

Causes and Consequences of Food Loss and Waste: An Analysis of Food Waste Management Attitudes, Food Sustainability and Food Security

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Abstract

Discussion of food loss is more important now than it has ever been. It is widely accepted that food loss is one of the primary bottlenecks in food security and climate change mitigation due to its catastrophic economic, environmental, and social consequences. Many studies on food waste and loss have focused on consumer behaviour toward food selection and waste creation at the household level. However, investigations at the process level have been generally ignored. In addition to product alterations, inventory management, handling, and packaging all contribute to food waste. In the face of these global food challenges, very little research has been conducted to identify management, employee or customer actions which lead to food waste and hamper food security and sustainability throughout all the production stages. Against this backdrop, this study identified causes of food waste and loss along the lines of micro, meso, and macro drivers and explained the general consequences associated with food waste. The findings point to the need for addressing logistic and food storage concerns with the aid of both corporate and governmental efforts.

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I. Introduction

The Food and Agricultural Organization (FAO)'s Safe Food Initiative is an example of a global effort to reduce food losses and waste in both rich and poor countries. Discussion of food loss — the loss of edible food mass along the supply chain (from production to post-harvest processing and distribution to people who eat it) (Flapper et al., 2002) — is more important now than it has ever been. It is widely accepted that food loss is one of the primary bottlenecks in food security and climate change mitigation due to its catastrophic economic, environmental, and social consequences. Globally, between 1.3 and 2 billion tonnes of food are lost or wasted, resulting in an annual global cost of around 1 trillion dollars, of which approximately 310 billion dollars are in poor nations and approximately 680 billion dollars are in developed ones (van-Kampen and van-Donk, 2014). West Africa appears to be underperforming in terms of food waste during food processing, despite the fact that food loss occurs worldwide. This may be due to inefficiencies in the production system and management of the processing.

There are a lot of studies on food waste and loss that focus on consumer behavior in terms of food selection and waste generation at the household level from a supply-side perspective. This framework is based on the Food Waste Hierarchy, which is a framework for managing food surplus and food waste. (Gekas and Nikolopoulou, 2017) Food products are handled an estimated 33 times before they reach the hands of customers in a store (Oreopoulou and Russ, 2007). Even though there has been an abundance of supply-side research focusing on food waste and losses at various supply chain stages (such as distributors and retailers), studies at the process level have been overlooked (Risse, 2003). Indeed, it is surprising how little research has been done on the many aspects of sustainable operations that contribute to food waste, such as product modifications, inventory management, handling, and packing (Russ and Schnappinger, 2007; Ha et al., 2014). At the company level (i.e., the phases when substantial/excessive food loss is likely to occur), a sparse number of studies have examined management, staff and customer activities when examining food waste sustainability across the manufacturing stages.

There are numerous challenges that are readily identified with the spate of global food waste. Because of this, global hunger programmes now concentrate on decreasing food losses and waste in both affluent and poor countries. Despite the global nature of food loss, West Africa looks to be failing in terms of food waste prevention due to poor processing systems and production management inefficiencies. Consequently, many

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studies on food waste and loss have focused on consumer behaviour toward food selection and waste creation at the household level. However, investigations at the process level have been generally ignored. In addition to product alterations, inventory management, handling, and packaging all contribute to food waste. In the face of these global food challenges, very little research has been conducted to identify management, employee or customer actions which lead to food waste and hamper food security and sustainability throughout all the production stages. This study aims to fill these research gaps by focusing on attitudes of management and staff towards food waste and loss as well as the economic, social, and environmental consequences of food loss and waste.

II. Social Identity and Food Waste Management Attitudes

Similarities and differences between members of an in-group and an out-group become more apparent when social identity is emphasized. As a result, members of an in-group adopt attitudes and behaviors that are more in line with those of the in-group than those of the out-group. For more information on the impact of in-group norms, see evidence from norm focus theory, which differentiates between injunctive and descriptive social norms, which describe what is expected or desired by the majority within an organization (Ittner, 2008).

