Reducing Food Waste Through Choice Architecture: Insights from Denmark, the UK, and San Francisco

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Introduction

Food waste remains a significant challenge to sustainability and global food security. According to the United Nations Environment Programme (UNEP), in 2022, globally, about 1.05 billion tonnes of food was wasted, accounting for roughly 19% of available consumable food (UNEP, 2024). 60% of total food waste is generated at the household level, while food service and retail sectors are responsible for the remaining 40% (UNEP, 2024; Drishti IAS, 2024). Food waste is a significant contributor to greenhouse gas emissions, responsible for roughly 8-10% of global emissions, nearly five times the total emissions from the global aviation sector (UNEP, 2024; U.N. News, 2024). Additionally, the decomposition of organic waste in landfills produces methane, a potent greenhouse gas contributing to climate change. The Food and Agriculture Organization (FAO) estimates that if food waste were a country, it would be the third-largest emitter of greenhouse gasses globally, following China and the United States (FAO, 2023).

Besides environmental consequences, food wastage has a significant economic and social cost. Food waste costs the world an estimated $1 trillion annually, including the value of the food wasted and the associated disposal costs (World Resources Institute, 2023). Global food wastage contrasts starkly with global hunger statistics: around 783 million people suffer from hunger, and approximately one-third of all food produced is never consumed. (U.N. News, 2024). To put it into perspective, the World Bank states that reducing food loss and waste by just 25% would be enough to feed an extra 870 million people yearly, illustrating the need for solutions. (World Bank, 2023).

Choice architecture offers one of the best areas to reduce food waste, as it subtly touches human behavior through behavioral economics by designing the context within which people make choices, nudging them toward more sustainable decisions entirely subconsciously. For instance, research proves that a slight decrease in portion sizes leads to decreased waste within a food service context: in the U.S., portion changes at college dining halls cut food waste by up to a third (Kallbekken & Sælen, 2021). For instance, if perishable goods, such as fresh fruits and vegetables, are positioned at eye level in a grocery store, the consumer will select these over the goods with a longer shelf life, reducing waste. Additionally, public-private partnerships offer a powerful tool for scaling up the implementation of choice architecture. The Pacific Coast Food Waste Commitment is another example demonstrating how partnership and coordinated action by retailers, governments, and nonprofits can deliver success in reducing food waste. Over the three years of the program, from 2019-2022, a 25% reduction in unsold food was seen, saving almost 190,000 tons of food from going to waste and $311 million (BioCycle, 2024).

The problem concerning food wastage is not limited to wealthier countries; it is an issue independent of the income grade of countries. The average household food waste per year per capita differs by only 7 kg between high-income, upper-middle-income, and

lower-middle-income countries, indicating that food wastage is a problem also independent of economic class. Moreover, as stated by the World Economic Forum, addressing food waste could mitigate other challenges like water scarcity and biodiversity loss by reducing the need for land and water to produce food that ultimately goes uneaten (World Economic Forum, 2023). The challenge of food waste demands urgent, comprehensive action. Integrating choice architecture and public-private partnerships presents a realistic avenue for step change to ameliorate food waste, underpin environmental sustainability and economic efficiency, and provide better food security. With a rising global population and strained resources, these interventions are not merely optional but necessary for a sustainable future.

Defining Food Loss and Waste

Food waste refers to food suitable for consumption but discarded or left to spoil at retail, household, or food service levels. It differs from food loss, which occurs earlier in the supply chain due to production, post-harvest treatment, and processing issues. The Food and Agriculture Organization (FAO) categorizes food waste into three categories:

- **Avoidable Food Waste**: Edible discarded items, such as leftovers or surplus food.
- **Possibly Preventable Food Waste**: Edible food that some people eat but others might not, such as bread crusts or apple peels.
- **Unavoidable Food Waste**: Inedible parts of discarded food, such as bones, eggshells, or fruit pits.

Food wastage is a major issue that greatly affects the environment and economy. When accumulated in landfills, organic food waste decomposes to produce methane, a greenhouse gas with 80 times the effect of carbon dioxide (in the first 20 years of reaching the atmosphere) (Environmental Defense Fund). Transportation, manufacturing, and agriculture all create greenhouse gasses, making food waste a far more significant environmental issue than one might initially expect.

