Food loss and waste: the new buzzwords. Exploring an evocative holistic 4Es model for firms and consumers

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Abstract

Purpose – Etymologically, the word “loss” means to be deprived, temporarily or permanently, of use of faculty or an advantage. Therefore, when businesses and entrepreneurs suffer large amount of losses, they can be attributed to a non-effective and non-efficient way of handling assets. Consequently, high levels of bad management can be the cause for food losses (FL) across the agri-food supply chain, food waste (FW) depends on consumers’ behavior in organizing food basket. Food loss and food waste (FWL) negatively affect environment and global economy. The purpose of this paper is to propose a holistic 4Es (Ethical_Equity_Ecological_Economic) approach aimed at better managing and treating FLW along the agri-food chain from upstream to downstream stages by addressing entrepreneurs and consumers’ approach.

Design/methodology/approach – The work focuses on the definition and designing of three possible tools: (1) the implementation of a FL_break-even point model; (2) the Hazard Analysis Critical Control Point (HACCP) procedures including a scheme for FL critical points and (3) a consumer’s tax FW declaration model. Beginning with these tools, the work tries to define a holistic model by involving all the actors performing in a strictly inter-linked system.

Findings – Approaching the FLW issue in a holistic way can ensure the involvement of engaged and productive people at work, lead to strategies and policies aimed at enriching consumers’ awareness and entrepreneurs’ management approach, and can address the handling of FLW toward Ethical, Equity, Ecological and Economic (that means effective and efficient) paths.

Social implications – Monitoring and decreasing FLW by implementing the proposed tools from upstream to downstream of the food supply chain can certainly improve the reliability of firm production and investment decisions, and at the same time, behavior of people who feel to be part of an interrelated system. This can help to lighten FLW negative impacts on consumers’ income and on pollution as well as indirectly on poverty.

Originality/value – This paper wants to make an innovative attempt to approach the FLW issue in a global and holistic way, while focusing on behavior and awareness of firms/entrepreneurs and consumers/citizens. In addition, the tools and approach defined pave the way for subsequent empirical works to follow.

Keywords Food losses and waste handling, Break-even point, HACCP procedure, Tax declaration model, Holistic approach

Paper type Conceptual Paper

1. Introduction

Over the last decade, food loss and food waste (FLW) represent the new buzzwords that guide the path of international and national policies, strategies and programs (Chaboud and Daviron, 2017). Schneider (2013) shows how several terms have been used interchangeably, such as food loss, food waste, biowaste and kitchen waste. Indeed, someone (ADEME, 2016) decides not to differentiate the terms food “loss” and food “waste”. Instead, they indicate the same outcome for both terms: food products lost for human consumption. The more ancient notion declares that food waste or loss represent, in any way, the destruction or deterioration

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of food (Kling, 1943a, 1943b). According to the World Resources Institute (WRI) (2015), terms, food loss and waste, refer to food and are associated as inedible parts, removed from the food supply chain as well. In particular, food loss (FL) happens in the production and distribution segments of the food supply chain and is mainly caused by the functioning of agri-food supply systems or its institutional and legal framework (FAO, 2013 and 2014). Only food that is still edible at the time of disposal is considered as waste: food waste (FW) is a subset of food loss and occurs when an edible item goes unconsumed (Buzby et al., 2014a). Therefore, food losses represent the main set of food “lost” in the supply chain between producer and market (FAO, 2018a, b). They represent irrational use of resources while producing a negative direct impact on the income of entrepreneurs and consumers (through higher prices) and indirect negative impact on the rate of undernourishment of the global population (Aanclerio et al., 2015; Fiore et al., 2015a, b; Bellia et al., 2015). In addition, this great vain amount of food resources (Koester, 2015 and 2017; FAO 2014 and 2013; Fiore et al., 2015b; Buzby and Hyman, 2012; WRAP, 2009; OECD, 2008) determines along the supply chain activities the increase of greenhouse gas (GHG) emissions, that can remain in the atmosphere for thousands of years by determining a global impact, no matter where emissions were first emitted (Vittuari et al., 2020a, b; Fiore et al., 2017; Sala et al., 2017; Alemu et al., 2017; Cerri et al., 2016; Venkat, 2011).

