the first time, actions which as previously seen are critically contributing to the final amount of food waste generated in households.

Given the relevance of the issue, however, tries were done to avoid these limits by alternating more expensive and limited number interventions, to more low-cost and inclusive ones, making therefore possible to reach also larger targets, at least through informative interventions.

To better develop and manage the project, it has been divided into two parts, one theoretical and one practical. Some of them will be implemented in specific time periods, while others will develop along the whole academic year. Most of the interventions put in place are complementary with each other though not necessarily subsequent, thus possibly implemented in the same period of time. Of all, only two interventions, the most complex and expensive, will instead need to be carried out one after the other, the first being propaedeutic to the second.

Food waste prevention among young university students				
Intervention Timeline				
	Part 1 - Theory		Part 2 - Practice	
	MEETINGS	OTHER ACTIVITIES	COMPETITION	OTHER ACTIVITIES
SEPT. 22	X 2			
OCT. 22				
NOV. 22				
DEC. 22				
JAN. 23				
FEB. 23				
MAR. 23				
APR. 23				
MAY. 23				
JUN. 23				

Fig. 13. Source: Personal elaboration. Intervention timeline.

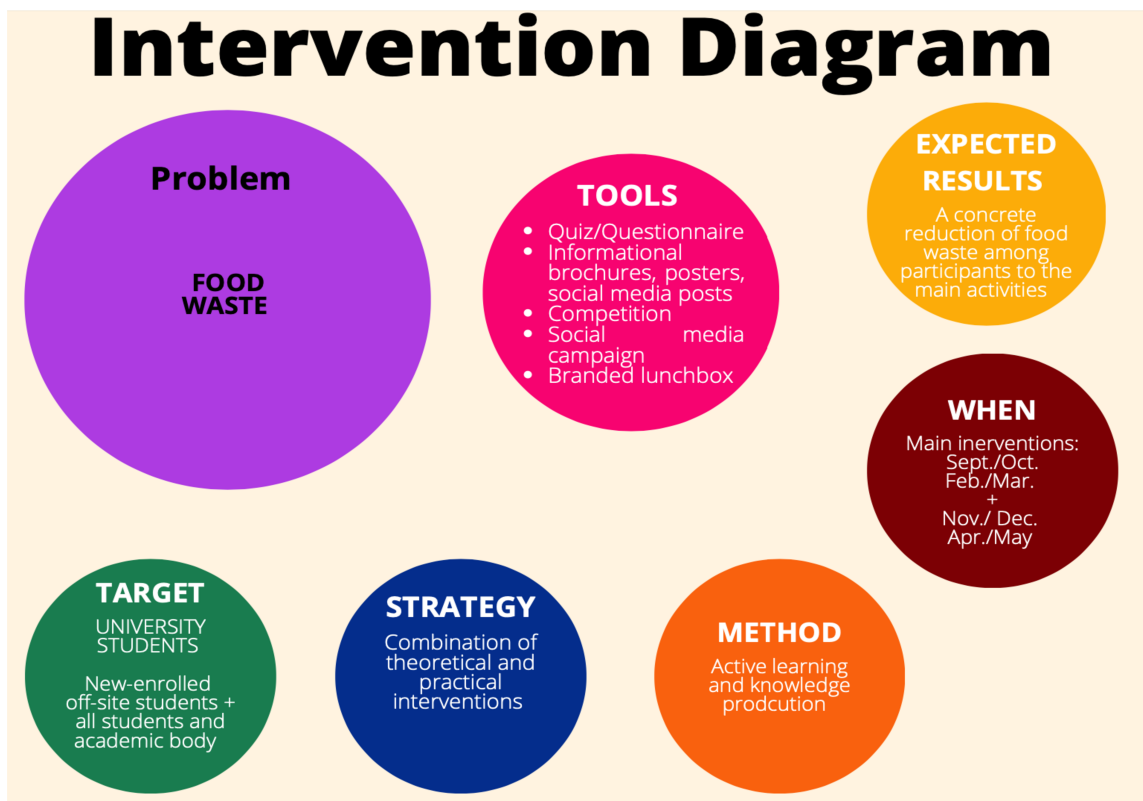


Fig. 14. Source: Personal elaboration. Intervention diagram.

4.2.1 Theoretical interventions

Despite being conscious that purely theoretical interventions, do not consent the achievement of effective changes in people's behaviors, the implementation of some activities devoted to the assessment of students' knowledge on food waste issues and before proposing others to its enhancement, was considered a necessary starting point. Despite the centrale role given to students' engagement it was decided, for convenience's sake, to refer to these interventions as to a theoretical part.

In this phase, as in the practical one, are included both fixed number meetings and open interventions.

In this part of the project, focus will be on testing the awareness of students on the issue, and providing them with information such as, the drivers, the consequences, the barriers towards a reduction of food waste as well as suggestions of potential and concrete counteractions. This phase is therefore mainly devoted to the spread of knowledge on the topic while already providing some hints on alternative solutions.

The most important and complex intervention to be designed and implemented within this section will be represented by in person meetings to which off-site new enrolled students will be invited to participate.

According to the theory of active learning in which, as stated by Konopka et al. (2015), "the construction of knowledge" (p. 1537) must be left to the students themselves, the focus here will be on trying to enhance participants awareness on the issue of food waste, by giving hints and tools but leaving the creation of knowledge to them. Particular attention will be devoted to the need of developing a holistic perspective and to the interdependent concept that wasting food does affect sustainability in all its facets.

These meetings, representing the very first and formative phase of the project proposal, will see the involvement of experts in creating interactive moments of knowledge share and production. The activity will be set up as follow.

5 encounters will be organized by the university, the first three will take place in the months of September and October while the last two in February and March. The decision to opt for these moments during the A.A. is relative to the fact that they coincide with the moments in which new students are most probably arriving in the city. To apport a realistic contribution within this work, we need indeed to consider, as previously mentioned, several constraints possibly limiting the target of our suggestions. These meetings will therefore be set aside only for eligible students (new-enrolled and off-site) who will be invited, through institutional emails, to reserve their spot in these meetings. Each gathering will last one day and will be divided in two sessions lasting around three hours each, which will take place within the same day, and will be divided


by a lunch break of one hour. Professors and experts (especially of circular economics, social sciences, political sciences, etc.) from the university or guests will be the mediators of these meetings. Their role will be of guiding students to the discovery of the intricacy of food waste issues and sustainability. As anticipated, to perform better, the number of students will be limited to 30 per day of meeting, for a total of 150 students involved. During the meetings the sequence of activities must be intense, therefore a good structure is necessary, a more detailed description follows in the next lines:

- Presentation (5 min): the mediator introduce himself/herself and the project;
- Quiz/ Questionnaire (See *Fig. 14*): (20 min): students will be asked to answer some questions. The themes will be sustainability and food waste for the quiz, while the questionnaire will focus more on socio-demographic variables as well as consumption habits and preferences. Most of the answers will be closed, while for few they will have to provide a short answer. The quiz/questionnaire will be submitted individually through a link so that answers in anonymous could be immediately collected and shown on a screen, to present the percentages to the class. This tool has the role to be break the ice at the beginning of the meeting, but more importantly, to set the basis of further discussions;
- Part 1 – Reception of knowledge (90 min): answering the main issues presented in the quiz/questionnaire the mediator will present the issue of food waste, the meaning and relevance of a systemic perspective to deal with it, the main consequences that brought to the actual condition;
- Part 2 – Production of knowledge (60 min): participants will be divided in 5 groups of six, and will be asked to think, discuss, and provide three to five sentences (per group) on the reasons they consider most accountable as drivers or barriers towards and/ or against food waste;
- Lunch break (1 hour): students will be asked to bring their own lunch, preferably made of leftovers;
- Part 3 – Reception of knowledge (90 min): two sentences will be selected by each group to be presented to the class and the mediator will share specific notions on the main reasons for food waste according to the literature, open pro-active discussion is always welcome;
- Part 4 – Production of knowledge (60 min): once informed on the drivers and barriers identified by the literature as mainly generating food waste, students will be asked (still divided in groups) to produce three to five sentences where they suggest ideas for potential interventions to achieve a reduction of food waste;

- Part 5 – Reception and production of knowledge (40 min): in this part the mediator will gather the solutions and ask other groups to constructively comment them;
- Wrap up (15 min): time for final conclusions, comments, and further questions;

In the following pages, a printable version of this tool can be found.

Fig. 15. Source: Personal elaboration. Quiz/Questionnaire



TEST YOUR LEVEL OF SUSTAINABILITY LITERACY

Hello!! This brief quiz and questionnaire are an ice-breaker to let us know you better, and engage in a productive conversation on the theme of sustainability and food waste. Do not worry if you won't know some of the questions they might be deliberately complex!!