Community-level initiatives are part of the solution to curbing food waste. In New York City, residents disposed of 1.2 billion pounds of food, a staggering number (NYC Department of Sanitation, 2023). Of this discarded food, 86 million pounds, or 6.8%, were still in intact packaging, leading to the implementation of the organics collection program, which minimizes the likelihood of collected food being food scraps than in packaging. Similarly, San Francisco has considerably reduced the amount of waste from its food service sector destined for landfills through its mandatory composting and recycling laws. This “zero-waste” program has, since 2012, reduced 80% of discarded waste going to landfills, significantly reducing the environmental cost of San Francisco’s waste management (Natural Resources Defense Council, 2017)

Defining Choice Architecture

Choice architecture is the design of the context in which people make choices that can nudge them to make better decisions without forbidding any options. Some important concepts include:

- **Nudges**: Simple interferences that guide peoples' decisions in a particular direction without removing their freedom of choice. An example is putting healthy food options at eye level in the cafeteria (Thaler & Sunstein, 2008).
- **Defaults**: Pre-set options that take effect if no active choice is made. An example is automatically enrolling employees in retirement savings plans to boost participation rates (Madrian & Shea, 2001).
- **Framing**: Presenting information in a way that has an impact on decision-making. An example is labeling an item "75% lean" instead of "25% fat" because the former labeling has a more positive connotation from a consumer perspective. (Levin et al., 1998).
- **Anchoring**: Using some initial information as a reference point in subsequent judgment. An example is using initial price offers in a negotiation to set an anchor for final agreements (Tversky & Kahneman, 1974).

Choice architecture has already been applied successfully in various fields. Nudging has been shown to push people toward healthier behaviors, such as using visual cues in cafeterias to highlight healthy food or defaulting them into opt-out organ donation systems. This circumstance significantly raises donor rates (Johnson & Goldstein, 2003). Individuals have been able to save more by automatically enrolling in retirement savings programs and encouraging responsible use of credit cards by setting lower default limits. Choice architecture also encourages sustainable behaviors such as recycling and energy conservation through default settings on appliances and providing feedback on energy consumption compared to neighbors (Allcott, 2011).

Previous Studies and Analysis

Research on food waste and behavioral interventions has highlighted several effective strategies. A study by Schmidt and Matthies (2018) found that educational campaigns, combined with practical tools like meal planning and shopping lists, can lead to a 15-20% reduction in household food waste. This study combines informational and behavioral strategies to achieve more substantial and sustained household food waste reductions. A meta-analysis by Stöckli, Niklaus, and Dorn (2018) reviewed the effectiveness of various nudges in reducing food waste. These included "stop signs" on buffet tables and public commitments to reducing food waste, which decreased food waste by up to 30% in households and food service environments. This analysis highlighted the versatility and effectiveness of nudges in different contexts, reinforcing the potential of behavioral interventions to address food waste.

Furthermore, a study by Wansink and van Ittersum (2013) explored the impact of plate size on food consumption and waste. The research found that smaller plates can reduce food intake by approximately 22%, subsequently reducing food waste. This finding supports the idea that simple changes in the dining environment can significantly affect consumer behavior and waste reduction.

Successful Applications of Choice Architecture

The next few sections will give an overview of various movements in different parts of the world that all share a common goal: to reduce food waste. Each of these movements utilizes

choice architecture in different ways, but all are successful in reducing food waste in their community.

Stop Wasting Food — Copenhagen, Denmark

The “Stop Wasting Food” initiative, known in Danish as “Stop Spild Af Mad”, was founded by Selina Juul in 2008 and has become a significant force in reducing food waste in Denmark. This grassroots movement utilizes principles of choice architecture to influence consumer behavior and reduce food waste. In just five years, Denmark has managed to reduce its food wastage by a significant 25%, leading the world in food waste reduction (Cremer, 2018) “Stop Wasting Food” often partners with supermarkets to add labeling on products nearing their expiration dates. These labels, combined with substantial price reductions, serve as visual nudges that encourage consumers to purchase items that might otherwise be discarded and add economic incentives to reducing food waste. Reports indicate that such initiatives have helped reduce food waste in participating stores by up to 25% (Stop Wasting Food, 2020; Second Harvest, 2021). These methods have been so successful that Denmark has taken this idea further by opening Wefood, the nation’s first grocer to exclusively sell recently expired food with minor flaws or damaged packaging. The first Wefood was so successful that a second store opened within a few months.