As a result, farms and consumers’ approach and behavior represents a great contributor to global GHGs emissions, whose effects are expressed in terms of climate and biodiversity change (Beretta et al., 2017; Chaboud, 2017; Vittuari et al., 2016).

Research and international policy reports have highlighted the possible causes of FLW: lack of awareness and coordination among the different actors of the chain, logistic and retailer issues, presence of the certification rules that reject foods not perfect in form or appearance, consumer preferences for certain aesthetic standards, non-use or sub-optimal use of available technologies, social factors and dynamics, mission and dimension of stakeholders and all in all people’s behavior (Beretta and Hellweg, 2019; Setti et al., 2018; FAO, 2018a and 2014; Yamada et al., 2017; Van Der Werf and Gilliland et al., 2017; Fiore et al., 2015a, b).

Despite the growing diffusion of literature and policy strategies on the FLW topic, there are few empirical studies aimed at defining diverse tools at several stages of the agri-food supply chain. Extant literature seems to fail in simultaneously considering the FLW issue from all possible perspectives of the chain. On the other side, on 29th September 2020, during the first International Day of Awareness of Food Loss and Waste (virtual from Rome/Nairobi/New York), the UN Food and Agriculture Organization (FAO), the UN Environment Programme (UNEP) and firm partners have urged every actor to do more and more to decrease FLW and improve food security and natural resources.

Then, a new approach appears to be necessary both to academia and to industry that calls for that. Analyzing the FLW issue ranging from the entrepreneurship to consumer perspective could be fundamental for getting a deeper understanding of the extent of the issue and for providing useful elements of knowledge to producers and consumers as well as academics and policymakers. In addition, the coronavirus disease 2019 (COVID-19) pandemic is producing some retail and consumption disruptions, which subsequently affect the management of FLW as well as GHG emissions, which entail a holistic perspective (Aldaco et al., 2020) instead of an individual or non-holistic combination.

Therefore, the aim of this scientific work is to propose new tools that merge into a new approach aimed at improving the monitoring and handling of FL and FW, thus lightening ethical equity (in considering huge global poverty), economic and sustainable issues that are linked to. Therefore, starting from the Three E’s of Sustainability (Goodland, 1995), we try to define an evocative holistic 4Es—Ethical_Equity_Ecological_Economic—approach, starting from the definition of three tools/procedures for firms and for consumers/citizens: (1) a firm break-even point model, including FL costs; (2) a FL scheme to be integrated in Hazard Analysis Critical Control Point (HACCP) procedures (3) and a consumer’s tax_FW
declaration model acting as a sort of certification of food waste with definition of modes, recycling centers and percentage estimated of FW from consumer’s side.

The structure of this conceptual work is as follows: next section deals with comparative studies of other authors’ work and opinions about the FL and FW topic within the national and international context of research, policies and strategies.

Furthermore, the core section describes the tools and procedures that could improve effectiveness and efficiency of a firm. These tools could also better address people behavior and problem solving which will contribute to creating a fertile field for giving insights and shedding more light and raising awareness on the topic. Finally, the paper tries to define and design a holistic 4Es (Ethical_Equity_Ecological_Economic) approach, consequently, drawing any future research suggestions and discussing any possible implications deriving from the concrete future implementation of such model.