QUIZ

1. Do you know when the debate on sustainability started?
1. In 1798, in "An Essay on the Principle of Population"
 2. In 1987, in the Brundtland Report
 3. In 1969, in an official document signed by thirty-three African countries
2. Which are the three pillars of sustainability?
1. Economy, society, environment
 2. Environment, climate, market
 3. Resources, waste production, society
3. How much food do you think is wasted in one year in the whole world?
1. 68.8 million tonnes
 2. 1 billion
 3. 931 million tonnes
4. Where do you think does most of the food gets wasted inside the FSC (production, manufacture, distribution, retail, consumption)
1. Production
 2. Manufacture
 3. Distribution
 4. Retail
 5. Consumption
5. Is there a difference between food surplus, food loss and food waste? If yes, do you know it?
- | | |
|---------------------------------|---------------------------------|
| 1. <input type="checkbox"/> Yes | 1. <input type="checkbox"/> Yes |
| 2. <input type="checkbox"/> No | 2. <input type="checkbox"/> No |

* answers will be anonymous but if during the discussion you will feel of sharing your answers with the group feel free to do it.



TEST YOUR LEVEL OF SUSTAINABILITY LITERACY

6. What types of food do you think are mostly wasted?

- 1. Cereals
- 2. Fruits and vegetables
- 3. Dairy

7. How important do you think the correct storage of food has in its conservation?

- 1. It's irrelevant
- 2. It might play a role
- 3. It's very important

8. How long do cooked grains last in the refrigerator before getting spoiled?

- 1. Paper
- 2. Container
- 3. Cling film

9. Do you know the difference between avoidable and non-avoidable food waste?

- 1. Yes
- 2. No

...IT'S TIME FOR SOME OPEN QUESTIONS

10. Do you know how to correctly read the labels?

- 1. Yes
- 2. No

If yes, then...

11. What does best before mean?

.....

12. What does use-by mean?

.....



TEST YOUR LEVEL OF SUSTAINABILITY LITERACY

13. Do you know some recipes to reuse leftovers?

1. Yes

2. No

If yes, can you tell us what is it and how did you learn it? e.g., my grandma taught me this

.....

QUESTIONNAIRE

One last step, please answer these last few questions to let us know you better

1. Are you interested in sustainability issues? Answer from 1 to 5 (1 = I am not interested and 5 = I am deeply interested)

1

2

3

4

5

2. How much do you consider food waste a problem for our society? Answer from 1 to 5 (1 = it is not that important and 5 = it is a central problem for all of us)

1

2

3

4

5

3. How much did your family consider food waste a problem for our society? Answer from 1 to 5 (1 = it is not that important, 5 = it is a central problem for all of us)

1

2

3

4

5

4. Would you prefer buying less (quantities) more often or buying more (quantities) less often?

Less more often

More less often



TEST YOUR LEVEL OF SUSTAINABILITY LITERACY

5. Do you prefer fresh or long-life products?

Fresh

Long-life

6. How relevant is the economic aspect for you when buying food? Answer from 1 to 5 (1 = I don't mind, 5 = I pay a lot of attention to offers)

1

2

3

4

5

7. How would you describe your cooking skills? Answer from 1 to 5 (1 = very bad, 5 = very good)

1

2

3

4

5

8. Do you consider appropriate the level of knowledge on sustainability and food waste among your peers?

Yes

No

9. Do you live in:

Shared apartment

In an apartment alone

In an institutional dormitory

10. Is this your first experience living alone?

Yes

No

11. What faculty have you enrolled in?

12. How old are you? Where are you from?

THANK YOU FOR YOUR TIME!

Beside these meetings, in which will be seen the implementation of some relevant precepts of educational theories like active learning and reverse pedagogy, other “less complicated” interventions will be devoted to the involvement of a bigger audience, namely not only new enrolled and off-site students but whoever is willing to enhance their pro-environmental behaviors and sustainability knowledge.

These interventions will include the design and publication of leaflets and posters to be hung in places of passage or of meeting, so that everyone could read or take them, i.e. canteens, libraries, hallways, etc..

Being devoted to a wider public, their design must be clear and concise, eventually accompanied by images to immediately captivate the readers’ eyes.

Within the leaflets the information must be correct and to the point, aimed at increasing the knowledge of who’s reading while sparking their interest on the topic. In addition, practical advice on how to reduce the food waste in the everyday life will accompany the theoretical notions making the readers potentially able to immediately perform concrete actions.

Posters on the other hand, will have the scope to spotlight the problem and present it with images and some catch phrases or questions to draw the attention of students’, or that of whoever is attending the university buildings. They might also propose potential activities to be performed in order to reduce the production of food waste. It will be the reader’s responsibility in this case to deepen his or her knowledge on the issue.

For this reason, on leaflets and posters there will also be internet links, directing readers to official web pages of organizations active in the reduction of food waste (among the most renowned Fondazione Barilla, Slow Food, Last Minute Market).

Other interventions to spread and raise awareness on this issue, might also involve the use of social media and electronic devices.

Indeed, through the institutional email and posts on the official social media pages of the university (Instagram, Twitter, Facebook, LinkedIn) students and academics could be reached and addressed, toward interesting scientific journals, articles, videos, shedding light and generating interest on the problem.

Through the same means, practical suggestions on how to reduce household food waste could also be shared.

4.2.2. Practical interventions

Despite the abovementioned being all interesting and useful ways to raise awareness on the topic of food waste, as previously emerged, it is not enough to provide information and knowledge to achieve effective results. What needs to be done is to implement, simultaneously

to the theoretical activities, other interventions through which the target population can be helped and spurred in the concrete implementation of pro-environmental behaviors. The interventions that will be suggested within this framework will mainly lean on economic and social incentives, which have already resulted very effective in spurring behavioral changes.

As it was for the theoretical activities, also in this section there will be one more complex and articulated intervention devoted to a smaller group of students while others will be of wider reach.

It has been developed starting from the theory of social comparison (Festinger 1954) where it is stated that in absence of “objective, non-social means” (p.118) humans tend to evaluate their opinions and ability through the comparison with others presenting similar characteristics, as well as in accordance to what has been stated by Abrahamse and Steg (2013), namely that this tendency “can affect people’s willingness to engage in sustainable behaviors” (p. 3).

The intervention will be a competition as, as also reported by Van Geffen et al. (2020), it counts among the interventions potentially facilitating behavioral change.

This activity will leverage the will of participants of improving their approaches towards food waste by comparing themselves with their past selves and with their colleagues, with the double aim of feeling better with themselves as well as within the society.

To provide continuity and prove the effectiveness of combined interventions, this activity will be the temporal and concrete continuation of the theoretical meetings, it will take place after them and the participants will be the same. The overall duration of this will be of two months, considered as a correct timeframe to give the participants the time to engage in the competition but at the simultaneously not lasting enough to become a burden to them.

An initial meeting will introduce the participants to the structure of the competition and their tasks. The goal is straightforward, the reduction of households’ food waste production. Students, provided with correct instructions, will be asked to write on kitchen diaries what were exactly the products and amounts (in broad terms, as many of them could not have the means to precisely measure quantities) of waste they produced. Considering budget and technological constraints, an objective measurement of the quantities of waste produced by each participant would be difficult to be implemented by external parts, thus, kitchen diaries seemed a good compromise to have “more accurate and less uncertain” data on the actual waste (Withanage et al., 2021, p.8). In addition, they will be asked to note, the causes that drove them to waste, and the feelings associated, i.e. “I forgot I had three uneaten yogurts in the fridge, and they spoiled; I felt guilty”, “I bought too much fruit, because it was on offer, but I couldn’t finish it before it got rotten, I wasted half of it, I felt I should have thought about this possibility”.

Beside this part, which should be performed in autonomy, twice a month a general meeting will be organized. Students will be asked to send their notes to the moderators, maximum three days before the meetings, so that they could analyze them and select the winner of the month, namely the one who mostly improved (reduced the waste) in comparison to its own results of the previous month.

The meetings will last around two hours in which, every time, the moderator will do a brief introduction on different food waste prevention methods. Participants will be asked to share their experiences, what they found easy or difficult, what they did to improve or change their behaviors, whether they were satisfied or not, etc.

Winners will be awarded with a 10% discount for ethical groceries (some local partners will be selected).

Despite the high potential of this intervention, it is important to be conscious of the limits of its implementation, above all stemming from budget constraints. This could be bypassed if the intervention was implemented in collaboration with other organizations active in the spread of sustainability literacy, or with European funds (as part of the Farm to Fork Strategy).

