

Zero-Waste Cooking Practices To Reduce Food Waste - Proposing Framework For Households

Auth

Abstract

With increasing awareness on food waste, various initiatives have been introduced over the years to control food waste created in food supply chain. However, evaluating prevention of food waste is still as nascent stage and proper methods are still not prepared to determine their effectiveness. It hampers finding best practices among current initiatives and giving priority to the most promising initiatives. To meet these needs and propose an ideal approach to assess food waste prevention programs, an evaluation framework has been prepared by the "European Commission Joint Research Centre" for preventing food waste.

The framework is compatible with the "EU Platform on Food Losses and Food Waste" which is aimed to share knowledge and best practices on initiatives to prevent food waste. An intervention has been proposed with "Information and Communication Technologies (ICTs)" to reduce food waste in households. Over 1/3rd of all edible food is wasted or lost every year in the global supply chain and it is especially a pressing issue in the global north. Consumer activity is traced with storage, acquisition, disposal stages and consumption to provide a complete range of recommendations on using ICTs to control food waste in households. This study critically examines the evaluation framework to ensure relevant and sufficient data for proper assessment. This study would enable decision-makers and practitioners to determine the success of current programs and prioritize adoption of best practices.

Keywords – food waste, household food waste, Information and Communication Technologies, food supply chain, evaluation framework

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I. Introduction

As per the UN Food and Agriculture Organization (FAO), over 1/3rd of food produced across the world is wasted or loss. It shows a threat to food security and loss of resources with "food supply chain (FSC)" (FAO, 2013). In addition, it has a harmful financial impact on farmers' income and consumers. In 2007, the cost of food waste was around US\$750 billion globally (FAO, 2013). Since global population is rising rapidly and with the rise in prosperity with constant changes in lifestyle, the demand for energy, food, and feed will also pose unexpected burden on natural resources in the next decades. Hence, reducing food waste is a strategy to fill the gap between demand and supply of food items (Godfray and Garnett, 2014).

Rise in interest in economic and environmental loss due to food waste has resulted in rising public and political consensus on addressing this problem (FAO, 2019). Hence, businesses, local authorities, organizations, and institutions have put several measures in place and introduced campaigns to reduce food waste during processing, production, consumption, and distribution of food in food service establishments and households (Reynolds et al, 2019). There is a research gap on determining the efficiency of prevention techniques, especially because of lack of evidence. Few studies have examined the success of current food waste prevention programs.

Aschemann-Witzel et al. (2017) have determined the major success factors for 26 initiatives to reduce food waste by consumers. There is a collaboration between various stakeholders, involving people with ideal competencies, proper timing, suggesting solutions which are easy to implement, adopting positive focus, and large scale of operations are some of the important factors to secure the success of measures to prevent food waste. Reynolds et al (2019) explored 17 interventions which were employed for waste reduction and 13 of them had reduced food waste.

There are different promising approaches which changed the type and size of plates, initiatives changing guidelines related to nutrition, and awareness campaigns based on small samples. It is found that potential efficiency of measures to reduce food waste is merely being determined to a limited extent, requiring development of larger sample size and longitudinal studies. It

would gain better insight to possible effect of various actions, eventually supporting decisions based on evidence to reduce food waste. Stöckli et al. (2018) has reviewed interventions for reducing food waste and it has concluded that it is possible to evaluate interventions in a systematic approach with a framework implementing standardized measurement approaches and definitions to address behavioral change and specific behaviors.

II. Literature Review

Aprilia et al (2022) conducted a pilot study to determine the knowledge of college students about domestic food waste management with an online questionnaire. Descriptive results section has described the central tendency of data collection for all the variables. All the participants were selected from the webinar on waste management by people from environmental groups and universities. Findings suggest that knowledge of students related to household food waste control has been diverse. Some of them keep on considering waste management as a demanding and time-consuming activity. Community knowledge related to food waste management must start from home. Hence, eco-friendly activities should be implemented and promoted regularly at the university, school, community, and government levels to improve quality of life of people.

Around 1/3rd of food produced across the world is wasted with supply chain of food causing social, environmental, and economic impacts. Restaurants hold second highest position to classify the responsible bodies for generating food waste and a huge amount of restaurant expenses are wasted. Only a few studies have been conducted on managerial implications and factors playing a vital role on this kind of waste. Principato et al (2018) collected data from 127 restaurants in Tuscany and Lazio, Italy. This study proposes a theoretical model to explore factors of food waste in restaurants. It also determines whether food waste is associated with clients and cooking in restaurants. Findings suggest that restaurant managers' attitude and types of menus and size of restaurants play vital roles.

