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REDUCTION OF FOOD WASTE IN GROCERY STORES IN RURAL AMERICA

REDUCING FOOD WASTE AT RETAIL STORES—AN EXPLORATIVE STUDY

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PAPER ABSTRACT: This study focuses on the problem of food waste in grocery stores in rural America and in food deserts, and the opportunities for designers to address these issues. Previous research has emphasized the need for food loss and waste management, and the environmental and socio-economic impacts it has in North America. The primary causes of food waste in these areas include expiration dates, spoilage, consumer purchasing behavior, and over-ordering of food products. Other studies have also examined how distance and attitudes towards shopping affect consumer behavior and the effectiveness of various strategies. Solutions to this problem could include a designed system incorporating technology that addresses the specific needs of low-income consumers in these areas. This paper presents the findings from a literature review and qualitative data collected through interviews. The results of this study can provide valuable insights for designers looking to reduce food waste in rural America and food deserts by identifying the key drivers of food waste, understanding consumer behavior and preferences, understanding current systems and their limitations, and identifying effective solutions that address the unique challenges of these areas.

Keywords: Food waste, Design Opportunities, Industrial Design, Environmental impacts, Consumer Behavior and Preferences.

1. INTRODUCTION

The purpose of this study is to understand the causes and impacts of food waste, and the proposed solutions in order to identify any design opportunities. While the rural population in America is dropping there are still millions of Americans living in rural areas with limited food access. This limited food access is made even more problematic when paired with the food waste seen from their limited grocery stores. Many rural Americans may desire to shop where they have a better selection or where the store aligns more with their values however "...two thirds of consumers [shop] in the store closest to home." (Steiger, 2022). This can be even more extreme in areas that are considered food deserts where in some places it can take up to 95 minutes to reach a grocery store (Mulrooney et al., 2017).

2. LITERATURE REVIEW

The purpose of this research topic is to better understand and call attention to the problem of food waste in rural America. The search was initially conducted in the Kansas State University Library

database and Google Scholar. To make sure the information was relevant to the current population being studied only literature published between 2016 - 2023 (recent 7 years) was reviewed. Keywords used to find articles of interest are as follows: rural, low-density population, food deserts, food waste, and inventory management. As a result, 2 literature reviews, 6 empirical studies, and 1 project showcase paper related to the topic of interest were reviewed for this study. After appropriate literature was found with the above-mentioned steps, they were reviewed with the pertinent literature being included at the end of this document. The primary purpose that this paper will expand upon is the exploration and understanding of in-store management systems that will reduce food waste at the source rather than fixing it after the food is already in the hands of the consumers, and what could be done to handle waste domestically.

2.1 CAUSES OF FOOD WASTE

Unfortunately, grocery retailers expect to lose about $18.2 billion collectively every year in food discard commonly referred to as shrink. While this number does include losses from theft and accounting errors, most of it sources from food waste and is therefore the main focus of this review. Food waste has many causes, some caused by supply and demand issues that result from much higher up and some are more small scale (Steiger, 2022).

The first big issue is overstocking. Many consumers have negative perceptions when shelves are not completely full. In order to appease consumers' desire for full shelves grocery stores over-order and over-stock the shelves with products that will expire before they are sold due to a lack of demand for the actual product (Steiger, 2022). The next cause is the perceived shelf life of certain food commonly referred to as ultra-fresh or highly perishable products. These products include ready-made snacks or fresh bread. Other foods fall into these categories such as meat and fish, that if handled improperly, can be easily made unsafe to eat. The last foods in this category are fruits and vegetables that may easily be damaged and considered as no longer good to eat or already spoiled. All of these foods do have relatively short shelf lives but the perceived shelf life is even shorter, meaning that if the food was really good for a week but consumers only perceived it as good for 2-3 days the grocery store would need to sell it within those 2-3 days because it would not be purchased otherwise (Riesenegger & Hübner, 2022). This issue can be exacerbated by workers who are overly cautious and throw away products prematurely that have a good chance of still being chosen by consumers.