At the end of these meetings, it would have been nice to involve students into a shared dinner made up by dishes prepared with their leftovers, avoiding in this way eventual waste, and enabling them to talk and share anti-waste recipes. This activity, however, could not be performed in the university buildings due to legal constraints on hygienic issues, e.g. Regolamento UE n° 852/2004.

Therefore, the educational institution could limit itself suggesting this to the students who will be able to organize it in a different space.

As for the theoretical section, other interventions will be jointly developed to reach a wider range of students.

The design and sell of a branded lunchbox, in addition to the other items for sale in the university shop, could function as an invite for students to bring their home-made meals for lunch. Those who purchase this lunchbox, will also be gifted of a short leaflet with recipes' suggestions on how to better store food or leftovers to make them last longer or on how to prepare excellent dishes with them.

However, to achieve a more incisive change in the eating habits of students, the university should also provide them with a safe and warm place, where to consume the meals they bring from home.

Lunch areas should be furnished with microwaves, boilers, and some other kitchen essentials, in order to provide students who want to eat their own lunch within the university buildings the possibility of doing it. This intervention would also have other positive implications in relation

to the wellbeing of students. Indeed, as reported by Jönsson et al. (2021), and Dunbar (2017) commensality, or the practice of eating together, has always been central to human development, and focus of research in various academic disciplines, from evolutionary anthropology to social sciences and health-related subjects. On this practice have spoken and written many important intellectuals, giving life to two main schools of thought. The first supported by scholars as Simmel, endorses the idea that eating together functions as a bonding element within the society, while according to the second one, this practice can function in the opposite way, therefore as a “social demarcation, and hierarchical distinction” (Grignon 2001, as cited in Jönsson, et al., 2021, p. 4).

In accordance with the first conceptualization, Dunbar (2017) performed a research to prove the hypothesis that eating with others does provide social, as well as individual benefits. According to him, the potential direct and indirect fitness benefits of eating together are real and he divided them in three different levels, “communal, networking and personal” respectively resulting in “building wider community and inter-community relationships, [...] making and reinforcing (i.e. servicing) friendship and family relationships, [...] and at more frequent (perhaps even daily) intervals and at the personal level in terms of health benefits.” (Dunbar, 2017, p. 2). Despite some unsolved questions about whether it is the practice of eating together to create social engagement or the contrary, according to Dunbar’s analysis on a sample of 2000 people, it appears evident the correlation between social eating and bigger clique sizes, higher levels of satisfaction, higher levels of happiness, increase in the number of people considering life worthwhile, with only one negative correlation related to the engagement with the society.

From these results the conclusion came up that, creating some places where students could share their lunches, could not only incentivize the reuse of leftovers to prepare meals to be eaten together but would also enable students to create and improve their social bonds, making the experience in the university even better, thus increasing the reputation of the Atheneum.

The last interventions to be suggested will imply again the use of institutional social networks. Besides the theoretical role these means of communication could have in spreading knowledge and raising awareness among the targeted public, they can be a successful tool to engage students in performing more pro-environmental behaviors, assigning them the power of making concrete actions and sharing the results with their peers, with the opportunity to influence them or be influenced.

Through the launch of a specific, hashtag #UnipdLoveLeftovers, a social media campaign could spur the correct and wholesome use of foods and leftovers to prepare meals. Being the University of Padua an important national and international educational pole, the focus could

also be given to food specialties from all over the world. Starting from the importance food had in the peasant tradition, which associates all of us, in which nothing had to be wasted, students will be incited in using leftovers, creating not only new and recommended recipes but also sharing less common dishes from their regional or national traditions. Final step of the campaign is of course represented by the upload and share of pictures representing these on a specific page, part of the institutional social media page accompanied by the abovementioned hashtag.

5. Conclusions

5.1 Past, present, and future of a worldwide challenge

The ever-growing population is one of the trends at the basis of the manifold issues humankind has found itself to face since centuries.

Suggested solutions have always considered, as major tool, the increase of production, however, this intensity has not solved the problems as hunger or undernutrition but instead has mainly generated negative impacts and consequences, not only at the environmental level but undermining the pillars of sustainability as a whole.

Indeed, to ensure the ambition shared by different political agendas in recent years of a sustainable development, a switch from the affirmed linear economic model that has been governing global markets for decades toward a more circular one is desirable.

With an increasing awareness on the need to behave in a resource-efficient manner to preserve the system we live in, light must be shed on the issue of food waste.

Achieving sustainable food systems is indeed a crucial goal for a fairer future.

Data are explicit on the inefficiency of food systems as currently working, indeed on the totality of food produced, only 40% reaches the mouths of those who need it (Hensel, 2022), meaning that most of the time it is not a problem of availability though of accessibility.

The reasons for these huge losses, are determined by several factors, related to likewise conditions.

In the least developed and developing countries most of the losses take place in the post-harvest phase, however, concerning developed countries and therefore the context in which this work unfolds most food is wasted in the final stages of the food supply chain (FSC), namely, purchasing and preparation, and consumption.

According to the report published by the Capgemini Research Institute (Bridges, et al., 2022) and as also reported in the UNEP Food Waste Index (2021), as unexpected as it might be, most of the food waste is generated in a domestic environment.

The reasons driving people toward these unsustainable wastes are manifold, from cultural traditions to inability, from economic reasons to unconsciousness.

These numerous interacting elements make the path toward more sustainable food systems even more hampered as this complexity can only be tackled with equally complex counteractions.

Despite the relevance of this issue, only recently have the scientific and academic world realized how reducing food waste could generate a cascade of positive feedback. Indeed, the literature on the theme results many times incomplete or too heterogeneous. This is due to the lack of

shared definitions on how to outline food waste. This uncertainty, together with the lack of harmonized measurement methods, lies among the main causes of lagging countermeasures.

Within this thesis, reference was done to food waste as the “wholesome edible material intended for human consumption, arising at any point in the FSC that is instead discarded, lost, degraded or consumed by pests” (FAO 1981, as cited in Papargyropoulou et al. 2014, p. 108), with specific attention toward final consumers and their actions in favor or against food waste.

As mentioned before, one of the reasons accounted for this trend among final consumers is unawareness.

Only in recent years, an increase in the number of interventions and strategies planned and addressed to help final consumers in tackling the main drivers of food waste has been registered. However, if considering the academic literature, little attention has been focused on these activities and most of the interventions belong to the grey literature, namely have been implemented by practitioners and therefore do not present a theoretical framework. Despite the overall benefit that might stem from these, the lack of a scientific background has generated a gap in terms of homogeneity in addressing similar issues.

This “negligence” has brought, many times, to the design of interventions that did not result in effective outcomes.

Indeed, what emerged is that most of the interventions designed to be implemented within households were of educational type. Despite the relevance knowledge and education play in the creation of conscious and active citizens, according to the little literature dealing with behavioral change associated to food-related practices, educational and informational campaigns have revealed to be the less effective interventions in spurring a concrete change toward a more sustainable behavior (Osbaldiston and Schott, 2012; Van Geffen, et al. 2020).

What also emerged as an important gap is the consideration of households potentially composed of roommates rather than from “traditional” familiar nuclei, which obviously implies different habits and food-related practices.

From these elements developed the goal of the present research, namely, to propose an intervention to reduce food waste among university students while shedding light on the need of addressing this target as active subjects within the food systems moreover as they are often on their first experience of living on their own keeping in mind the need of doing it in an engaging way.

To achieve this goal, the intervention suggested involves the provision of informational fundamentals and concrete alternatives to more wasteful behaviors.

The intervention at issue is composed by two parts one theoretical and one more practical each characterized by one main activity and some others, not less important, background actions. For

the same limits introduced in advance, the main interventions are set aside for a specific target consisting of new-enrolled off-site students therefore considered at the first experience in dealing with food-related practices such as doing the groceries, cooking, or storing food or leftovers. Not forgetting however, that the broader the audience the better, interventions addressing the whole student and academic bodies accompany these closed-number events.

Within the thesis, practical suggestions, on how to concrete implement the work are given, with a timeline and other prepared tools, e.g., quiz/questionnaire.

However, as already stated in chapter 4, due to time and monetary constraints, the intervention designed within this work was not implemented in the real world and therefore, conscious of these practical limits it was not the aim of this work to collect data that could prove or nullify the assumption that educational campaigns combined with the provision of practical tools could result in a concrete reduction and long-term prevention of household food waste.

If the university of Padua, or whichever higher educational institution, would find this work as a potentially beneficial tool worthy of being concretely implemented, monitoring and evaluation methods could be additionally designed and implemented.