Various authors have focused on valorization of byproducts and food wastes to improve environmental and economic sustainability of food chain. A lot of measures have been proposed to discover biomass suppliers to get various biodegradable products. Integrated value chains are among the most promising ways to boost evolution of food industry to a bioeconomy. Ribeiro et al (2022) adopted mixed-method approach to identify the streams of food waste and its byproducts and identify the most promising uses and valorization methods developed lately for applying by products and food wastes. The study has also pointed out the proposal of valorization schemes and major challenges to ensure implementation in food sector.

Households have been one of the major sources of waste and have minimal reuse. Wastes like fruit and vegetable peels and waste can be processed into eco-enzyme fluid for various purposes. Making bio-enzyme is easy for anyone. It is an organic element as complex solution from the process of fermentation of kitchen waste like vegetable and fruit peels. "Eco-enzyme" is the term coined by Dr. Rosukon Poompanvong, founder of "Organic Agriculture Association, Thailand in 1980s. Later on, Dr. Joean Oon was a naturopathy researcher in Penang, Malaysia brought more broad term. In development, using eco-enzyme is increasing and it is commonly known as a multipurpose liquid. In the field of environment, this liquid is used widely in liquid waste treatment, improve soil and air quality, and lake water purification. In the field of health, using eco-enzyme can prevent hair loss, make hand sanitizer, and hives. Along with reducing disposal of waste to landfills, creating bio-enzymes has also been alternative to reduce using synthetic chemicals which can affect the environment and human health. Awareness is also needed to process household waste into eco-enzyme to ensure zero waste at domestic level (Muliarta & Darmawan, 2021).

Research Gap

Consumers interact with food items with different goals and in different contexts. Hence, analysis is promoted with segmentation of household food waste in different stages. Various taxonomies are proposed to redefine the path with consumption and it ends in disposing food (Principato, 2018). Difference in models are associated with whether some activities are classified as different stages like meal preparation, meal planning, and storage. This study explores three stages of food waste as well as nature of food waste.

Research Objectives

- To discuss the characteristics of food waste and propose theoretical framework for households
- To segregate household food waste in different stages
- To provide in-depth individual analysis of various stages

III. Methodology

This study presents an insight to the approach when it comes to form an evaluation framework for actions to prevent food waste and to develop a measure to determine environmental performance of the measure.

For food waste prevention, this exploratory study scans several papers published on food waste prevention frameworks and contribution of various stakeholders and experts from academia, private organizations, and food business operators.

IV. Data Analysis

Characteristics Of Food Waste and Theoretical Framework for Households

Household food waste can be understood well by categorizing it to identify the best targeted measures for different types of waste. This categorization should consist of comprehensive framework to build relations between different categories of household food waste and interventions and reasons. This framework is ultimately aimed to improve social and economic benefits while reducing environmental footprint related to household food waste. It is worth noting that various studies adopt their varied and different categorization systems (Withanage et al, 2021), resulting in disjointed scene of categorizing food waste. This change in approach compares relative benefits of various researchers directly to reduce household food waste and it is not favorable to a translatable and unified area of research.

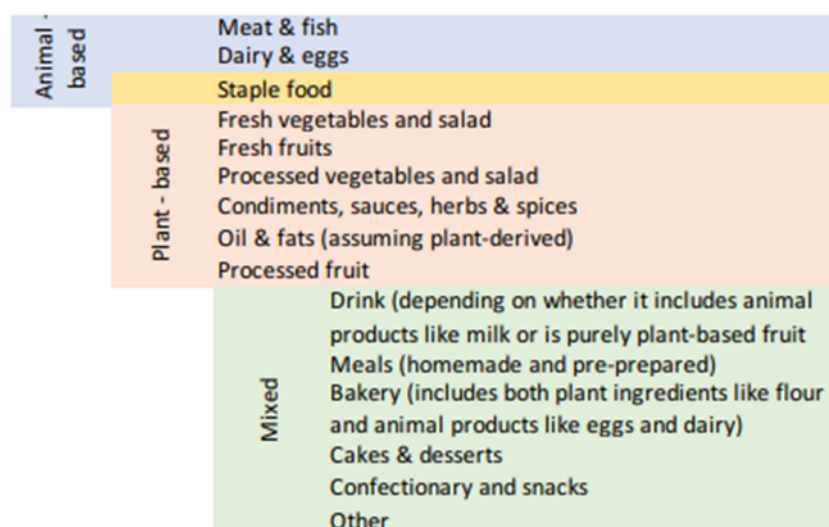
There are various definitions on the concept of food waste which further complicate the matter (Jellil, 2020). The term can cover a lot of states related to food loss at the level of production to discarding food at consumption level. This ambiguity often causes inconsistency and doubts in analysis and collection of data, which ultimately affects interventions from reduction of food waste. This section will critically review and analyze the scenario of household food waste categories and their implications in wider context of research.