Additionally, the initiative promotes reducing portion sizes for ready-made meals and fresh produce in supermarkets. By offering smaller portions, the initiative addresses the problem of over-purchasing, particularly in single-person households, which often leads to waste. This aspect of choice architecture aligns portion sizes more closely with consumer needs, reducing the likelihood of food spoilage.

The initiative’s impact extends beyond consumer behavior to influence national policies and corporate practices. For example, the Danish government has incorporated food waste reduction goals into its environmental policies, largely due to the “Stop Wasting Food” advocacy efforts. On the corporate front, major food retailers such as REMA 1000 and Coop have adopted many of the initiative’s recommendations, such as reducing the size of bread loaves to match consumption patterns better. (Wikipedia, 2020; Independent, 2020).

Technological solutions have also been part of the initiative’s strategy: Danish tech startup “Too Good To Go” developed a mobile app that connects consumers with businesses to rescue surplus food at the end of the day. This app allows restaurants, bakeries, and grocery stores to sell unsold but still fresh food at a discounted price, thus preventing it from being discarded. This approach has reduced food waste and provided consumers with affordable food options.

The “Stop Wasting Food” initiative exemplifies the effective use of choice architecture in reducing food waste. The initiative has successfully influenced consumer behavior and policy through strategic labeling, portion size adjustments, educational campaigns, advocacy, and technological innovations. This comprehensive approach demonstrates the power of combining various strategies to reduce food waste significantly and serves as a model for other countries aiming to address this critical issue.

Love Food Hate Waste — United Kingdom

"Love Food Hate Waste" (LFHW) is an initiative launched by the Waste and Resources Action Programme (WRAP) in the U.K. in 2007. Like "Stop Wasting Food", LFHW has reduced food waste through the strategic use of choice architecture, altering consumer behavior by employing various nudges and educational tools to help individuals make more sustainable choices regarding food consumption and waste. Since 2007, household food waste has decreased by 1.1 million tonnes, preventing 2.3 million tonnes of total waste. The carbon savings of this reduction is estimated to be around 930,000 tonnes of CO2 per year. In terms of household food waste, there has been a reduction of 3.75, or 270,000 tonnes per year, between 2010 and 2012, showing the impacts of this initiative in such a short timeframe. Since 2007, avoidable household food waste has been cut by 21% (Marsh).

One of the primary strategies LFHW uses is disseminating practical tools and resources that encourage better food management. For instance, LFHW provides portion calculators to help consumers determine appropriate serving sizes, which reduces the likelihood of over-purchasing and subsequent waste. This tool is a classic example of a nudge, subtly guiding individuals to make more informed and sustainable choices without directly restricting their freedom (WRAP, 2021).

Educational campaigns are a significant component of LFHW's strategy. The annual Food Waste Action Week, part of the initiative, focuses on raising awareness and promoting behavioral changes through various events, workshops, and media campaigns. The 2023 campaign, themed "Win. Don't Bin", provided tailored tips on making the most of purchased food, encouraging consumers to use leftovers and plan meals more effectively (Love Food Hate Waste, 2023). This effort leverages social norms by showcasing waste reduction as a standard and desirable practice, encouraging widespread adoption.

LFHW has partnered with supermarkets to simplify food labeling and promote better purchasing decisions. Labels now include storage instructions and reminders to use products before they expire. Supermarkets like Aldi, Lidl, and Tesco have incorporated LFHW advice into their packaging, making it easier for consumers to follow these practices. This partnership exemplifies how modifying the choice environment can significantly reduce food waste at the consumer level.

The initiative's success has also led to its adoption in other countries, including Australia, Canada, and New Zealand. These international campaigns adapt the LFHW model to local contexts, sharing global insights and strategies to reduce food waste. LFHW's international reach emphasizes its approach's effectiveness and its principles' universal applicability.

Zero Waste - San Francisco, California

San Francisco has established itself as a leader in waste management, particularly through its ambitious zero-waste goals and innovative use of choice architecture. The city's

comprehensive approach to waste reduction includes mandatory composting and recycling laws, public education campaigns, and partnerships with various stakeholders.