The underpinning aim of this work in conclusion was to shed light on a complex and crucial issue for the entire world system, such as food waste, still many times underrated or misaddressed. While doing so also to point out the need for broader and more comprehensive commitment from both the academic and the practitioners' spheres which, collaborating in the development of extensive and engaging strategies, could play a fundamental role in the improvement of such a delicate condition.

Bibliography and sitography

Abrahamse, W., Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-analysis. *Global Environ. Change*

<http://dx.doi.org/10.1016/j.gloenvcha.2013.07.029>

Adnani, M., 2017, *The Economics Review*.

<https://theeconreview.com/2017/01/13/what-neuroscience-has-to-say-about-decision-making/>

Annunziata, A., Muca, F. L., & Mariani, A. (2022). Preventing Household Food Waste in Italy: A Segmentation of the Population and Suggestions for Action. *Sustainability*, 14(12), 7005.

<https://doi.org/10.3390/su14127005>

Arnould, E., Sheth, J., & Malhotra, N. (2011). Consumer culture. *Sheth Jagdish/Maholtra Naresh (Hg.): International Encyclopedia of Marketing*.

https://www.researchgate.net/profile/Eric-Arnould-2/publication/242465260_Global_Consumer_Culture_in_Encyclopedia_of_International_Marketing_Jagdish_Sheth_and/links/54be73830cf218da9391ed03/Global-Consumer-Culture-in-Encyclopedia-of-International-Marketing-Jagdish-Sheth-and.pdf

Asatani, K., Takeda, H., Yamano, H., & Sakata, I. (2020). Scientific attention to sustainability and SDGs: Meta-analysis of academic papers. *Energies*, 13(4), 975.

<https://doi.org/10.3390/en13040975>

Aschemann-Witzel, J., De Hooge, I. E., Rohm, H., Normann, A., Bossle, M. B., Grønhøj, A., & Oostindjer, M. (2017). Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste—A multiple case study. *Journal of cleaner production*, 155, 33-45

<http://dx.doi.org/10.1016/j.jclepro.2016.11.173>

Atkins, P., & Bowler, I. (2016). *Food in society: economy, culture, geography*. Routledge.

Benartzi, S., Beshears, J., Milkman, K. L., Sunstein, C. R., Thaler, R. H., Shankar, M., Tucker-Ray, W., Congdon, W.J., & Galing, S. (2017). Should governments invest more in nudging? *Psychological Science*, 28(8), 1041–1055.

<https://doi.org/10.1177/0956797617702501>

Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom*. 1991 ASHE-ERIC higher education reports. ERIC Clearinghouse on Higher Education, The George Washington University, One Dupont Circle, Suite 630, Washington, DC 20036-1183.

Boyes, E., & Stanisstreet, M. (2012). Environmental education for behaviour change: Which actions should be targeted?. *International Journal of Science Education*, 34(10), 1591-1614.

<https://doi.org/10.1080/09500693.2011.584079>

Brame, C. (2016). *Active learning*. Vanderbilt University Center for Teaching.

Bridges, T., Perrin, J.B., ... Pande, S. (2022). Reflect. Rethink. Reconsider. Why food waste is everybody's problem. Capgemini Research Institute.

<https://www.capgemini.com/insights/research-library/food-waste/>

Brundtland, G.H. (1987) *Our Common Future: Report of the World Commission on Environment and Development*. Geneva, UN-Dokument A/42/427.

<http://www.un-documents.net/ocf-ov.htm>

Buseti, S. (2019). A theory-based evaluation of food waste policy: Evidence from Italy. *Food policy*, 88, 101749.

<https://doi.org/10.1016/j.foodpol.2019.101749>

Canali, M., Amani, P., Aramyan, L., Gheoldus, M., Moates, G., Östergren, K., ... & Vittuari, M. (2016). Food waste drivers in Europe, from identification to possible interventions. *Sustainability*, 9(1), 37.
<https://doi.org/10.3390/su9010037>

Caradonna, J. L. (2014). *Sustainability: A history*. Oxford University Press.
<https://books.google.it/books?hl=it&lr=&id=G2vrAwAAQBAJ&oi=fnd&pg=PP1&dq=history+of+sustainability&ots=GSuWR50gr&sig=3iU7QofGNPvefsZ3EVZX-idVKCI#v=onepage&q=history%20of%20sustainability&f=false>

Chenard, K. C., & Duckworth, R. A. (2021). The special case of behavioral plasticity?. In *Phenotypic Plasticity & Evolution* (pp. 301-325). CRC Press.

Coste, M., Feiteira, F., Condamine, P., (2021). Reducing Food Waste at the Local Level - guidance for municipalities to reduce food waste within local food systems. Zero Waste Europe, Brussels.
<https://www.slowfood.com/wp-content/uploads/2022/01/Guidance-on-food-waste-reduction-in-cities-EN.pdf>

The Club of Rome (accessed on 15/06/2022)
<https://www.clubofrome.org/history/>

da Silva, J. G. (2012). Feeding the world sustainably. *UN Chronicle*, 49(2), 15-17.
<https://doi.org/10.18356/89c2a819-en>

De Brigard, F. (2017) Cognitive systems and the changing brain, *Philosophical Explorations*, 20:2, 224-241,
<http://dx.doi.org/10.1080/13869795.2017.1312503>

do Paço A., Laurett R. (2019) Environmental Behaviour and Sustainable Development. In: Leal Filho W. (eds) *Encyclopedia of Sustainability in Higher Education*. Springer, Cham.
https://doi.org/10.1007/978-3-319-63951-2_14-1

Dunbar, R. I. M. (2017). Breaking bread: the functions of social eating. *Adaptive Human Behavior and Physiology*, 3(3), 198-211.
<https://doi.org/10.1007/s40750-017-0061-4>

Eurostudent. (2021) Le condizioni di vita e di studio degli studenti universitari 2019-2021.
<https://eurostudent.it/nona-indagine-2019-2021/>

Evans, D., Campbell, H., Murcott, A. (2013). *The Sociological Review*, 60:S2, pp. 5–26 (2013), pag. 5, 7
DOI: 10.1111/1467-954X.12035

FAO, Hunger and Food Insecurity. (Accessed on, 13/06/2022, 21/06/2022)
<https://www.fao.org/hunger/en/>

FAO. (2021). *World Food and Agriculture - Statistical Yearbook 2021*. Rome.
<https://doi.org/10.4060/cb4477en>

FAO, IFAD, UNICEF, WFP and WHO. (2021). *The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all*. Rome, FAO.
<https://doi.org/10.4060/cb4474en>

Festinger, L. (1954). A Theory of Social Comparison Processes. *Human Relations*, 7(2), 117–140.
<https://doi.org/10.1177/001872675400700202>

Fischler, C. (1988). Food, self and identity. *Social science information*, 27(2), 275-292.
<https://doi.org/10.1177/053901888027002005>

Fondazione Barilla

<https://www.fondazionebarilla.com/chi-siamo/>, (Accessed on 12/09/2022)
<https://www.skilled4food.net/skilled-il-progetto/>, (Accessed on 12/09/2022)

Foster, J. E. (1998). Absolute versus relative poverty. *The American economic review*, 88(2), 335-341.
<https://www.jstor.org/stable/116944>

Gaiani, S., Caldeira, S., Adorno, V., Segre, A., & Vittuari, M. (2017). Food wasters: Profiling consumers' attitude to waste food in Italy. *Waste management*, 72, 17-24.
<https://doi.org/10.1016/j.wasman.2017.11.012>

Garrone, C., (2022). Anti-spreco alimentare, tutte le misure in Italia e all'estero. Ecologica Online.
<https://www.ecologica.online/2022/08/08/anti-spreco-alimentare-tutte-le-misure-in-italia-e-allestero/>, accessed on 14/09/2022

Giannetti, V., Livi, G. (2021). L'impegno contro lo spreco alimentare: un'opportunità di cambiamento per la sostenibilità globale. *Agriregionieuropa Numero Speciale - Agricalabriaeuropa n.2*, Nov. 2021
<https://agrireregionieuropa.univpm.it/it/content/article/31/58/limpegno-contro-lo-spreco-alimentare-unopportunita-di-cambiamento-la>

Giordano, C., Alboni, F., & Falasconi, L. (2019). Quantities, determinants, and awareness of households' food waste in Italy: A comparison between diary and questionnaire quantities. *Sustainability*, 11(12), 3381.
<https://doi.org/10.3390/su11123381>

Graziano Da Silva José (2012). Feeding the world sustainably. The future we want? No. 1&2 Vol. XLIX
<https://doi.org/10.18356/89c2a819-en>

Gregory, G. D., & Di Leo, M. (2003). Repeated behavior and environmental psychology: the role of personal involvement and habit formation in explaining water consumption 1. *Journal of Applied Social Psychology*, 33(6), 1261-1296.
<https://doi.org/10.1111/j.1559-1816.2003.tb01949.x>

Green School.