2.2 PROBLEM AREAS

Through the aforementioned causes of food waste, larger chain grocery stores are disproportionately responsible for food waste and overall loss. With changes to management, transportation, and store initiatives, food security may drastically increase in areas of low-income food desert populations. This is emphasized by the fact that "Due to strong competition and the imperative of realizing sales, they often prioritize availability. (Supermarkets) tend to overstock their displays as full shelves, usually to drive sales." (Riesenegger & Hübner, 2022) This overstocking increases pressure and can, in turn, cause small markets and corner stores to, "require significant financial input and equipment ... to increase

availability of healthy choices" (Mogil et al., 2021). This is compounded by studies showing that transportation is the first major stage of food loss alongside the breakdown of the supply chain that is becoming more widely addressed in the post-COVID environment. This is then reflected in many loss stages of initial harvest, transportation, distribution, brokering, and finally wholesale, all of which have some element of transportation or exchange in ownership before reaching the final consumer. This repeated transferring results in "About 31% of post-harvest food available for human consumption lost or wasted annually in the United States." and the biggest problem area can be summarized as "Roughly one third (43 billion lbs.) of food loss occurs in grocery and other retail food stores." (Ceryes et al., 2021).

2.3 PROPOSED SOLUTIONS

Though these statistics are gathered from urban environments and high-density populations, food deserts also exist outside of these focused groups. This can be better addressed through control of inventory management systems and local sourcing, such as store owners reducing the prices of food products that are close to their expiration in order to sell remaining product while still making a profit and reducing food waste. (Horoś & Ruppenthal, 2021). Small changes like this are much more manageable in smaller scale grocery store environments much more akin to rural areas. This can be further taken advantage of through order management and better tracking of purchased products since "…the role played by recently developed digital technologies in unlocking sustainability-related actions in supermarket chains in emerging economies has been somewhat underexplored." (de Souza et al., 2021) Most notably taking advantage of these technologies is Amazon with their Go, Fresh, and Style stores based strictly on purchases being tracked via technology integrated into carts and linked to Amazon Accounts. This creates a feedback loop that may be made even more effective when paired with utilizing an automatic replenishment program that may reduce their level of food waste by up to 20%. (Kiil et al., 2017) These opportunities should be integrated regardless of hired cashiers or the walk out systems such as those in Amazon stores.

If technology is not human-centered and only back-end management, it may be wiser to rely on local systems and manage surplus instead. This could be utilized in the efforts of the idea of a "secondary market". As defined by the Commission of Environmental Engagement, secondary markets are market environments for the "purpose of selling at a discounted price or redistributing food products from producers, processors, and primary retailers." (CEC. 2017.) The use of these markets offer otherwise wasted food a second life as "misfits" and labeling them at a marked-down price to incentivize purchase and consumption. The flip side of this conundrum is to strictly manage production and most preferably, we should be preventing surplus food in the first place rather than managing the waste. (Riesenegger & Hübner, 2022) This seems to be a counterintuitive option with so much waste still remaining in the system. The more realistic option would instead be to approach community food systems to explore the opportunities to support local farmers so that they would then increase the access, variety, and freshness of produce at communal grocers (Liang et al., 2021) While there will always be waste in the

system, empowered local communities and providers may be able to overcome the potential losses that create food deserts and cut waste in a singular blow.

For foods that are inevitably wasted or become inedible, there are systems that can be implemented as a part of food recovery. Prevention and reduction have been covered as the basis of resource management but plans of food rescue and recycling (Animal feed, Industrial use, and composting) are still relatively underutilized in populations outside of rural environments. This makes these proposed solutions the most preferable in the eyes of environmental considerations as well as general emissions (Ceryes et al., 2021).