Towel reuse was also investigated by Laverty (1996) based on norms derived from distinct identities. Towel reuse was most strongly influenced by the rules pertaining to the most relevant and immediate identification, which in this case was the previous occupants of the participants' current hotel room. Current visitors may not feel a strong connection to previous guests, but they do share an identity, and the behavior of previous visitors serves as the primary script for how to act in this particular situation. According to the social identity perspective, people are influenced by the behavioral norms of the most relevant in-group in any given situation. This finding supports that theory.

Research shows that when norms are at odds, the impact on behavior may be lessened. In the case of food waste management, for example, the in-group members' waste management objectives are jeopardized when there is a disconnect between what they approve of and what they do (Gekas and Nikolopoulou, 2017). In addition, perceptions of conflict in pro-waste reduction descriptive norms among in-groups may either excite or demotivate intentions to act in pro-waste reduction ways, depending on the pre-existing waste management attitudes of group members (Pap et al., 2004).

In addition, the social identity approach recognizes that individuals who identify more strongly with the group should be more influenced by in-group norms (Ittner, 2008). Individuals who have a stronger sense of belonging to a group are more likely to engage in normative behaviors within that group, such as recycling (Evans, 2011) and using sustainable farming methods (Mebratu, 1998). More strongly identified members of any given group are more likely to adhere to the group's norms than those who are less well-known. It has also been found that the self-investment component of identification (i.e., the significance and pleasure of the group) influences adherence to in-group norms relevant for carbon emission reduction, in a recent study exploring various aspects of group identification (Laverty, 1996).

III. Food Waste Sustainability, Impact, and Food Security

3.1 Sustainability

The term "sustainability" has become a common term that is often used in discussions about environmental and corporate challenges. According to Filho (1997), the term "sustainability" was first used in the 1970s to refer to forest management. According to Filho (1997), sustainability may take on a variety of forms, including long-term, lasting, sound, and systematic. At its most fundamental level, sustainability is the belief that humanity should coexist with the environment and society (Mebratu, 1998). Furthermore, Filho (1997) describes sustainability as a developmental process that allows nations to advance economically and socially without jeopardizing their natural resources while remaining ethically acceptable, morally just, and financially viable. However, Solow (1991) and Costanza et al. (1997) criticize the idea of sustainability, arguing that it should not be limited to attempts to conserve the environment, but rather be a much larger word that encompasses both resource utilization and waste minimization.

Sustainability is typically characterized as development that "meets current demands without jeopardizing future generations' capacity to fulfil their own," to ensure inter-generational fairness. Sustainable development envisions a world in which people are healthy now and, in the future, communities and nations are safe, peaceful and flourishing, and economic opportunity is available to all. It also envisions a biosphere whose integrity and health are restored and maintained to the extent necessary to make all of these other goals a reality. The four dimensions of sustainability must be addressed in order to achieve this goal (Cortese and Rowe, 2006). Sustainability is "a process that helps create a vibrant economy and a high quality of life while respecting the need to sustain natural resources and protect the environment. It expresses the principle that future generations should live in a world that the present generation has enjoyed but not diminished (Clough et al., 2006). Environmentalists have long used the term "sustainable," and the vast majority of the available literature and

assessment tools reflect this. However, it is becoming increasingly apparent that long-term success is impossible without addressing issues of social justice. Without social justice, no community or institution can last. As such, true sustainability necessitates compassion for all members of the biosphere. The ability to speak fluently

It is impossible to argue with the fundamentals of sustainability when they are expressed this way. Almost everyone wants to be able to provide their children with the same quality of life as they did. If you're in charge of a company, you'd like to keep it profitable, and you'd also like to see it grow. The ability of businesses to meet their short-term financial needs without jeopardizing their (or others') ability to meet their long-term financial needs can be defined as sustainability if this logic is followed. Thus, the concept of sustainability is based on the idea of time. Sustainable development was thought of as a systemic issue by the WCED. If we're going to meet our future generations' needs while also protecting the planet's regenerative health, we need to make smart decisions about how we use and dispose of our limited supply of natural resources. In order to maintain a macro-level equilibrium in economic, social, and ecological systems, resources must be distributed over time at the micro-level (WCED, 1987).