<https://www.green-school.it/pillars/view-restyled/3/cibo-e-spreco>. (Accessed on 27/08/2022)

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., & Meybeck, A. (2011). Global food losses and food waste. Extent, causes and prevention. Swedish Institute for Food and Biotechnology (SIK) Gothenburg, Sweden and FAO

Hawkes, C., Parsons, K., & Wells, R. (2019). *Brief 2: Understanding the food system: Why it matters for food policy*. London: Centre for Food Policy.
<https://openaccess.city.ac.uk/id/eprint/22795/>

Hewitt, P.G., (2020). Exponential Growth and Doubling Time. *The Science Teacher*, Vol. 87, Issue 9
<https://www.nsta.org/science-teacher/science-teacher-julyaugust-2020/exponential-growth-and-doubling-time>

Hensel, K., (2022). Facing the food waste crisis, *IFT*, Vol. 75 No. 11
<https://www.ift.org/news-and-publications/food-technology-magazine/issues/2021/december/features/facing-the-food-waste-crisis>

Higgs, K. (2014). *Collision course: Endless growth on a finite planet*. MIT Press.

Higgs, K., (2021). How the world embraced consumerism, retrieved on [bbc.com](https://www.bbc.com/future/article/20210120-how-the-world-became-consumerist) (accessed on, 16/06/2022)
<https://www.bbc.com/future/article/20210120-how-the-world-became-consumerist>

Huang, C. H., Liu, S. M., & Hsu, N. Y. (2020). Understanding global food surplus and food waste to tackle economic and environmental sustainability. *Sustainability*, 12(7), 2892.

<https://doi.org/10.3390/su12072892>

IPES-Food & ETC Group, (2021). A Long Food Movement: Transforming Food Systems by 2045
<http://www.ipes-food.org/pages/LongFoodMovement>

Jönsson,H., Michaud,M., Neuman, N. (2021) What Is Commensality? A Critical Discussion of an Expanding Research Field. *Int. J. Environ. Res. PublicHealth*,18,6235.

<https://doi.org/10.3390/ijerph18126235>

Kahneman, D. (2011). Thinking, fast and slow. Ferrar, Straus & Giroux

Konopka, C. L., Adaime, M. B., & Mosele, P. H. (2015). Active Teaching and Learning Methodologies: Some Considerations. *Creative Education*, 6, 1536-1545.

<http://dx.doi.org/10.4236/ce.2015.614154>

Kostadinova, E. (2016). Sustainable consumer behavior: Literature overview. *Economic Alternatives*, 2, 224-234.

https://www.unwe.bg/uploads/Alternatives/Elena_9_ALTERNATIVI_br2_2016-en.pdf

Laaninen, T., Calasso, M.P. (2020). Reducing food waste in the European Union. EPRS | European Parliamentary Research Service

[https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2020\)659376](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2020)659376)

Lanfranchi, M., Calabrò, G., De Pascale, A., Fazio, A., & Giannetto, C. (2016). Household food waste and eating behavior: empirical survey. *British Food Journal*.

<https://doi.org/10.1108/BFJ-01-2016-0001>

Legge 19 Agosto 2016, n. 166, “Legge Gadda”

Leone, U., (2018), Il club di Roma, 50 anni dopo con gli stessi dilemmi. (Accessed on, 15/06/2022)

<https://ilbolive.unipd.it/it/news/club-roma-50-anni-dopo-stessi-dilemmi>

Lindenberg, S., & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. *Journal of Social issues*, 63(1), 117-137

<https://doi.org/10.1111/j.1540-4560.2007.00499.x>

Magaudda, P. (2015). Consumer Culture, History of. *The Wiley Blackwell Encyclopedia of Consumption and Consumer Studies*, 1-7.

DOI: 10.1002/9781118989463.wbeccs055

McDonald, B. L. (2010). *Food security*. Polity.

Meadows, D. H. (2008). *Thinking in systems: A primer*. chelsea green publishing.

[https://books.google.it/books?hl=it&lr=&id=CpbLAGAAQBAJ&oi=fnd&pg=PR9&dq=Meadows,+D.+H.+\(2008\).+Thinking+in+systems:+A+primer.+chelsea+green+publishing.&ots=LAofqcvER3&sig=ewsTY4VWxnf8Ej-P9_DddqRwAlc#v=onepage&q&f=false](https://books.google.it/books?hl=it&lr=&id=CpbLAGAAQBAJ&oi=fnd&pg=PR9&dq=Meadows,+D.+H.+(2008).+Thinking+in+systems:+A+primer.+chelsea+green+publishing.&ots=LAofqcvER3&sig=ewsTY4VWxnf8Ej-P9_DddqRwAlc#v=onepage&q&f=false)

Meadows, D. H., Meadows, D. L., Renders, J., & Beherens, W. W. III. (1972). *The Limits to Growth*, Universe Books, NY.

Milfont, T.L., Markowitz, E. (2016). Sustainable consumer behavior: A multilevel perspective, *COPSYC*

<http://dx.doi.org/10.1016/j.copsyc.2015.12.016>

Milan Urban Food Policy Pact, 15 October 2015

<https://www.milanurbanfoodpolicypact.org/wp-content/uploads/2020/12/Milan-Urban-Food-Policy-Pact-EN.pdf>

<https://www.milanurbanfoodpolicypact.org/resources/mufpp-policy-brief-2022/#>, (Accessed on 13/09/2022)

<https://www.milanurbanfoodpolicypact.org/the-milan-pact/#>, (Accessed on 13/09/2022)

Milan Urban Food Policy Pact, (2015). Indicators 41. And 42. <https://www.fao.org/3/CB4026EN/CB4026EN.pdf>, <https://www.fao.org/3/CB4027EN/CB4027EN.pdf>

Ministero dell'Università e della Ricerca

<http://ustat.miur.it/dati/didattica/italia/atenci-statali/padova>, (Accessed on 01/09/2022)

Munesue, Y., Masui, T., & Fushima, T. (2015). The effects of reducing food losses and food waste on global food insecurity, natural resources, and greenhouse gas emissions. *Environmental Economics and Policy Studies*, 17(1), 43-77.

<https://doi.org/10.1007/s10018-014-0083-0>

National Geographic Society, 2022, Education (Accessed on 18/06/22)

<https://education.nationalgeographic.org/resource/anthropocene>

OECD, Glossary of Statistical Terms. (Accessed on 25/06/2022)

<https://stats.oecd.org/glossary/detail.asp?ID=6814>

Osbaldiston, R., Schott, J.P., 2012. Environmental sustainability and behavioral science: meta-analysis of proenvironmental behavior experiments. *Environ. Behav.* 44 (2), 257–299.

<http://eab.sagepub.com/content/44/2/257>

Parkin, S., Johnston, A., Buckland, H., Brookes, F., & White, E. (2004, February). Learning and skills for sustainable development: Developing a sustainability literate society. Guidance for higher education institutions. In *Higher Education Partnership for Sustainability (HEPS)/Forum for the Future, London.* [Available from: www.forumforthefuture.org.uk/uploadstore/curriculum

DOI: [10.4236/jcc.2014.22007](https://doi.org/10.4236/jcc.2014.22007)

Pellegrini, G., Sillani, S., Gregori, M., & Spada, A. (2019). Household food waste reduction: Italian consumers' analysis for improving food management. *British Food Journal*, 121(6), 1382-1397.

<https://doi.org/10.1108/BFJ-07-2018-0425>

Principato, L., Secondi, L. and Pratesi, C.A. (2015), "Reducing food waste: an investigation on the behaviour of Italian youths", *British Food Journal*, Vol. 117 No. 2, pp. 731-748.

<https://doi.org/10.1108/BFJ-10-2013-0314>

Regolamento (CE) N. 852/2004 del Parlamento Europeo e del Consiglio del 29 aprile 2004 sull'igiene dei prodotti alimentari (GU L 139 del 30.4.2004, pag. 1)

Ritchie, H., Roser, M. (2020) - "Environmental Impacts of Food Production". *Published online at OurWorldInData.org*. Retrieved from: '<https://ourworldindata.org/environmental-impacts-of-food>' [Online Resource]

<https://ourworldindata.org/environmental-impacts-of-food>

Salite, I., & Pipere, A. (2006). Aspects of sustainable development from the perspective of teachers. *Journal of Teacher Education and Training*, 6, 15-32

https://www.researchgate.net/profile/Anita-Pipere/publication/273445539_Aspects_of_sustainable_development_from_the_perspective_of_teachers/links/50339a10cf24cee39fd69ab/Aspects-of-sustainable-development-from-the-perspective-of-teachers.pdf

https://www.researchgate.net/profile/Anita-Pipere/publication/273445539_Aspects_of_sustainable_development_from_the_perspective_of_teachers/links/50339a10cf24cee39fd69ab/Aspects-of-sustainable-development-from-the-perspective-of-teachers.pdf

Scalvedi, M. L., & Rossi, L. (2021). Comprehensive measurement of Italian domestic food waste in a european framework. *Sustainability*, 13(3), 1492.