In 2002, San Francisco set a goal to divert 75% of its waste from landfills by 2010 and achieve zero waste by 2020. Remarkably, the city exceeded its initial target, recovering over 80% of waste and significantly reducing landfill disposal (EPA, 2021). The foundation of this success lies in the strategic application of choice architecture, which involves designing the environment to nudge individuals and businesses toward more sustainable behaviors.
One of the critical components of San Francisco's strategy is its mandatory recycling and composting ordinance, enacted in 2009. This law requires all residents and businesses to separate recyclables, compostables, and trash into three distinct bins. The ordinance leverages the concept of defaults by making recycling and composting the standard practice, thereby reducing the effort required for individuals to participate. As a result, the city has seen substantial compliance and a marked increase in waste diversion rates (SF GSA, 2020).
San Francisco's success is also attributed to its robust public education efforts. Programs like "Food to Flowers" educate young students about composting in their school cafeterias, fostering early adoption of sustainable practices. Additionally, the city's comprehensive outreach includes multilingual support and community workshops, ensuring that all residents are informed about proper waste sorting and its benefits (SFE, 2021).

The city's innovative programs extend to businesses as well. The Food Service Waste Reduction Ordinance, effective since 2007, prohibits the use of polystyrene foam to-go containers, mandating the use of compostable or recyclable alternatives. This ordinance reduces non-compostable waste and aligns with consumer preferences for environmentally friendly packaging, thus using social norms to encourage compliance (SF GSA, 2020).
Another notable initiative is San Francisco's extensive composting program, which started in 1996 and has become the largest in the United States. The program collects approximately 650 tons of organic waste daily from residents and businesses, converting it into high-quality compost for local farmers and vineyards. This effort exemplifies the circular economy approach, transforming waste into valuable resources, closing the loop, and minimizing environmental impact (Future of Food, 2021).

Moreover, the city's public-private partnership with Recology, the waste management company, has been crucial. Recology's innovative three-stream collection system and its role in processing waste into compost and recyclables have been central to the city's achievements. This collaboration ensures the infrastructure supports the behavioral nudges implemented through policy and education (ArchDaily, 2021).

San Francisco's approach to waste management illustrates the effective use of choice architecture in promoting sustainable practices. The city has significantly reduced its environmental footprint by making recycling and composting the default options, educating the public, and implementing supportive policies. These efforts demonstrate how strategic design and comprehensive planning can substantially improve waste management and sustainability.

Implications for Policy and Practice

Both government and organizational bodies can assist in reducing food waste through the means of choice architecture. This section will propose how these groups can utilize these methods.

Government Strategies

Governments can implement robust regulatory frameworks that make sustainable practices the default option, increasing social acceptance of the movement against food waste and making it easier to take action. For example, San Francisco's mandatory composting and recycling laws require residents and businesses to separate recyclables, compostables, and trash into distinct bins. This regulatory approach leverages the concept of defaults, making sustainable waste management practices more effortless and habitual for the public (S.F. Department of the Environment, 2021), increasing participation in combating this issue. Another effective policy is the introduction of waste reduction targets and incentives. Governments can set ambitious goals, such as Denmark's target to reduce food waste by 25% by 2025, supported by financial incentives for businesses and households that achieve significant waste reductions. These targets can be reinforced through public reporting and benchmarking, creating social norms around waste reduction.

Educational campaigns are also vital for informing the public about the importance of reducing food waste and how they can contribute. Governments can run nationwide campaigns similar to the U.K.'s "Love Food Hate Waste" initiative, which provides practical tools like portion calculators, meal planning guides, and storage tips. These campaigns can use framing to highlight the financial and environmental benefits of reducing food waste, thus influencing consumer behavior. Moreover, governments can integrate food waste education into school curriculums, fostering a culture of sustainability from a young age. Programs like San Francisco's "Food to Flowers" educate students on composting and waste reduction, ensuring these practices become second nature, leaning into making sustainable practices a "default", and encouraging the prevention of food waste as a baseline behavior from a young age (SFE 2021).

Lastly, governments can partner with businesses and NGOs to implement comprehensive waste reduction programs. For instance, Denmark's collaboration with supermarkets to introduce clear labeling and price reductions for near-expiry products has been highly effective. Such partnerships can leverage the strengths of both sectors, combining regulatory oversight with innovative business practices to reduce food waste. Another example is the partnership between the City of New York and local nonprofits like City Harvest, which redirects surplus food from restaurants and grocery stores to food banks and shelters. This partnership reduces food waste and addresses food insecurity, demonstrating the multifaceted benefits of such collaborations.