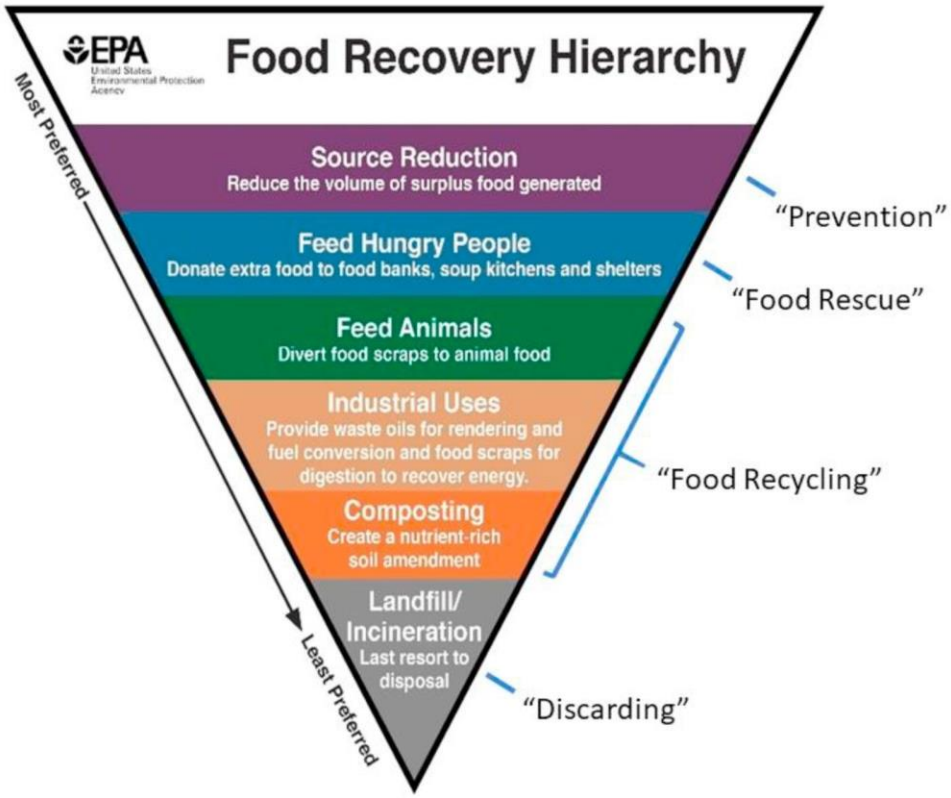

Figure 1. Ceryes, C. A., Antonacci, C. C., Harvey, S. A., Spiker, M. L., Bickers, A., & Neff, R. A. (2021). "maybe it's still good?" A qualitative study of factors influencing food waste and application of the E.P.A. Food Recovery Hierarchy in U.S. supermarkets. Appetite, 161, 105111. https://doi.org/10.1016/j.appet.2021.105111

2.4 DISCUSSION

The gathered information has produced insights based on existing technologies and approaches to solving the food desert problems of both urban and rural America. Opportunities present themselves as in-store management systems, price reduction, and marketing efforts, as well as preventative waste measures. This can be applied to industrial design lenses by encouraging more human friendly designs aimed at the sales and transport of food. Through further exploration, there is also potential for more tailored approaches for rural environments such as select inventory and stock management or

prediction-based software to minimize waste based on trends through user purchasing. Another option to take down waste at a supermarket level is to aggressively restrain overstocking through utilizing stocking shelves of less depth. This may give the consumers the impression of larger scale availability while requiring fewer products to be set on shelves and risk being wasted.

2.5 CONCLUSION

Through this literature review it can be seen there is a struggle for proper inventory management in North American supply chain logistics that leads to egregious waste of food products. With the majority of these products being wasted or mishandled in transport and waiting stages of the supply chain, it would be an opportunity to pursue products or systems that aim to streamline these processes. Due to the second leading cause of food waste being shelf waste and time-related spoilage secondary approaches may be taken. This offers up opportunities in consumer marketing and mobile solutions to grocery store alternatives. This could be innovative for business models by creating marketing less reliant on inventory basis'. Whether it is a more human and product-centered design, or management focused back-end, the business owners and food desert communities would benefit from these potential solutions.

3. INTERVIEW

The purpose of the interview being conducted is to understand food waste in grocery stores from both consumer and management perspectives. By exploring both sides we can see what is actually important to consumers versus what the company believes is important. This information will show what consumer desires are not being met and give a straightforward set of issues to address in a designed system.