2. Background: the management of FLW from upstream to downstream stage

Food for human consumption passes through diverse upstream and downstream stages, from farm to consumer. Food losses occur during post-harvest stage and across the different steps of the agri-food chain (the causes can be moisture loss; loss from mold, pests or not enough climate control) (Kumar and Kalita, 2017). The food scraps or losses on the time of harvest and storage are the cause of lost income for small farmers and higher prices for consumers and correspond to inefficient use of resources even more negative if considering the disarming levels of poverty, inequality and undernourishment over the world. On the other hand, a copious availability of food and a decrease and volatility in food prices have determined a negligence behavior and a life style toward a wasteful economy (Drejerska et al., 2018; Fiore et al., 2017; Sullivan, 2011; Stuart, 2009). Wasting food depends on elements such as buying and/or cooking too much, not compiling a shopping list, not planning meals in advance, unawareness of the impact to waste food and on retailers’ messages that push to compulsive purchasing (Stancu et al., 2016; Doron, 2012; Stefan et al., 2012, 2016; Lebersorger and Schneider, 2014; Silvenius et al., 2014). Indeed, generally retailers spend a great deal on in-store marketing to stimulate consumers toward an uncontrollable purchasing, for “grabbing consumers” at the point of purchase (Fiore et al., 2015b; Bell et al., 2011; Chandon et al., 2009) (Figure 1).

Therefore, developing countries deal with all mentioned above, with losses due to issues linked to 1. Crop production, harvesting; 2. Storage, processing, packaging, transportation and 3. Market access, market systems. On the other hand, industrialized countries mainly collect waste because supply is bigger than demand; there is human negligence and diverse unaware behaviors that determine “bad” consumer choices.

The efficiency and effectiveness of the supply chain management can improve thanks to skills and high awareness of entrepreneurs in the chain who in turn are consumers as well. A recent study (Nurchayati et al., 2020) suggests to governments and policymakers to take into account entrepreneurs’ behavioral aspects when supporting SMEs because the latter appear crucial for reaching business goals.
Then, the handling approach and so the behavior represent the core of the management issue from upstream to downstream stage, from farmer to consumers, from farm to fork. Changes in behaviors to levels that can be managed appear the basis to identify, to handle, and to reduce FLW. These new behavioral paths imply not only changes in food supply chains and in the FLW generation but also repercussions in the managerial and policy patterns.

Over the last two decades, the issue of FLW is becoming an increasingly debated and investigated topic and several policy strategies are dealing with it (EU policies, ONU and FAO strategies etcetera). Lately, the UN Sustainable Development Goals (SDGs) Target 12.3 focus on halving per capita global food waste at the retail and consumer levels and on reducing food losses along production and supply chains, including post-harvest losses by 2030 (FAO, 2018a). In addition, the extent of the FLW issue is being researched, analyzed and investigated worldwide.