Organizational Strategies

Retailers can play a crucial role in reducing food waste by adopting innovative supply chain practices. Implementing dynamic pricing strategies for near-expiry products, as seen in Denmark, can incentivize consumers to purchase items close to their use-by dates. Additionally,

retailers can offer smaller portions of fresh produce and ready-made meals to match consumer needs more accurately, thereby reducing waste and providing economic benefits for actively reducing food waste (for both the consumer and the retailer).

Organizations can also optimize their supply chains by improving inventory management and forecasting. Advanced data analytics can help predict demand more accurately, reducing overproduction and waste. Collaboration with suppliers to implement “just-in-time” delivery systems can ensure that products arrive fresh and are consumed before they spoil (Kibert & Grosskopf, 2020).

Retailers can also redesign store layouts to promote sustainable purchasing behaviors. Placing perishable items like fruits and vegetables at the front of the store and eye level can encourage consumers to buy these items first. Additionally, clear and attractive labeling and reminders to check expiration dates can nudge consumers toward better purchasing decisions (Thaler & Sunstein, 2008).

Organizations can reduce food waste by training employees on best practices for inventory management, food storage, and waste reduction. Engaging staff in sustainability initiatives and setting organizational goals for waste reduction can foster a culture of responsibility and innovation. For example, training restaurant staff to minimize food prep waste and optimize portion sizes can significantly reduce food waste (Gunders et al., 2017). Organizations can engage consumers through loyalty programs that reward sustainable behavior. For instance, offering discounts or points for customers who purchase near-expiry products or bring their containers can promote waste reduction. Collecting consumer feedback on waste reduction initiatives can help organizations refine their strategies and address any barriers to sustainable behavior.

Conclusion

The findings from Denmark, the U.K., and San Francisco all provide significant insights into the effectiveness of choice architecture in reducing food waste. In Denmark, the “Stop Wasting Food” initiative has demonstrated that simple changes such as clear labeling and price reductions on near-expiry products can significantly reduce food waste, highlighting the power of economic incentives and visual nudges in influencing consumer behavior. In the U.K., the “Love Food Hate Waste” initiative has shown that providing consumers with practical tools and educational resources can effectively reduce household food waste, emphasizing the importance of consumer education and accessible resources (such as portion calculators and storage tips) in changing behavior. San Francisco’s comprehensive waste management success illustrates the effectiveness of regulatory frameworks and infrastructural support in promoting sustainable waste management practices. By making recycling and composting the default options, San Francisco has facilitated large-scale behavioral change, illuminating the role of policy and infrastructure in reducing waste.

Despite the promising findings, several limitations must be considered. The scope of these initiatives is primarily localized, raising questions about their generalizability to other regions with different cultural, economic, and infrastructural contexts. For example, the success

of San Francisco's waste management program is partly due to its specific regulatory environment and the strong public-private partnership with Recology, which may not be easily replicable elsewhere (Goldstein, 2019). However, more broad initiatives like those similar to "Love Food Hate Waste" have great potential to spread to other areas without much hassle. Despite these concerns, the importance of continuing efforts to reduce food waste through innovative approaches cannot be overstated. Food waste contributes significantly to environmental degradation and economic inefficiency, making adopting effective strategies like choice architecture imperative. The initiatives in Denmark, the U.K., and San Francisco serve as valuable models, demonstrating that simple, well-designed interventions can substantially reduce food waste. By building on these successes and addressing the identified gaps, governments, organizations, and individuals can make significant strides towards a more sustainable future.

While the findings from these initiatives are promising, several areas require further investigation. Future research should explore these interventions' long-term sustainability and adaptability to different cultural and economic contexts. Studies focusing on integrating choice architecture with technological innovations, such as mobile apps and digital nudges, could provide new insights into enhancing the effectiveness of waste reduction strategies. Additionally, examining the interplay between individual behaviors and systemic factors, such as food policies and supply chain logistics, will be crucial in developing comprehensive solutions to food waste (Kibert & Grosskopf, 2020; Gunders et al., 2017)