Macro-systems are nested inside of smaller firms. Managers must manage their investments to ensure both a short-term profit and a long-term income stream if their companies are to remain in business for the long term. There are risks at the micro- and macro-levels of analysis for companies that don't manage intertemporal trade-offs well." By failing to control their income flow, companies face direct risks at the micro level. Firms may lose long-term value if they under-invest in research and development. A systemic collapse would expose companies to indirect risks because they collectively fail to balance the short and long term (Hayes and Abernathy, 1980). As a result, companies that manage both short and long-term risks are better able to mitigate risks at both the individual and aggregate levels of analysis.

Sustainability necessitates compromise, particularly over the long term. For companies, the choice is between investing more now for larger profits or less now for smaller profits (Laverty, 1996). All of these ideas apply to debating whether or not to pursue extraction over exploration. A company's profits come from marketing and sales of its current products as well as research and development to ensure that there will be additional products in the future. According to Solow (1991), sustainability is frequently confused with green and is a nebulous concept. He suggests that mankind must leave the earth in the same state in which we found it, but also contends that such a notion is impractical and even undesirable. Costanza et al. (1997) argue that although each system has a temporal limit for completion, the notion of sustainability has no such limit since once achieved, sustainability must be maintained in perpetuity. The authors go on to explain that nothing, not even the universe, is eternal. They contend that neither sustainability nor its duration can be quantified. Sustainability is only realized when a system reaches its typical maximum life duration since this indicates that resource consumption and waste have been minimized (Solow, 1991; Costanza et al., 1997). Karpagam says that the majority of definitions are based on the Brundtland Commission's conceptualization of sustainable development as progress that tackles current generational challenges without jeopardizing future generations' ability to address their own. (Obamen et al., 2019).

3.2 Food Waste Sustainability

Systematic food waste reduction is the goal of sustainable food management, which includes all aspects of the food supply chain, from production and distribution to retail and consumption, and includes judgments on whether or not food can be recovered or disposed of at the end of its useful life. The Environmental Protection Agency (EPA) is committed to promoting innovation and highlighting the importance and efficiency of food management. We can assist businesses and consumers save money, offer a bridge in our communities for those who don't have enough to eat, and protect resources for future generations by implementing sustainable food management practices. With the well-known "Reduce, Reuse, and Recycle" philosophy at its core, this strategy aims to increase environmental awareness while also reducing food waste (Dhir et al., 2020).

Food production that isn't eaten is a "waste" of economic and ecological resources, whether it's lost in the manufacturing and transformation processes or thrown away after consumption. In addition, it has a negative impact on the community. This section focuses on the economic, social, and environmental impacts of food waste on the food system's sustainability. Small businesses and households have micro, meso, and macro impacts on the supply chain, respectively (macro-level).

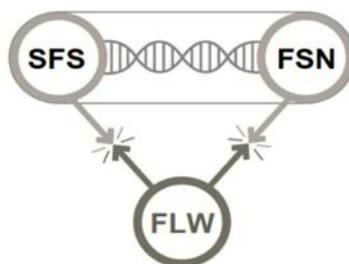


Figure 1 The conceptual relationships between sustainable food systems, achieving food security, and food losses and waste are shown schematically. [1]

Food security and nutrition (FSN) and sustainable food systems (SFS) are inextricably intertwined. Food losses and waste (FLW) undermine food system sustainability as well as food and nutrition security.

3.3 Food Waste Impact

Sustainability and environmental concerns are greatly impacted by the amount of food that is wasted. Researchers have labeled food waste an "unsustainable hotspot" (Eriksson et al., 2019). The most pressing concerns in this context are the impact on the environment (Kallbekken and Saelen, 2013), financial losses (Hennchen, 2019), food security (Wang et al., 2017), and the overall economic impact of this waste (Heikkila et al., 2016). Estimates suggest that the economic cost of thrown away food is 23% higher than the cost of buying it (Papargyropoulou et al., 2014). Similarly, in China's HORECA, it was discovered that the ecological impact of such rubbish was nearly twice the area of its arable land (Wang et al., 2018). Even while food-service professionals were well-aware of the financial ramifications and motivated to reduce waste, customer satisfaction, rather than environmental protection, was their top priority (Hennchen, 2019). Inefficient use of resources has a negative impact on society, the environment, and the economy when food isn't being used to feed people. One of the most pressing sustainability issues is food waste.