A study conducted in Turkey demonstrates that the total amount of waste was found to be approximately 20 million tons/year (Salihoglu et al., 2018); while, in the United States, some years before, Buzby and Hyman (2012) estimate that the annual food losses value is almost 10% of the average amount to purchase food and prove that the main wasted food groups are meat, poultry and fish (41%). By considering calories per capita per year, it can be calculated that the FW amount is equal to 1,249 uneaten calories (Buzby et al., 2014b), while according to Beretta et al. (2017), food wasted by households and food services causes even almost 60% of the total climate impact. Furthermore, other authors (Van Der Werf and Gilliland, 2017) demonstrate that food waste generation is significantly “elevated” for North America, compared with European estimates. Another recent research (Birney et al., 2017) studies ecological impacts (foodprints) of the US diet and related FLW by carrying out an analysis of energy, water, land, and fertilizer requirements (inputs) and GHGs emissions (outputs). In order to find any solutions, several tools have been brought into play all over the word: FL used as biomass or biofuel and FW destined for charity associations, for food banks, for animal feed are the main recycling/re-use destinations of lost and wasted food (Thieme and Makkar, 2017; Makkar, 2017; De Boeck et al., 2017; Sönmez et al., 2016). However, other interesting instruments have been individuated: high functionalization of food packaging, shelf life extension and on the other hand educational marketing campaigns, municipal solid waste composition, doggy-bags and regional laws, protocols and strategies (Yokokawa et al., 2018; Fanelli and Di Nocera, A. 2017; Setti et al., 2018; Gutierrez et al., 2017; Yamada et al., 2017; Oprea and Gaceu, 2016; FAO, 2014 and 2013; WRAP, 2009). In addition, the solutions also concern with evocative means, such as enforcing social emotions and trust (Jagau and Vyrastekova, 2017), and concrete-fiscal one, as pay-as-you-throw volume based pricing (Thyberg and Tonjes, 2015). All in all, the reduction or unburdening of the issues linked to food losses (upstream) and food waste (downstream) has an immediate ethic equity (considering the global world poverty and inequality levels) and ecological-economic impact (in terms of climate change and so of missing efficiency and effectivity) and aims at a general objective of well-being improvement (FAO, 2018a, b; 2014; Vittuari et al., 2020a, b; Fiore et al., 2015a, b; Int Food Policy Report, 2016). Data and methods on the extent of food losses and waste are non-homogeneous, and the possible destinations/re-use/ recycle of loss and wasted food are currently scarce in some industrialized countries (Redlingshöfer et al., 2017; Xue et al., 2017). In addition, data seem to be characterized by inconsistency and by a narrow temporal, geographical, sectorial coverage (Xue et al., 2017; Chaboud, 2017). In addition, Koester (2013) underlines that calculating methodologies are unsatisfactory and doubtful and the estimates seem extremely inflated which translates into spreading untrustworthy feedback to policymakers who neglect some other important concerns, such as questions about food safety, health risks or economic losses. Government policies could certainly affect and reduce the amount of FLW by spreading the necessary knowledge, and supporting and intervening financially and regulating the issue (Figure 2 - Adamashvili et al., 2019) even if a global holistic approach appears fundamental Aldaco et al. (2020); Zorpas (2020).
Despite the unsatisfactory data, their emptiness and non-homogeneity, the presence of heterogeneous tools, which are not easy to adopt everywhere equally, allows FLW to represent the new buzzwords in research, global strategies and policies. The reason being its need for crucial monitoring and reduction in order to reach a fair, effective and efficient management of agri-food systems from upstream to downstream stages (firms and consumers).

Therefore, several scholars recently highlight the importance of a holistic approach (Pellegrini et al., 2020; Aldaco et al., 2020; Zorpas, 2020; Peña-Montoya et al., 2020; Messner et al., 2020) to face the global FWL challenge. However, as highlighted by some authors (Messner et al., 2020; Vilarino et al., 2017), FWL issue, like other green challenges, appears to be in a fundamental conflict of interest with old linear theories and practices. It is considered crucial to think outside of the “bin” and to propose a more holistic approach. Therefore, within this framework, we can notice a theoretical and empirical gap in defining a global holistic management approach, within a unique research, which browses the main actors of the supply chain (down and up-stream) as well as its stakeholders. Thus, this study attempts to answer the two evocative research questions: could defining several tools, along “down and up-stream” stage of the supply chain be the starting point of a holistic approach? Could firms and consumers approach and behavior be simultaneously addressed to turn the path (from linear to circular/sustainable) and to close the loop?

3. Three management tools along the FSC

The causes of firm food losses can be traced, in special way, in lacking of proceduralization and rationalization of firms’ procedures (Salihoglu et al., 2018) and in not taking this issue into account. A proceduralized strategy that improves the efficiency and the behavior of both the businesses’ entire supply chain and of consumers/citizens is, therefore, required. Therefore, since several tools were defined by other scholars (Yokokawa et al., 2018; Fanelli and Di Nocera, A. 2017; Setti et al., 2018; Gutierrez et al., 2017; Yamada et al., 2017; Thyberg and Tonjes, 2015; Oprea and Gaceu, 2016; FAO, 2014; 2013; WRAP, 2009), as highlighted before, in production, logistic, marketing, policy, normative field, here the work tries to define and propose three new management and monitoring tools that can be applied to each step regardless of the stage of the supply chain or the country.

These three proposals represent the starting point for defining a holistic 4Es (Ethical_Equity_Ecological_Economic) approach; they are as follows: (1) the implementation of a FL_break-even point model based on FL; (2) the HACCP procedures including a scheme for FL critical points and (3) a consumer’s tax FW declaration model. The work branches into three parts each one dealing with the three tools just mentioned.