<https://doi.org/10.3390/su13031492>

Sen, A. (1981). *Poverty and famines: an essay on entitlement and deprivation*. Oxford university press

- Shaw, P. J., Smith, M. M., & Williams, I. D. (2018). On the prevention of avoidable food waste from domestic households. *Recycling*, 3(2), 24.
<https://doi.org/10.3390/recycling3020024>
- Slooman, S. A. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin*, 119(1), 3–22.
<https://doi.org/10.1037/0033-2909.119.1.3>
- Soma, T., Li, B., & Maclaren, V. (2021). An evaluation of a consumer food waste awareness campaign using the motivation opportunity ability framework. *Resources, Conservation and Recycling*, 168, 105313.
<https://doi.org/10.1016/j.resconrec.2020.105313>
- Sonetti, G., Barioglio, C., & Campobenedetto, D. (2020). Education for sustainability in practice: a review of current strategies within Italian universities. *Sustainability*, 12(13), 5246.
<https://doi.org/10.3390/su12135246>
- Spreco Zero, Last Minute Market.
<https://www.sprecozero.it/reduce/>, (Accessed on 27/08/2022)
- Stancu, V., Haugaard, P., & Lähteenmäki, L. (2016). Determinants of consumer food waste behaviour: Two routes to food waste. *Appetite*, 96, 7-17.
<https://doi.org/10.1016/j.appet.2015.08.025>
- Stávková J., Stejskal L., Toufarová Z. (2008): Factors influencing consumer behaviour. *Agric. Econ. – Czech*, 54: 276-284.
<https://doi.org/10.17221/283-AGRICECON>
- Stöckli, S., Niklaus, E., & Dorn, M. (2018). Call for testing interventions to prevent consumer food waste. *Resources, conservation and recycling*, 136, 445-462.
<https://doi.org/10.1016/j.resconrec.2018.03.029>
- STREFOWA – Strategies to Reduce Food Waste in Central Europe, ,
<https://www.interreg-central.eu/Content.Node/STREFOWA.html>, (Accessed on, 11/09/2022)
<https://www.lifefoster.eu/food-waste-in-the-eu/>, (Accessed on, 06/09/2022)
<http://www.reducefoodwaste.eu/pilot-actions.html>, (Accessed on 11/09/2022)
<http://www.reducefoodwaste.eu/pa13-food-waste-prevention-in-households.html>, (Accessed on 11/09/2022)
- Sulitest.org (Accessed on 20/06/2022)
<https://www.sulitest.org/en/vision-mission.html>
- Sustainability for all, Do you know when sustainability first appeared? (Accessed on 17/06/2022)
https://www.activesustainability.com/sustainable-development/do-you-know-when-sustainability-first-appeared/?_adin=02021864894
- Teigiserova, D. A., Hamelin, L., & Thomsen, M. (2020). Towards transparent valorization of food surplus, waste and loss: Clarifying definitions, food waste hierarchy, and role in the circular economy. *Science of the Total Environment*, 706, 136033.
<https://doi.org/10.1016/j.scitotenv.2019.136033>
- Tilman, D. (1999). Global environmental impacts of agricultural expansion: the need for sustainable and efficient practices. *Proceedings of the national Academy of Sciences*, 96(11), 5995-6000.
<https://doi.org/10.1073/pnas.96.11.5995>
- Too Good To Go.
<https://toogoodtogo.it/it/campaign/commitment/commitments>, (Accessed on 13/09/2022)
<https://toogoodtogo.it/it/press/releases/combattere-lo-spreco-alimentare-lapp-too-good-to-go-in-italia>, (Accessed on 13/09/2022)

- Trudel, R. (2019). Sustainable consumer behavior. *Consumer psychology review*, 2(1), 85-96.
<https://doi.org/10.1002/arcp.1045>
- United Nations Environment Programme (2021). Food Waste Index Report 2021. Nairobi.
<https://www.unep.org/resources/report/unep-food-waste-index-report-2021>
- United Nations, Sustainable Development Goals Knowledge Platform (Accessed on 20/06/2022)
<https://sustainabledevelopment.un.org/sdinaction/hesi/literacy>
<https://sustainabledevelopment.un.org/rio20.html>
<https://sustainabledevelopment.un.org/topics/sustainableconsumptionandproduction>
- United Nations, Sustainable Development Goals.
<https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>, (Accessed on 06/09/2022)
- University of Oxford (Accessed on, 20/06/2022)
<https://www.futureoffood.ox.ac.uk/what-food-system>
- van Geffen, L., van Herpen, E., van Trijp, H. (2020). Household Food Waste—How to Avoid It? An Integrative Review. In: Närvänen, E., Mesiranta, N., Mattila, M., Heikkinen, A. (eds) Food Waste Management. Palgrave Macmillan, Cham.
https://doi.org/10.1007/978-3-030-20561-4_2
- Van de Kerk, G., & Manuel, A. R. (2008). A comprehensive index for a sustainable society: The SSI—the Sustainable Society Index. *Ecological Economics*, 66(2-3), 228-242.
<https://doi.org/10.1016/j.ecolecon.2008.01.029>
- Vivero Pol, J.L. (2015). Food is a public good. *World Nutrition* Volume 6, Number 4, April 2015
<https://www.researchgate.net/publication/274377117>
- von Braun, J., Afsana, K., Fresco, L.O., Hassan, M., Torero, M., (2021). Food Systems – Definition, Concept and Application for the UN Food Systems Summit. The Scientific Group for the UN Food Systems Summit
https://agroavances.com/img/publicacion_documentos/ScGroup_Reader_UNFSS2021_compressed.pdf#page=40
- Wilmoth, J., Menozzi, C., Bassarsky, L., Population Division/UNDESA (2022). Policy Brief n. 130.
<https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/PB-130-FINAL.pdf>
- Withanage, S. V., Dias, G. M., & Habib, K. (2021). Review of household food waste quantification methods: Focus on composition analysis. *Journal of Cleaner Production*, 279, 123722.
<https://doi.org/10.1016/j.jclepro.2020.123722>
- WHO, (2018). Millennium Development Goals.
[https://www.who.int/news-room/fact-sheets/detail/millennium-development-goals-\(mdgs\)](https://www.who.int/news-room/fact-sheets/detail/millennium-development-goals-(mdgs))
- WRI, accessed on 17/06/2022
<https://www.wri.org/food>
- Yearworth, M. (2014). *A Brief Introduction to System Dynamics Modelling* (pp. 15). University of Bristol. 24 October 2014
- 1° Anniversario - Patto contro lo spreco alimentare - Impact Report (2021)
<https://toogoodtogo.it/it/download/impact-report-patto-2021>
- 100 Food Facts - Piccola Guida per Grandi Cambiamenti. Fondazione Barilla.
<https://www.fondazionebarilla.com/i-food-facts/>

Annex 1

Category Food waste - Indicator 41



Food and Agriculture
Organization of the
United Nations



Milan Urban Food Policy Pact Monitoring Framework

March 2021 version

Indicator 41: Total annual volume of food losses & waste

MUFPP framework of actions' category: Food waste

The indicator measures (decrease in) total annual volume of food losses & waste.