3.1 METHODOLOGY

The proposed questions for the interviewees address either their shopping habits and their attitudes towards their rural local grocery store or their role in running rural local grocery stores. This addresses what if anything those stores do to prevent food waste and what they do with food waste. The second group was also asked about how their system, if any, addresses varying demand for products e.g., higher demand for turkeys around thanksgiving, and any other information about that system that may be gathered.

3.2 DATA COLLECTION

6 participants were interviewed to further research food waste in rural grocery stores. 4 were consumers who lived and primarily shopped in a rural area. The other 2 participants were owners and/or managers of rural grocery stores. All participants were recruited through previous contacts, or a flyer posted in rural local grocery stores. After giving consent to be interviewed and recorded the respondents spoke to a researcher for 15-30 minutes and answered 11-13 questions (depending on the respondent group they fell into) These interviews were recorded to allow the researchers to further

analyze responses and determine how they can better address the issues of food waste in rural areas and their grocery stores.

3.3 DATA ANALYSIS OF CONSUMERS

Of the consumer interviewees, 75% choose their grocery store because of its conveniently short distance from their home with 50% of the respondents occasionally visiting a store that is farther away but has a larger selection. This secondary store was typically at least an hour away and was only visited 1 to 2 times a month while the primary store was visited multiple times a week. The respondents frequently check the expiration dates of the products they are buying as well as visually inspect the produce. When they did find products that were out of date about half would find a worker and report it to them. The respondents did not associate an expired product on the shelves with a negative viewpoint of the store but typically attributed it to a lack of turnover because of the limited customer base. The consumers did report having very little food waste because of the frequency that they were able to visit the grocery store allowing them to only purchase what they needed. They also said they could not think of anything the stores could do to help them reduce their waste as they already believed it was at a minimum. The main way they disposed of this waste is through trash with one respondent also feeding scraps to her farm animals. The last question respondents were asked was if they had any comments or concerns about food waste, most commented they did not think about it frequently enough to have any concerns, but one did mention that she hoped food that could not be sold due to expiration dates but was still good to eat could be donated to those in need.

3.4 DATA ANALYSIS OF MANAGEMENT

Within the management perspective, there were interviews of managerial positions of the Walmart corporation to be used as a wide-scale control setting, and interviews of a rural grocery owner and related employees. These perspectives informed us of many commonalities in the supply chain, product handling, waste management techniques, and surprisingly community engagement. The latter was most interesting as there was an expectation that, at a corporate level, community engagement would dwindle and remain less important than it did to local grocers whether in produce supply or waste recycling. In local scenarios there were great measures to ensure that locally sourced produce (if not bought) was making its way back to the community and consumers when it passed its expiration.
To go further into detail, it would be best to start at the beginning of the chain. The stores receive refrigerated trucks from regional distributors of produce, meats, and dairy, which are immediately handled into refrigerated storage with as little delay as possible. These storage areas are dedicated then to each department within the store management to be handled when inventory is called for stocking or replenishment. This is typically handled within an “ISA” or In-stock Assistant, which is a digitized system that tracks inventory trends, history, as well as analysis per store database. This system often determines to flag or note products not moving fast enough or potential loss of revenues due to expiration. This ISA becomes mostly used in larger corporate store environments, for example, this is Walmart’s system of inventory management. However, on a local level these systems are often less

autonomous and more up to store management and the experience of the employees. With these systems often left to personal management experience and community sales experience, this leaves local grocers in a state of training through generations. With successful business planning and experienced staff, local stores thrive. Without it, new and small businesses struggle to not be put under by larger corporate competitors.

3.4 FINDINGS

Communal Support: Through these interviews the information gathered has a few major commonalities on both sides' consumer and management. One is the altruism of corporate chains and local grocers. By having strict policing of products on the shelves and minimizing waste in strategy, many businesses are able to give items slightly past expiry or visually imperfect to different causes such as animal feed, community shelters, and even back to the local community as a form of thanks to their patrons. This finding is echoed by user surprise upon hearing corporations following in similar footsteps to local grocers in these aspects of communal support.