![Figure 2. The influence of government policy on the FLW issue](source(s): Adamashivili et al., 2019)
3.1 The FL_break-even point model

If considering the impacts of FL on the firm system, equity, ecological, ethical and economic costs will come into light (Beretta and Hellweg, 2019, FAO, 2018a and 2014; Yamada et al., 2017; Van Der Werf and Gilliland et al., 2017; Fiore et al., 2015a, b). Here, the work tries to define a FL_Break-Even Point (FL-BEP) diagram that shows possible impacts and correlated variable and semi-variable costs. Food represents much more than what is on our plates (FAOa, 2018) and FL represents a misuse of labor, water, energy, land and other natural resources that went into producing it. Figure 3 below highlights how FLW not only determine USD 1tn of economic costs per year, but they also contribute to environmental costs that reach around USD 700bn and social costs, around USD 900bn (FAOb, 2018). Indeed, FLW determine 3.5 Gt CO2e of GHGs (greenhouse gas emissions) equal to USD 394bn of costs per year. Water scarcity, mainly for dry regions and seasons, increases and causes soil erosion (equal to USD 164bn per year and USD 35bn per year). In addition, there are costs deriving from wind erosion, risks to biodiversity (pesticide use, eutrophication processes and fisheries overexploitation etc. impacts), and loss of livelihoods due to soil erosion. A significant element to be taken into account in considering the costs linked to FLW is certainly also the possible risks of conflicts equal to about USD 396bn per year and health issues deriving from pesticide exposure (more or less USD 153bn per year).

According to IAI (2017), the lack to be yet filled up to deal with this global issue is:

1. including the agriculture firm stage in measuring and reducing FL;
2. providing a better firm framework in order to stop over-production of food;
3. monitoring food surpluses at the firm level.

In line with this research, Beretta et al. (2013) demonstrate that most unnecessary food losses happen at the household (almost half of the total), processing and agricultural production stages of the food value chain.

The purpose of this tool is defining a firm methodology that can assess and monitor FL surpluses at the agricultural stage and as a result can try to fill up these gaps. Here below, the two following figures highlight in which stage of the food supply chain is the main percentage of FLs concentrated, considering, for example, only two sectors: oilseeds and pulses, and fruits and vegetables (see Figure 4a, b). Noticeably, the agriculture sector represents the step of the supply chain that is more affected by the issues related to FL.

In considering the gap highlighted by IAI (2017), we propose to implement a FL_BEP model because FL is a firm loss, a variable cost and it represents an uncertainty, which is a risk.

Food Loss = Firm loss = Variable Cost = INEFFICIENCY = Uncertainty = Risk

![Figure 3. Food wastage footprint](source(s): FAO, 2018b)
A risk can be considered from different perspectives, and it is an interdisciplinary category and occurs in many areas within a project, an investment and at different stages of investment activities, but also spans across operational and financial areas. Generally, the BEP can find the application in the decision-making process of a business. The formula is as follows:

\[ Q = \frac{F}{P - v} \]

where \( Q \) is break-even quantity, \( F \) is total fixed costs, \( v \) is variable cost per unit, \( P \) is selling price or inflow per unit. If we include the variable cost linked to the amount of FL in the formula, we will obtain the following one where variable cost FL, (a function of the amount of production), is added. Then, the denominator can be changed in the formula as follows:

\[ (P - v - v_{FL(prod)}) \]

In this formula, \( V_{FL(prod)} \) represents the variable cost per unit deriving from FL. The higher the volume of the loss, the greater the damage is. Figure 5 shows how the profit area changes and decreases, including variable costs that are linked to FL.
The sensitive analysis is used by businesses together with the BEP to calculate risks in investments and projects grounding on a base case and possible deviations in percentage (Figure 6). Additional tools and techniques, such as the Monte Carlo method can allow for real options to be taken into account but sensitive analysis demonstrates an oversimplification of the stochastic Monte Carlo method. In general, sensitive analysis completes the BEP analysis and vice versa, both being two tools that find applications in the firm decision-making process and examine a series of data in order to gather more information (Hartman, 2007).