Economic, environmental, and social costs are substantial (Ramsden, 2010) when food is wasted. Food waste has a detrimental impact on all of these areas: food security, food quality, economic growth, and the environment (Bansal and M. DesJardine, 2014). Amasuomo and Baird (2016) have explored the impact of food waste on the food sector's sustainability on a sociological, environmental, and economic level. To feed the world's growing population, cutting down on food waste could be an important strategy. This could also have an impact on food prices. One third of global food production is wasted, and there are over 800 million people who are chronically hungry as a result of this food waste. There is a social consequence to rising food prices because lower prices would lead to more food available for customers. All of the other development goals are also weakened by hunger.

According to the Food and Agriculture Organization of the United Nations, food insecurity and malnutrition have a substantial influence on human health, well-being, and physical and cognitive development. Especially at open-air landfills where food waste accumulates and infections flourish (UN, 2010), poor waste management can impair the health of a large number of people. According to producer prices, food waste has an economic impact of approximately USD 750 billion (UN, 2010) on the environment. In terms of the bottom line, food waste is costly for everyone involved, including the farmer and consumer. For a producer, it represents the loss of resources such as fossil fuels, water, labor, and raw materials, as well as the costs associated with their storage, processing, and distribution. In addition to being a cost to the producer, any type of waste that is generated during the supply and production chain is an underutilized resource. As a result of this wasted resource, the consumer is left with high food costs and little purchasing power (UN, 2010).

It is also important to know and think about the reasons why food waste should be seen as unethical. These reasons are linked to the effects that food waste has on the environment. It is only possible to understand the consequences of today's food waste in the context of "fewer" losses and waste. Since the concept of impact is inherently comparative, it must be measured against some reference point. Food waste has both "explicit" and "opportunity" impacts, which are distinct. Food waste's "explicit" effects are frequently linked to the movement of food waste and the final destination. On the other hand, the "opportunity" impacts of food waste are measured in terms of the value of a foregone better option and less food waste in terms of economic, social, and environmental impacts.

Reduced food waste and loss, according to most recent studies, would have significant economic, social, and environmental benefits that outweigh any costs associated with taking action to improve food systems (and, in some cases, with negative costs, too). A better path to sustainability does not require zero food loss, but rather much less loss and waste than what we currently experience. It is possible that the additional costs of achieving very low levels of food loss and waste (including social and environmental costs) may eventually prove prohibitive and counteract the increased benefits.

3.4 Food Waste and Food Security

People who go hungry because their food supply is ineffective is an evidence of an ineffective global food system, regardless of the cause. Food waste is often seen as a reflection of the present food system's inefficiencies as well as its inequity. Complex causes of hunger and malnutrition cannot simply be reduced to food waste or concerns about how much there is to eat. Because of this, caution is advised when making generalizations concerning global food waste and world hunger. Increasing availability and quantity of food in countries with food insecurity does not always follow from reduced food waste in food-secure or food-exporting countries.

When it comes to "fortunate" food losses, they are more prevalent in food-insecure countries than "behavioral" food waste under food-secure countries, indicating a global imbalance in the food system's availability and accessibility dimensions (behavioral as the result of a "choice to discard" food that could have been eaten). Furthermore, our definitions of food loss and waste show that high-income countries, which consume more food, lose a greater amount of food than low-income countries, which produce more food. What impact might food waste have on food security? Initially, it focuses on three essential strategies that are commonly oversimplified in the current body of knowledge.

- First and foremost, there will be a reduction in global and local food supplies.
- Two more issues to consider are the negative impacts on access caused by higher food costs for consumers or economic losses for players throughout the supply chain.
- It is vital for food production in the future to consider the long-term consequences of unsustainable usage of natural resources.