Categories of food waste as per food group

The most common and simple approach of categorizing household food waste is by combining as per food types as per the "Waste and Resources Action Program (WRAP, 2013). WRAP categorizes household food waste in 15 major types of food, which can be grouped further into plant-based, animal-based, and mixed products (Jellil, 2020) (Figure 1). There are limitations in this way of categorization of food waste. It focuses mainly on the type of food discarded, offering important data on the energy content, mass, and economic cost of household food waste, but fails to address the behavioral factors which play a vital role in household food waste.

This categorization ignores most important aspects like causes behind food waste, which may vary drastically among types of food. For instance, factors contributing to fruit waste might vary drastically from the ones resulting in disposal of meat products. In addition, this categorization often ignores the qualitative aspects of household food waste and it doesn't focus on the food condition when discarded, whether it is surplus, spoiled, or because of personal choices. A complete knowledge of household food waste must cover not just the type of food waste, but its condition and context too.

Figure 1 – Categorization of household food waste



Source – WRAP (2013)

Theoretical Framework for Analysis

Researchers have focused on two key theoretical approaches to know the causes behind food waste in households (Schanes et al, 2018). Psychology-based methods have identified the interpersonal and cognitive factors which would result in food waste for consumers (Steg & Vlek, 2009). For instance, the “theory of planned behavior (TPB)” has explained food waste in terms of intentions and motivations of individuals (Ajzen, 1991; Graham-Rowe et al, 2015). Sociological methods have been based on impact of external and social factors (Schanes et al, 2018). It is possible to use social practice theory to explain food waste as household practices affected by wider social and economic context (Southerton & Yates, 2014).

Though psychology-based methods provide insights into psychological systems which result in food waste, they cannot explain why intentions of people to avoid food waste usually don't behaviorally manifest (Schanes et al, 2018). Meanwhile, “social practice theory” enables clear knowledge of this intent. There is a lack of deeper knowledge in behavioral gap related to interaction of people with pollution cues (Evans, 2012). According to Schanes et al (2018), better understanding of food waste behavior is originated with combination of these views. As analytical framework, the “Installation Theory” enables incorporation of both perspectives of social practice and psychological theory, as it defines behavior due to individual, social, and environmental factors.

This study proposes an analytical framework of “Installation Theory” for two reasons – it enables people to fill the gap in the theoretical studies, providing complete knowledge of food waste, by focusing only on the practices and intentions of consumers, but also material conditions of affordances and social regulations can intervene to determine behavior. In addition, the “Installation Theory” refers to the mode of producing behavioral change in real world and it is ideal to identify practical solutions. It is argued that ICTs and mobile applications are objects which play a vital role in installation. They support the individual's behavior by improving and extending competencies. For instance, a shopping list acts as an extension of memory of an individual. In addition, ICT's interface can be analyzed as affordance to scaffold some behaviors (Farr-Wharton et al, 2014). Finally, social norms are applicable in digital settings, especially when interaction is made between the user and other users online (Major, 2000), given that social layer can be used by mobile apps.