Overview table

MUFPP Work stream	Food waste
MUFPP action	<p>Convene food system actors to assess and monitor food loss and waste reduction at all stages of the city region food supply chain, (including production, processing, packaging, safe food preparation, presentation and handling, re-use and recycling) and ensure holistic planning and design, transparency, accountability and policy integration.</p> <p>Raise awareness of food loss and waste through targeted events and campaigns; identify focal points such as educational institutions, community markets, company shops and other solidarity or circular economy initiatives.</p>
What the indicator measures	Total annual volume of food losses & waste
Which variables need to be measured / what data are needed	<p>-Food waste generated at system stages:</p> <ul style="list-style-type: none"> • Production • Handling and storage • Handling and storage • Distribution and point of purchase • Household/ consumption <p>- Types of food wasted</p> <p>-Edible vs inedible food</p> <p>-Destinations of food waste (landfill, composting, redistribution, etc.)</p>
Unit of measurement <i>(i.e. Percentages, averages, number, etc.)</i>	Tonnes or Kilograms of food waste
Unit(s) of Analysis <i>(i.e. people under 5 years old, etc.)</i>	Weight of food entering municipal waste stream
Possible sources of information of such data	<p>- Municipal waste management department</p> <p>- Private haulage companies</p>

The views expressed in this product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

Possible methods/tools for data-collection	Sampling and weighing
Expertise required	No specific expertise is required to operate a weighing device and record the results.
Resources required/ estimated costs	Weighing can be costly if an entity is weighing food loss and waste from more than one location. In addition to the initial purchase or rental of a weighing device, transport of the device and personnel can be cost-prohibitive, particularly in areas with poor vehicular access. The main constraints on weighing, however, are logistics and feasibility rather than cost ¹ .
Specific observations	
Examples of application	The Natural Resources Defense Council describes the results of a food waste baseline assessment study in three U.S. cities—Denver, Nashville, and New York City—for residential and non-residential sectors, including the industrial, commercial and institutional sectors. The intent of the study was to characterise the amount of food that is wasted in these cities, identify some of the reasons why the food is going to waste, and then use that data to help inform and inspire initiatives to prevent wasting food, to rescue surplus food to benefit people in need, and to recycle food scraps. Outputs from the study not only include the results of the research, but also templates and descriptions of the methodologies in hopes that this study will contribute to a working model for other cities to perform similar assessments ² .

Rationale/evidence

A significant share of food grown for human consumption is never eaten. It is estimated that one third, by weight, of all food produced in the world was lost or wasted in 2009. This equates to US\$940 billion per year in economic losses and is linked to approximately one quarter of all water used by agriculture³. Food is lost or wasted throughout the supply chain, from production to household consumption. Food waste that rots in landfills emits harmful greenhouse gases. Target 12.3 of the United Nations Sustainable Development Goals calls for the halving of per capita global food waste by 2030.

Cities are key players because they are responsible for solid waste services and have economic, social and sustainability goals that food waste solutions can support. Many cities have analysed the types of materials that end up in the waste stream, few have done comprehensive food waste assessments, especially at the household level. Local governments need further data on the types of food that ends up in the waste stream, what proportion is edible versus inedible and why the food is wasted. This lack of information and the variations in methodologies are barriers to developing strategies to reduce food loss and waste. The World Resources Institute has developed a comprehensive “Food Loss and Waste Accounting and Reporting Standard” to facilitate the quantification of food loss and waste (FLW) and encourage consistency and transparency of the analyses⁴.

Glossary/concepts/definitions used

Food Loss and Waste: All edible and inedible parts that are discarded or wasted.

¹ World Resources Institute (2017). Guidance on FLW Quantification Methods: Supplement to the Food Loss and Waste (FLW) Accounting and Reporting Standard, Version 1.0. Available from http://flwprotocol.org/wp-content/uploads/2017/06/FLW-Protocol_Guidance-on-FLW-Quantification-Methods.pdf.

² Natural Resources Defense Council (2017). Estimating Quantities and Types of Food Waste at the City Level. Available from <https://www.nrdc.org/sites/default/files/food-waste-city-level-report.pdf>.

³ FAO (2011). Global food losses and food waste: Extent, causes and prevention. Rome. <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>

⁴ World Resources Institute (2017). Food Loss and Waste Accounting and Reporting Standard. Available from https://www.wri.org/sites/default/files/REP_FLW_Standard.pdf.

Food: Any substance that is intended for human consumption. This includes beverages and any substance that has been used in the manufacture, preparation, or treatment of food. "Food" also includes material that has spoiled and is therefore no longer fit for human consumption.

Inedible Parts: Components associated with food that, in a particular food supply chain, are not intended to be consumed by humans. Examples of inedible parts associated with food could include bones, rinds, and pits/stones. "Inedible parts" do not include packaging. What is considered inedible varies among users (e.g., chicken feet are consumed in some food supply chains but not others), changes over time, and is influenced by a range of variables including culture, socio-economic factors, availability, price, technological advances, international trade, and geography.

Destination: Where material removed from the food supply chain is directed, such as landfill, animal feed, composting, etc.

Preparations

A meeting should be organised with all staff who will be involved in this activity to:

- Familiarise them with food loss and waste assessments
- Agree on the objectives and scope of the analysis and data collection requirements
- Define the methodology to be applied for data collection and analysis, and
- How to coordinate the activities.

Sampling:

In many instances it will be impractical to weigh all the Food Loss and Waste (FLW), in which case a sample of FLW should be taken and weighed. Sampling is the process of choosing to measure or approximate, over a given period of time, the amount of FLW from a subset of FLW-producing units within a population, or from a fraction of the physical FLW produced. An entity may undertake both these types of sampling, which involve the following.

Selecting a representative sample impacts the accuracy of the data. It is important that the sample of FLW is as representative as possible of all units and all FLW in the population. There are two main approaches to sampling FLW-producing units, which differ in how well the data produced represents all units. The approaches are "probability" and "non-probability" sampling. In probability sampling, all FLW-producing units in the population stand a known and equal chance of being selected, thus produce a random sample that can statistically represent the characteristics of the whole population being studied. In non-probability sampling, the likelihood of any one FLW-producing unit being selected is often not known (e.g., sometimes because the exact size and nature of the population from which the sample will be drawn are not fully understood). Non-probability samples are less reliable indicators of the characteristics of the whole population. For further guidance, see Appendix A "Approaches to Sampling and Scaling Up Data" in the Loss and Waste Accounting and Reporting Standard (World Resources Institute, 2017).

Data Collection and Analysis

WRI's Food Loss and Waste Accounting and Reporting Standard⁵ provides detailed steps for data collection methods and data analyses. Please refer to the following resources for further clarification:

- Chapter 8: Collecting, Calculating, and Analysing Data
- Chapter 11: Recording Causes of Food Loss and Waste

⁵ World Resources Institute (2017). Food Loss and Waste Accounting and Reporting Standard.

For a clear language step by step guide to residential household waste assessment, see Chapter 3 of NRDC's Estimating Quantities and Types of Food Waste at the City Level. Chapter 4 provides an overview of industrial, commercial and institutional waste assessments.

References and links to reports/tools

Eurostat (2012). Guidance on municipal waste data collection.

World Resources Institute (2017). Food Loss and Waste Accounting and Reporting Standard. Available from https://www.wri.org/sites/default/files/REP_FLW_Standard.pdf.

World Resources Institute (2017). Guidance on FLW Quantification Methods: Supplement to the Food Loss and Waste (FLW) Accounting and Reporting Standard, Version 1.0. Available from http://flwprotocol.org/wp-content/uploads/2017/06/FLW-Protocol_Guidance-on-FLW-Quantification-Methods.pdf.

WRAP Cymru (2016). National municipal waste compositional analysis in Wales.



Food and Agriculture
Organization of the
United Nations



Milan Urban Food Policy Pact Monitoring Framework

March 2021 version

Indicator 42: Annual number of events and campaigns aimed at decreasing food loss and waste

MUFPP framework of actions' category: Food waste

The indicator collects information on the types of activities (events, campaigns, research studies), targeted sectors (households, business, foodservice, manufacturing, production etc.) and -if applicable- the actual impact on food waste reduction.

Overview table

MUFPP Work stream	Food waste
MUFPP action	<p>Convene food system actors to assess and monitor food loss and waste reduction at all stages of the city region food supply chain, (including production, processing, packaging, safe food preparation, presentation and handling, re-use and recycling) and ensure holistic planning and design, transparency, accountability and policy integration.</p> <p>Raise awareness of food loss and waste through targeted events and campaigns; identify focal points such as educational institutions, community markets, company shops and other solidarity or circular economy initiatives.</p>
What the indicator measures	Annual number of events and campaigns aimed at decreasing food loss and waste
Which variables need to be measured / what data are needed	<ul style="list-style-type: none"> ▪ Types of activities (events, campaigns, research studies) ▪ Targeted sectors (households, business, foodservice, manufacturing, production etc.) ▪ If applicable: the impact on food waste reduction in kg
Unit of measurement	Annual number of events and campaigns
Unit(s) of Analysis	Data disaggregation by type of activity and target audience
Possible sources of information of such data	<ul style="list-style-type: none"> - Civil society annual reports - Annual reports of organizations that implement recovery and redistribution of safe and nutrition food for direct human consumption - Lifelong learning / education institutions - Records from solid waste or environmental departments or external stakeholders supporting events and campaigns
Possible methods/tools for data-collection	<ul style="list-style-type: none"> - Analysis of records for the actions taken - Survey among relevant stakeholders

The views expressed in this product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

Expertise required	Data analysis, survey design and implementation
Resources required/ estimated costs	Desk study resource allocation
Specific observations	To the extent possible the actual impacts in terms of food waste or food loss reduction should be highlighted. This will ultimately support assessment of the use and effectiveness, and cost-benefits, of the events and campaigns.
Examples of application	Measuring the Impacts of a Campaign to Reduce Food Waste on Campus in Thailand. This study took place in two dining halls at a large university during the fall 2016 semester ¹ .