Management Systems: The second major finding is that little waste happens amongst all levels as compared to products sold regardless of scale. Local grocers' systems closely mimic corporate leaders of the industry, and many develop strategies based on their scale of business. Most training and experience become heritage to rural stores and creates more efficient and predictive ways of ordering stock, which in turn, further lowers waste product. These strategies paired with smarter inventory management systems allow managers to predict sales based on trends, experience, and historical data. Lastly, local grocers follow training and development similarly to corporate chains, resulting in nearly identical distribution and handling processes. Stores order products from distributors, which arrive in refrigerated storage trucks on pallets, the product is then handled by the store associates. Product moved to the floor for sale is checked for expiry in daily visual and tactile inspection until it is removed by consumers or handled as waste accordingly. As a result of this standardized process, consumers rarely run into a product that is damaged or deprecated, and consumers attribute any issues towards sales instead of the store management or image. These major elements blend to make a complex system that minimizes waste, puts consumers first, and gives back to local communities that support the store.

4. APPLICATION OF INDUSTRIAL DESIGN AND CONTINUATION OF RESEARCH

The research conducted has created a great launching point for further investigation into how industrial design can be utilized to address the issue of food waste. We are extremely interested in continuing this research and commencing the design of products based on these findings.

4.1 Diagnosis of Expired Food

Industrial designers can explore the development of innovative solutions for diagnosing expired food. Through intuitive and user-friendly interfaces, such as smart labels or mobile applications, consumers can easily determine the freshness and quality of food items. By empowering individuals to make

informed decisions about consuming or disposing of food, designers can contribute to reducing food waste and promoting healthier consumption habits.

4.2 Farmer's Market for Wasted Food and Composted Food-Upcycling

Another opportunity for industrial designers is the creation of farmer's markets specifically dedicated to wasted food and upcycled products made of food. These markets can serve as platforms for connecting local communities with surplus or imperfect food items that would otherwise go to waste. Designers can work on developing attractive and functional displays, packaging, and signage to showcase these products effectively.

4.3 Upcycling Food Waste

In addition to wasted food, the concept of upcycling can be integrated into these markets. For instance, industrial designers can collaborate with food producers to create banana chips from off-grade bananas. By developing innovative processing techniques and packaging designs, designers can transform these visually imperfect bananas into delicious and marketable snacks, reducing food waste while offering a unique product to consumers. Similarly, industrial designers can explore the production of pickles using cucumbers that would typically go to waste due to their shape or size. By developing recipes, optimizing preservation methods, and designing appealing packaging, designers can turn these overlooked cucumbers into tasty and shelf-stable pickles.

Through their expertise in design thinking and innovation, industrial designers can play a pivotal role in creating engaging products, systems, and experiences that promote community involvement, reduce food waste, and encourage sustainable practices. These opportunities not only contribute to addressing environmental challenges but also enhance community resilience and well-being.

4.4 Future Studies

The current plan to progress involves taking a step back and examining consumer food waste along with the options available to promote and facilitate composting by conducting additional surveys. This research and design will then be assessed on a larger scale, exploring how programs and products can be developed to collaboratively reduce food waste through composting and upcycling through community engagement, benefiting both consumers and stores.

5. REFERENCES

Ceryes, C. A., Antonacci, C. C., Harvey, S. A., Spiker, M. L., Bickers, A., & Neff, R. A. (2021). “maybe it’s still good?” A qualitative study of factors influencing food waste and application of the E.P.A. Food Recovery Hierarchy in U.S. supermarkets. Appetite, 161, 105111. https://doi.org/10.1016/j.appet.2021.105111

CEC. 2017. Characterization and Management of Food Loss and Waste in North America.