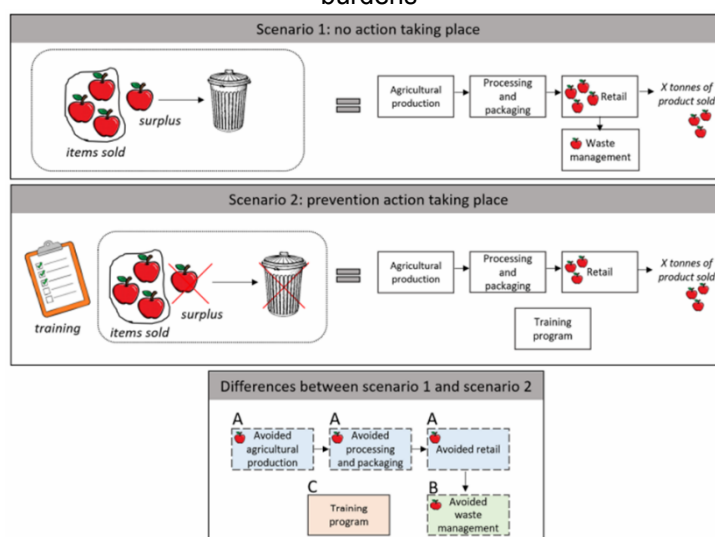
Caldeira et al. (2019) proposes an evaluation framework for preventing food waste with iterative process and with the contribution of various stakeholders. Due to role of various stakeholders like food waste experts, members of the EU, NGOs, private organizations, and food business operators, the literature was reviewed to know the relevant criteria to determine the performance of actions for prevention. As per the criteria defined in those studies and proposed, first draft was presented and developed in the framework in expert workshop which happened in September 13, 2018 in Italy.

The discussion resulted to refine the framework, which was obtainable to the EU members on food waste and refined further. Focusing on the diversity of actions to prevent food waste, relevant criteria was selected for all kinds of actions. Hence, framework was created to assess various actions consistently. A reporting template was created to gather data on actions to prevent food waste for assessment as per the developed framework. They covered initiatives on redistribution of extra food

from retail, food services, and manufacturing to people in need and initiatives to avoid the generation of food waste by nudging the change in behavior among citizens, and initiatives to prevent food waste by improving efficiency of processes of food production.

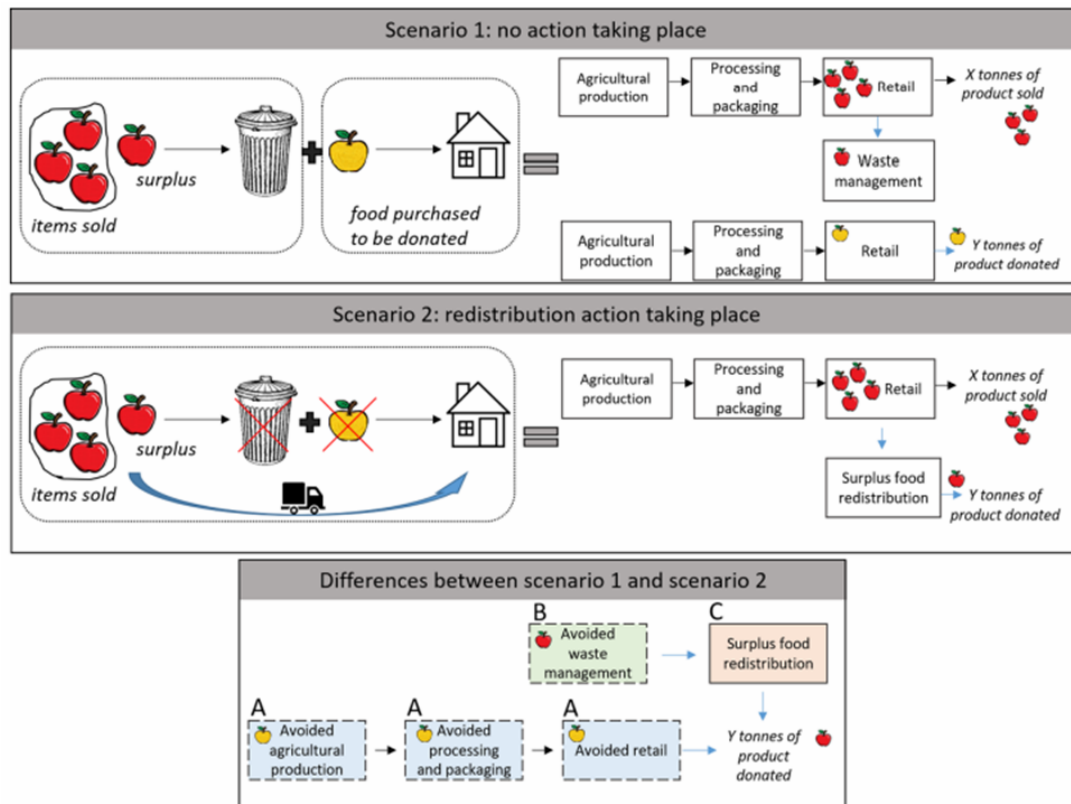
Implementing the measures to prevent food waste will have some costs related to it and in turn, it will bring some financial benefits to avoid wasting food with economic value and not covering disposal costs if it succeeds to reduce food waste. The framework is aimed to find out if savings outweigh the costs to determine economic feasibility to adopt the initiative. The conceptual model performs financial assessment in Figure 2 to prevent food waste at source and Figure 3 illustrates redistribution measures. Figure 2 and 3 represent prevention measures at retail stage which is also applicable in all stages of supply chain.