García-Herrero et al. (2019) by means of sensitive analysis and life cycle assessment for evaluating the environmental, and cost impact of food consumption and wastage in public school canteens, show that is possible to see promising reductions of environmental impact and costs. According to Schuyler (2001), the function of sensitive analysis is to define how dissimilarities in input values affect the value of the outcome.

From the firm side, it is necessary to consider the following conditions and assumptions before measuring the BEP: either production volume and marketing costs represent a function of production volume or sales volume; then, production value is equal to the value of sales, fixed operating costs represent unit costs for each volume of sales. Furthermore, total variable costs have to depend on the size of production and consequently, costs of total

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### Figure 5.
**Source(s):** Our processing

### Figure 6.
**A scheme of sensitive analysis**
production vary with the production volume. Therefore, FL as a variable cost (or semi-variable cost) depends on the volume of business. Finally, the value of sales clearly can be considered as a linear function of a unit sales price and of the number of the products sold. The final target is to create a model with a value that indicates a maximum acceptable level of FLs and is shown in volume of production. Besides, this is all a part of the normal management flow of firms. The index of potential reduction in FLs is a value (in percent) obtained when taking the actual amount of losses into account and considering a value that ranges in a predefined range depending on the weight assigned to the relevant subfund of the supply chain. By borrowing a recent proposal by Barletta et other scholars (2018), an interesting innovative application of the BEP could become the environmental break-even point (e-BEP). It can represent an economic indicator that can be applied to the environmental performance of policies.

Although the insertion of the FL variable cost in the BEP model can seem obvious, incorrect implementation into practice happens, even if BEP analysis for businesses is a well-known theory for optimization of management costs (Kampf et al., 2016). The general goal of a firm is to try to consolidate market position and the exact knowledge of costs (ibidem) is necessary in order to reaching this goal.

Moreover, this first tool can be considered as a crucial management and forecasting tool for business. It is aimed at determining the necessary amount of sales needed to achieve a balance between cost (including the environmental ones) and revenue. As a result, the correct economic approach can lead to minimizing costs.

3.2 The FL_HACCP procedure

The HACCP acronym stands for Hazard Analysis Critical Control Point, a control method used to protect and assure safety and health of the consumer: it is one of the common procedures utilized worldwide for tracking and tracing every step a food item takes within FSC.

The UE regulations 852-853-854-882 of 2004 contain all the rules to abide to, including a guide to the application of the HACCP method. Therefore, the HACCP regulation makes it mandatory for companies operating in the food sector to have a certification that verifies compliance with the HACCP regulation. This certification proves that the company complies with food safety and hygiene laws, not only on a national level, but also, across Europe. As a result, all agri-food industries, all public and private entities that exercise “the preparation, transformation, manufacture, packaging, storage, transport, distribution, handling, sale or supply, including the administration, of food products (for human consumption)” are the addressees of the procedure. There are two decision trees for raw material/packaging material and process step used in the HACCP system (Mohd Bakri et al., 2017). The effective application of HACCP-based food control system affects positively operating and economic performances of the food industries (Kharub et al., 2018). The principal benefit of a HACCP system is just the firm management (Nam, 2017) even if the functioning of the mandatory HACCP principles is often incomplete (Trafialek and Kolanowski, 2017).

The HACCP is based on the definition of the level of severity-risk of critical control points (Figure 7). What is more, FL can be treated, as discussed in the previous section, as a new kind of risk that would consequently require implementation of a further control point to define and avoid FL. The FL_HACCP includes a section FL_risk that produces an alert before reaching an acceptable level of risk that ensures no FL.