In addition, the scientific literature has revealed two less well-studied connections between food waste and food security and nutrition. Both nutritional and quality losses have an effect on nutritional status in the first place. Food production and consumption are "variable," necessitating the deployment of proper "buffering" mechanisms to cope with time-dependent variability, and their counterpart is concerned with the "stability" dimension and the features that a food system should have to assure it.

IV. Causes and Drivers of Food Losses and Waste

Food loss and waste can be reduced by identifying the root causes of the problem and prioritizing action plans. There are hundreds of distinct specific causes of food loss and waste due to a wide range of preconditions. According to the type of product, the level of food chain, and the setting, the significance of these antecedents varies greatly (Ballard et al., 2013; FAO, 2015; Eriksson et al., 2019; Heikkila et al., 2016).

The food supply chain is full of interconnected factors, and this leads to frequent losses and waste. If you think of it like a conveyor belt, activities at one point in the chain can have a long-term effect on the rest of the chain. Thus, we should look at every activity (whether it's a cause of food loss or waste or a mitigation strategy) along the food supply chain as a series of interconnected processes with critical control points, rather than just one activity at a time.

As this example shows, not all causes are on an equal "level of importance." Some of the "immediate" causes of food loss or waste can be attributed to the actions of individual actors in response to various "primary" factors that influence food throughout the supply chain and may result in losses. Aside from these secondary factors, such as how well-organized actors are, economic and market conditions along the food chain (product becomes unmarketable, etc.), or more systemic factors (such as a lack of information, etc.), these causes may be secondary to other factors.

- i. As a starting point, look at the "micro-level" causes of food loss and waste. A food chain's losses and wastes are generated by individual acts or inactions by players at each level in reaction to (or as a response to) external influences such as climate change.
- ii. Another element that contributes to food loss/waste is "meso-level." Structural issues and secondary causes of food loss/waste are two of them. At the same or a different stage of the chain, a meso-level cause can be found, or it can emerge from the way different actors are organized, relationships that exist along the food chain, and the state of infrastructures. The existence of micro-level causes may be influenced by or determined by circumstances at the meso-level.
- iii. There are a number of elements at the "macro" level which are responsible for food waste. Higher-level concerns such as a broken food system, lack of institutional or policy circumstances that promote actor coordination (including contract security), investment, and the adoption of best practices explain how food losses and waste might be clarified. The growth of all other factors that contribute to food loss/waste, including micro and meso factors, is facilitated by macro factors. Last but not least, they have a huge impact on the global scale of food loss and waste.

V. Economic, Social, and Environmental Consequences of Food Waste

5.1 Economic Consequences of Food Waste

Economists have paid little attention to global food losses and waste. Researchers in South Africa used an average price for each commodity category along the value chain to assess the cost of food waste. Approximately 2.1% of South Africa's annual GDP is lost as a result of food waste (Heikkila et al., 2016).

In order to build a full-cost accounting system for food waste, which the FAO has classified as an economic negative externality worldwide, effort has been done (FAO, 2014). To assess the financial effect of the 1.3 billion tonnes of food waste and loss in 2012, FAOSTAT market values were applied to the volume of food waste and losses. FAO estimates additional costs and repercussions worth \$900 billion and \$700 billion, however these are not included in this assessment.

The financial burdens and net expenses experienced by various food system participants vary (or even gains). Further research has demonstrated that food losses or waste have a direct impact on the price of food (Heikkila et al., 2016; HLPE, 2012). Net food sellers and net food purchasers are affected by food waste in different ways, as the HLPE research on food price rises and security explains in greater detail (HLPE, 2012). It's possible that some agents are less affected by food waste because of their market or purchasing power, or because of their location and ability to cooperate along the supply chain. Competition in non-competitive marketplaces forces the majority of buyers to pay for inefficiencies and losses in the production process. When the rivalry is strong, subordinate agents, who are contractually obligated to follow the "chain coordinator's" requirements, can bear the financial burden of market losses (often a major supermarket company, a trader, or even a processing industry). The food system's inefficiency is always to blame for a higher food price, regardless of the conditions. Without other factors, food waste has a disproportionate impact on the efficiency of public investments in agricultural programs, training, and subsidies.