Figure 2 – Conceptual framework to assess environmental and economic benefits to prevent food waste at source. Component A (blue) and Component B (Green) boxes refer to both environmental and economic savings by adopting the measures, while Component C (Orange) boxes are added burdens



Source - De Laurentiis et al (2020)

Figure 3 – Conceptual Framework to define environmental and economic benefits of actions as per redistribution of extra food. Component A (blue) and Component B (Green) boxes refer to both environmental and economic savings by adopting the measures, while Component C (Orange) boxes are added burdens



Source - De Laurentiis et al (2020)

Stages of Household Food Waste

Acquisitions

In the modern world, food for domestic consumption can be availed in different environments like farmers' markets, supermarkets, and online too. Grocery shopping still results in a few amounts of acquisition of household food (Saphores and Xu, 2021). In comparison to other locations of shopping, leading supermarket chains are majorly responsible for promoting food waste among consumers (Farr-Wharton et al, 2014). This way, food waste is usually caused by over-purchasing products which are not required, which are disposed of and not consumed consequently (Mallinson et al, 2016). Also known as buying decision made in store without explicit identification of the need for this type of purchase before entering into the store, impulse buying is responsible for over 60% of over-purchasing (Kollat and Willett, 1967; Mattila and Wirtz, 2008).

Consumption

At the stage of consumption, buying decisions are made by consumers related to food preferred to eat, quantity to serve, cook, and eat, and ingredients to use (Block et al, 2016). According to Secondi et al (2015), a lot of food wasted could have been consumed if it had been managed, portioned, prepared, and/or stored well. In this stage, an important part is whether consumers reuse leftovers after having a meal as it may be effective to cut down on food waste in households (Secondi et al, 2015). This study focuses on overall installation and kitchen to eat and prepare a meal, while understanding a lot of variety among households. For instance, a home have a dining table which is a shared space, while study space is not.

Disposal

It takes place once consumers choose to avoid keeping a specific food item. People have the option of throwing food in the dustbin, recycle it, or by donating it to someone else. Though composting relieves some of the harmful effects of food waste on the environment, it doesn't reduce food waste directly on its own and is not at the core of intervention. The association between food waste and recycling behavior is still not understood well. People who sort their waste also had reduced food waste levels (Secondi et al, 2015).

V. Discussion And Conclusion

This study has highlighted and identified sources of waste of food items in urban households of young buyers. Household food waste is a significant global challenge. This study contributes novelty by proposing evaluation framework to provide complete coverage to ensure that all kinds of household food waste are considered. Given all the potential food items, the model offers a step ahead for holistic model to understand and address the complexities. This framework importantly differentiates among the inedible and edible food items, understanding different categories of food waste.

It considers dynamic matter of food items over time, given that what may be consumed at one time may be inedible. In addition, the framework understands the role of feeding animals with household food waste and it consists of difference for food items which may be suitable for animals but not for humans. In addition, the framework promotes identifying special stages in managing household food items which play a vital role in generating various kinds of food waste. When it comes to align with certain reasons to generate food waste, the framework offers valuable details on the given factors resulting in waste at domestic level.

The framework was used to analyze the waste recorded and most of the wastes were edible. A huge percentage of edible food waste recorded may also cause ability to differentiate among types of food waste accurately with this model, i.e., foods which may have been inedible. It is worth noting that findings are not extrapolatable directly to the whole population. This limitation is majorly because of sample size of participants. Future studies should dig into certain reasons behind each household food waste and map the same over the stages of managing household food.

There is a need to understand the correlation among the causes behind stages of food waste and reasons behind them to provide crucial and valuable insight to know trends and patterns in generating household food waste. This knowledge will be vital to implement and design targeted interferences in order to mitigate household food waste efficiently. Hence, it reduces the ecological aspects associated to discard and produce foods that are not consumed.

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