A correct management of the FL, considered such a risk, calls for a holistic management approach as it uses an organizational structure (staffing) that facilitates management across all risk sets. In the field of risk management, the meaning of “holistic” is to underline how crucial the understanding of interrelationships among risks are and how to use a coordinated approach for risk management.
3.3 The consumer’s tax FW declaration model

Commonly, tax declaration is a document used in accounting that enables a citizen and subsequently a taxpayer to declare their income to the revenue authorities and pay the corresponding taxes, including the base tax and other diverse tax rates. In Italy, the declaration is made by filling in the so-called 730 form. Starting from this declaration, the work proposes to create a Tax FW declaration Model for all citizens that includes a section “FW: modes, beneficiaries, and % of recovering” where citizen defines the modes of recycling of food waste, the recycling centers, the charitable charity associations or food banks used for and the percentage estimated of food waste recovered in the last year. Charity associations, recycling centers and food banks will have a list of all citizens who deliver unused but viable food (according to FW guidelines) from the previous year. Monitoring tools can be implemented to randomly verify the correlation between what is declared in the Tax FL declaration Model and the list of citizens of the charity associations, recycling centers and food banks. The citizens obtain a deduction on individuals’ income tax by filling out the “FW: modes, beneficiaries and percentage of recovering” section. This model’s section can represent a beneficial tool that can be useful for improving the awareness and approach of citizens toward a virtuous behavior even if it does not clearly assure meticulous, secure and complete monitoring. This way, we are dealing with not only consumer behavior but above all, with a “common-social” approach, with a “public spirit” that represents positive attitude a citizen adopted for the benefit of the community (Andriani, 2016) to reach equity and ethics principles within a sustainable management of the FLW issue.

4. Discussing the three tools toward a holistic approach

The possible causes of FLW can be due to high unawareness, a lack of efficient management of the involved resources and aligned global research and policies (Salihoglu et al., 2018).

Reducing FLW appears to be crucial for reaching some SDGs that are SDG 2 (Zero Hunger) and SDG 12 (Ensuring sustainable consumption and production patterns) based on ethic, equity, ecological and economic principles.

By drawing a short conclusion from this global challenge, the definition of these three tools, while trying to design a holistic approach, can help improve the management of agri-food firms and can spread consumer awareness and as a result, “close the circle” (Commoner, 1970). Indeed, the idea is to merge the extreme parts of the chain in a circle (symbol generally used for the holistic approach) that consists of participants who in turn are entrepreneurs, consumers, citizens and policymakers.

Dealing with a holistic approach means addressing the whole issue by emphasizing the importance of the whole and the interdependence of its parts, and not just concentrating on fixing a part of it. As a beehive (Figure 8), whose structure is built either by people or by bees themselves, this is a holistic, operative approach where each one has to contribute to the common

![Figure 7.](image-url)
situation with their own behaviors, firms and consumers in order to reach Equity, Economic, Ethics and Ecological goals, starting from the Three E’s of Sustainability (Goodland, 1995).

The ecology-economic goals are crucial and load-bearing areas for determining a global system that can be based on elements of equity and ethics. Firms and people (Firms.People) can be producers, as well as firms that can act as key players in building a beehive that generates effective and efficient outcomes (the basis of economic theory) while they simultaneously, save and protect humans and the environment (under ethic and equity principles).

Ultimately, monitoring, reducing and overall better handling of FL and FW by means of this holistic management approach can improve the reliability and accuracy of the production and investment decisions of those firms. As a consequence, the results can help lighten issues like poverty, undernourishment, pollution and negative impacts on the income of entrepreneurs and consumers.

In line with other research (Petetin, 2020), this holistic approach could be a chance to move toward a food democracy model that “provides citizens with opportunities to actively contribute in the way that sustainable food systems are built to determine awareness on how food should be produced and consumed”. Here, the word “holistic” is used to highlight the significance of interrelationships as well as the importance of a coordinated approach for managing risks, costs and losses.

Furthermore, the holistic approach can be useful to achieve a winning strategy and a better management. It can also contribute to the spread of sustainable-circular paths within the supply chain context, where actors should act as a part of a strictly interlinked system (Giacomarra et al., 2019). Sustainable-circular paths appear to be a crucial firm and life paradigm not only for creating new products and processes (Santoro et al., 2017) but also, both for environmental and economic sustainability (Galati et al., 2018). The way of living and consuming must be converted and make circular and holistic. Wasting signals a way of consuming that is disruptive and needs to be rebuilt. Awareness passes through all the FSC steps as electric current. From here, people that act as managers, practitioners and academic can reflect on how to better use water, electricity but also consumer goods (new technologies, furniture, etc.). The fight against food waste is simple to implement, without upsetting our lifestyle, provided people are aware.