5.2 Social Impacts of Food Loss/Waste

In terms of societal consequences, the large volume of agricultural losses in developing nations affects labour productivity (marketable output per worker) and consequently salaries, slowing the rise of the consumer market, which would have supported producers' purchase of new technology. From a social perspective, this is a self-reinforcing loop that reduces the availability of resources for both producers and consumers. It is hard to break out of this cycle. At the micro-level, manufacturing costs is a critical decision consideration.

5.3 Environmental Impacts of Food Waste/Loss

Due to the resources used in its production as well as the effects of garbage disposal, which emits methane, a powerful greenhouse gas, food waste is bad for the environment (GHG). An effort to quantify the resources "wasted" because of food loss or waste was made recently. According to these simple proportional formulas, food production has a negligible effect on the environment because of food loss. A food's environmental impact depends on the method and location of production as well as the stage at which the loss or waste occurs, most notably for energy, which has the greatest impact on the environment.

All of these processes are included in life cycle analyses, as is the "end-of-life" component of food. For example, most studies calculate "food footprints," which account for the multiple ways resources are utilized or needed, as well as the external consequences created by a unit of food throughout its life cycle:

- The global FLW carbon footprint is expected to be 3.3 Gtonnes of CO₂ equivalent, or roughly 6–10% of human-caused greenhouse gas emissions, even without accounting for GHG emissions from land-use change (Prasertsan et al., 2014).
- A large amount of water is squandered in the production of lost food, making food loss and waste instances of water "waste" (FAO, 2014). Waste and food losses account for more than one-fifth of the world's water use and more than 300 million barrels of oil annually, according to the EPA. Worldwide, food loss and waste create a blue water footprint approximately three times the size of Lake Geneva, at 250 km³ (FAO, 2015).
- About 1.4 billion hectares of agricultural land are used annually to produce food that is never eaten, according to the FAO (2015). In industrialized countries, a 30 percent reduction in consumer food waste would save nearly 40 million acres of cropland, according to a McKinsey Global Institute study on global productivity practices for resources (Filimonau and Gherbin, 2019).
- Even though it's difficult to measure the detrimental effects of agricultural intensification and expansion on global biodiversity, food losses and waste are unquestionably a contributing factor (FAO et al., 2015).

The carbon, greenhouse gas (GHG), land use, water, nitrogen, and energy footprint of food that is thrown away by consumers is also greater than that of food that is lost after harvest. To put it another way, consumer waste contains all of the carbon emissions generated during the various stages of production and transportation before they are finally released into the atmosphere. Consumption waste is nearly eight times greater than post-harvest loss in terms of energy "waste" (Filimonau and Gherbin, 2019).

As part of SFS, efficiency is a major component, along with resilience and equity (Heikkila et al., 2016). Russ and Schnappinger (2007), for example, uses the concept of waste and losses to figure out how efficient a food system is. Food waste means that more natural resources are required to eat the same amount of food as before. Having a lot of food waste is a sign that the food system is not working correctly. It is critical for food systems to improve their economic, social, and environmental performance by enhancing their efficiency. In order to improve the efficiency of the food system, many issues must be addressed (Gekas and Nikolopoulou 2017). The need to feed the world by 2050 and the relationship between food security and climate change issues are two of these problems (HLPE, 2012).

VI. Conclusion

Food waste is an important phenomenon that has sadly received little attention despite the drive for sustainability, food security, and general welfare upliftment globally, particularly among less privileged groups in developing countries. Food waste has implications that can be classified into economic, social, and environmental dimensions which collectively have substantial capacity to compromise efforts in the direction of food safety, food security, and sustainable production. Against this backdrop, this study identified causes of food waste and loss along the lines of micro, meso, and macro drivers and explained the general consequences associated with food waste. The findings point to the need for addressing logistic and food storage concerns with the aid of both corporate and governmental efforts.

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