Rationale/evidence

A significant share of food produced for human consumption is never eaten. The Food and Agriculture Organization of the United Nations (FAO) estimates that a third, by weight, of all food produced in the world was lost or wasted in 2009. This level of inefficiency has significant economic, social, and environmental impacts. According to FAO estimates (FAO, 2014) the societal costs of a third of the food production getting lost or wasted each year amounts to about USD 2.6 trillion, of which USD 700 billion are societal costs of environmental impacts, USD 1 trillion are costs from economic losses of wasted and lost production, and USD 900 billion are costs due to individual well-being losses. This exacerbates the pressure on the global food system to ensure food security and nutrition for all. The amount of food lost or wasted translates into about a quarter of all water used by agriculture, and it requires cropland equivalent to an area the size of China, while being responsible for an estimated 8% of global greenhouse gas emissions. The wasted and discarded edible parts as well as the inedible parts associated with food (e.g., bones, rinds, pits/stones) take up space in landfills and contribute to increased management costs and greenhouse gas emissions during decomposition.

Many countries, cities, companies, and other entities can improve insight into how much, why, and where food and/or associated inedible parts are removed from the food supply chain. Achieving the Sustainable Development Goals is engaging all actors of the global food system. SDG 12.3 - *By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.*

Improved access to information and data availability in the public domain can:

1. Support strategies and prioritise actions to prevent food loss and waste
2. Identify the most efficient ways to prevent safe and nutritious food to be lost or wasted
3. Identify the context-based alternative – for when the resource becomes waste,

And thus help improve the design and targeting of food loss and waste campaigns and events.

For example, the Ontario Food Collaborative (OFC) in Canada is a cross-municipal collaboration to establish a multi-stakeholder strategy for reducing food waste in the Region, which resulted in the approval of a strategic plan of action in 2016. The Ontario Food Collaborative brings together stakeholders to take a holistic food systems approach in supporting individuals and families to reduce food waste. The OFC actors include Government (all levels), Non-Government Organisations (NGOs), Food Producers (Farmers), Food Processors/Manufacturers, Distributors and Retailers, and Restaurants/Food Services. Studies done by the Value Chain Management Centre, Food Waste in Canada (November 2010) and the 'York Region Integrated Waste Management Master Plan 2013' show that 40% of food produced and sold in Canada is wasted (valued at CAD 31 billion), with 51% of food waste in Canada occurring at home. Data are also available on the main sources of food waste in different parts along the supply chain. Household food waste results in economic losses of about CAD 1,500 per year for each Canadian household (equalling one quarter of the average household food

¹ <http://www.fao.org/save-food/regional/asiapacific/en/>

budget). In York Region, approximately 20% of the food wastage at home could be avoided by improved practices (based on York Region audit data). As part of their Waste Management Master Plan, the York Region has targeted a 15% reduction in avoidable food waste by 2031. The Environmental Services Department has developed a communications strategy and public education campaign to help residents take action to reduce food waste. The campaign was based on market research conducted by York Region amongst leading grocery stores to understand consumers' motivations regarding food purchasing, preparation, and waste; and to gather feedback and opinions on food waste and education².

Glossary/concepts/definitions used

Food Loss and Waste (FLW): All edible and inedible parts that are discarded or wasted.

FAO (2014) defines **food loss** as 'the decrease in quantity or quality of food'. It refers to agricultural, livestock, fisheries or forestry products intended for human consumption that are ultimately not eaten by people or that have incurred a reduction in quality reflected in their nutritional value, economic value or food safety.

An important part of food loss is '**food waste**', which refers to the discarding or alternative (non-food) use of food that was fit for human consumption – by choice or after the food has been left to spoil or expire as a result of negligence (FAO, 2014).

Recovery of safe and nutritious food for human consumption is to receive, with or without payment, food (processed, semi-processed or raw) which would otherwise be discarded or wasted from the agricultural, livestock, forestry and fisheries supply chains of the food system.

Redistribution of safe and nutritious food for human consumption is to store or process and then distribute the received food pursuant to appropriate safety, quality and regulatory frameworks directly or through intermediaries, and with or without payment, to those having access to it for food intake. (FAO, 2015)

Preparations

The team responsible for monitoring this indicator should agree on the type of data disaggregation and categories that will be used and the data collection method.

Sampling

Given that food loss and waste events and campaigns are still a new area, it is unlikely that sampling will be needed.

Data Collection and Analysis

During a monitoring/review meeting the following table can be discussed and filled. Specific observations made during the meeting can be added in the final column. Also recommendations for improvement can be added here.

Scoring sheet

² Gianfelici et al, 2016. York, Canada: The Ontario Food Collaborative-A city region initiative for preventing and reducing food waste. In: Dubbeling M., C. Bucatariu, G. Santini, C. Vogt and K. Eisenbeiß , 2016. *City Region Food Systems and Food Waste Management Linking Urban and Rural Areas for Sustainable and Resilient Development*. Deutsche Gesellschaft für Internationale Zusammenarbeit / GIZ, RUAF Foundation, Food and Agriculture Organization of the United Nations / FAO. Available from <http://www.ruaf.org/publications/city-region-food-systems-and-food-waste-management-2016> and <http://www.fao.org/3/a-i6233e.pdf>.

Category Food waste - Indicator 42

Characteristics	Scoring			Total score	Disaggregation of information	Observations / Recommendations
	Yes= 1 point	No= 0 points				
Presence of annual events and campaigns aimed at decreasing food loss and waste					Number and type of events and campaigns	
Intended Audiences: -Consumer households -Schools/hospitals/public institutions -Private sector in the food chain (producers, processing, retail, catering) -Other private sector (offices) -Other	Yes, consumer households= 1 point	No consumer households= 0 points			Number and types of groups targeted for events and campaigns	
	Yes, schools/Hospitals/public institutions= 1 point	No schools/hospitals= 0 points				
	Yes, private sector food chain= 1 point	Yes, private sector food chain= 1 point				
	Yes, other private sector= 1 point	No, other private sector= 0 point				
	Other (sub)categories= 1 point	No other (sub)categories= 0 points				
Impact in terms of food waste reduction	Yes= 1 point	No= 0 points			Data on actual impact in Kg or % food loss and waste reduction	
Design of events and campaigns is based on actual information on food loss and waste and stakeholder surveys	Yes, Completely= 2 points	Partially, 1 point	No=0 points		-Type of information and data used and how this was used -Type of questionnaires and the no. of replies received from participants (e.g. are participants able to identify the main causes and solutions to food loss and waste? Are they able to willing/able to implement actions to reduce loss and waste?)	
Total score:						

Note: For the purposes of these guidelines certain qualifiers and scoring points are defined in the scoring sheet above as to determine an overall score or value of the indicator. Nevertheless, for certain cities some of the qualifiers or scoring levels will be more crucial than others to determine the score of the indicator. Cities could, based on the local context and priorities, identify other or additional key qualifiers or scoring levels to define the overall score of the indicator. For example, one city may decide that targeting a specific audience/target group is critical as earlier data have shown that large percentages of food loss and waste are generated at specific stages of the food chain. Addressing

campaigns to such target groups may be reflected in giving these additional scoring points. Cities may also define other specific subcategories of target groups/audiences to be scored separately.

References and links to reports/tools

Dubbeling M., C. Bucatariu, G. Santini, C. Vogt and K. Eisenbeiß (2016). City Region Food Systems and Food Waste Management Linking Urban and Rural Areas for Sustainable and Resilient Development. Deutsche Gesellschaft für Internationale Zusammenarbeit / GIZ, RUAF Foundation, Food and Agriculture Organization of the United Nations / FAO. Available from <http://www.ruaf.org/publications/city-region-food-systems-and-food-waste-management-2016> and <http://www.fao.org/3/a-i6233e.pdf>.

Guidance on FLW Quantification Methods: Supplement to the Food Loss and Waste (FLW) Accounting and Reporting Standard, Version 1.0.

http://flwprotocol.org/wp-content/uploads/2017/06/FLW-Protocol_Guidance-on-FLW-Quantification-Methods.pdf

Hanson, C., Lipinski, B., Robertson, K., Dias, D., Gavilan, I., Gréverath, P. & Timmermans, T. (2016). Food loss and waste accounting and reporting standard. World Resources Institute: Washington DC, USA, 160. Available from https://www.wri.org/sites/default/files/REP_FLW_Standard.pdf