5. Conclusions
The purpose of this work was to propose new management tools from upstream to downstream of the FSC and then to implement a holistic approach that makes aware that
entrepreneurs, in turn, are the consumers in the global FLW issue. Additionally, the behavior and the promotion of “public spirit” aimed at the benefit of the community (Andriani, 2016) become crucial in dealing with the FLW challenge. FLW can result from a loss of awareness of the value of things and can also be due to a lack of trust in global systems.

This holistic handling approach for firms and consumers/citizens can certainly positively impact the thinking on the global system. It is expected that the adoption of this approach can increase the effectiveness and efficiency of the entire supply chain in terms of production, logistics and distribution, sustainability and ethics, thus, improving the general well-being of systems. In line with recent research (Vittuari et al., 2020a, b; Beretta and Hellweg, 2019), appropriate FLW monitoring and reduction could produce/save higher food amount and determine significant energy savings while decreasing GHGs emissions. With the implementation of these tools using a holistic approach, it is possible improve handling of food systems that can consequently increase the amount and the quality of the food across the world (Pellegrini et al., 2020).

Hence, the invitation to look at our goods from a new perspective: that of having to leave everything in the future in a sustainable/circular way. People often consume beyond needs. If people continue to starve when the Earth could feed up to 9bn people, all people have a responsibility to change things.

On the other hand, on a consumer level, peoples’ choices and decisions determine an “open space” between motivation behavior and outcome (Setti et al., 2018) and establish an additional (factual) gap in consumer’s decision-making that increases the intricacy of the food waste domain.

In this COVID19 pandemic period, wasting often derives from the fear of a lack and therefore from a fear for the future. The green swan, another recent buzzword, is the suggestive image used by the bank for international regulations to indicate the risks that derive from climate change in relation to global financial stability. Considering the huge extent of the FLW problem on a global level, more research is required to understand and solve the problem in order to avoid equity, economic and diverse ecological risks and overall instability across countries. This work resembles a piece of a mosaic that is tricky to build. Afterward, it becomes necessary to tackle uncertainty and use a holistic approach that highlights the urgency to enrich the knowledge of consumers and raise awareness about food waste and general food culture.

Therefore, the paper replies to two research questions that evoke as the three tools defined along down and up-stream stages of the supply chain, certainly merge to create a holistic approach that could simultaneously address behaviors of firms and consumers/citizens to take a turn on the path (from linear to circular/sustainable) and to close the loop. Managers and practitioners can improve the firm management by comprehending all the associated costs and risks and reach better performances. The FL-BEP model or the FL-e-BEP model (Beretta et al., 2018) stands with FL HACCP procedure as a landmark for improving the management activities and the balance between business costs and revenues. On the other hand, consumers/citizens acquire knowledge and become aware that it is useful to include the FLW issue when presented with choice opportunities.

However, an effective supply chain management can deliver success and give advantage to firms so appearing as useful tool to practitioners and/or executives and/or governments as well.

Conversely, supply chain processes are becoming more complex and the risks in supply chain management increase (Büyüközkran et al., 2020; Talib et al., 2015). In line with the latter authors, a Grey theory based Grey-AHP evaluation method could be used to determine the weight of losses and related costs as well as risks, by identifying how current business performance can be improved.

Although the tools and the approach proposed in the present study could allow for rapid evaluation of implementation methods and increasing functionality of ethic, equity,
ecological and economic principles in food businesses, more work and deeper analyses needs be done in order to confirm its reliability and validity.

This paper not only contributes to spreading knowledge but raises awareness of managers/entrepreneurs and consumer/citizens.

Based on this analysis, this paper presents a multidisciplinary integrative framework for future academics to further build on and for managers to be guided by.

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Further reading

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