Montreal, Canada: Commission for Environmental Cooperation. 289 pp.

de Souza, M., Pereira, G. M., Lopes de Sousa Jabbour, A. B., Chiappetta Jabbour, C. J., Trento, L. R., Borchardt, M., & Zvirtes, L. (2021). A digitally enabled circular economy for mitigating food waste: Understanding innovative marketing strategies in the context of an emerging economy. Technological Forecasting and Social Change, 173, 121062. https://doi.org/10.1016/j.techfore.2021.121062

Horoś, I. K., & Ruppenthal, T. (2021). Avoidance of food waste from a grocery retail store owner’s perspective. Sustainability, 13(2), 550. https://doi.org/10.3390/su13020550

Kiil, K., Dreyer, H. C., Hvolby, H.-H., & Chabada, L. (2017). Sustainable Food Supply Chains: The impact of automatic replenishment in grocery stores. Production Planning & Control, 29(2), 106–116. https://doi.org/10.1080/09537287.2017.1384077

Liang, C.-L., Kurkalova, L., Hashemi Beni, L., Mulrooney, T., Jha, M., Miao, H., & Monty, G. (2021). Introducing an innovative design to examine human-environment dynamics of food deserts responding to covid-19. Journal of Agriculture, Food Systems, and Community Development, 1–11. https://doi.org/10.5304/jafscd.2021.102.037

Mogil, S., Hill, E., & Quinlan, J. (2021). Characterization of the shopping preferences and needs of low-income consumers living in food deserts. British Food Journal, 124(11), 3468–3479. https://doi.org/10.1108/bfj-04-2021-0423

Mulrooney, T., Beratan, K., McGinn, C., & Branch, B. (2017). A comparison of raster-based travel time surfaces against vector-based network calculations as applied in the study of rural food deserts. Applied Geography, 78, 12–21. https://doi.org/10.1016/j.apgeog.2016.10.006

Riesenegger, L., & Hübner, A. (2022). Reducing food waste at retail stores—an explorative study. Sustainability, 14(5), 2494. https://doi.org/10.3390/su14052494

Steiger, B. (2022). (rep.). Grocery Retailing - US - 2022. Mintel. Retrieved February 13, 2023, from https://reports.mintel.com/display/1132439.

6. APPENDIX

Interviews for store workers/managers regarding food and waste management:

- What is your job title and what does that entail at your location?
- What is your level of experience in this role or similar positions?
- How is an expired or lost product handled at your location?
- Is food waste accounted for in inventory management at your store location?
- What system(s) are in place to help identify inventory needs, wasted products, and lost revenues? (i.e. inventory management software, visual inspections, etc.)

- How does your store location identify potentially expired products? Are there qualities that are typically present?
- With produce being one of the most problematic waste factors in consumer carts, how is that accounted for in inventory planning and sales?
- How are influxes of demand accounted for in the current system? (i.e. holiday seasons, spring breaks, etc.)
- How effective would you say these strategies of identification are in the long term?
- Has there been any improvement or any difference in the waste level or sales qualities?
- Do you see a larger opportunity in food preservation or sales in these products?
- Do you have any other connections or associates that we could further discuss these questions with?
- Any comments, questions, or concerns regarding food waste management or opportunities?

Interviews for consumers regarding food waste and habits:

- What is your name and age?
- How often do you purchase groceries?
- Do you have a favorite store or chain to buy from?
- If so, why is that store your favorite? (location, quality, staffing, inventory selection?)
- How do you identify potentially expired products? (Smell, visual inspection, checking packaging)
- How does seeing an expired product make you feel when shopping for your groceries? Do you feel that affects the way you see the store and its inventory?
- Are there times of the year that you find yourself going to the store more often for a certain seasonal item or food?
- How often do you find yourself having to discard food due to excess or spoilage?
- How do you handle that waste? (Composting, trash, burning, feeding to animals, etc.)
- Do you think any changes in stores would reduce this waste or help you plan usage for your purchases?
- Any comments, questions, or concerns regarding food waste management or opportunities?

Recruitment Flyer

Food Waste and Management Study

Have you gotten groceries recently?

Researchers want to learn about the ways we buy produce and how we can help increase sustainable availability in local stores across America.

What will participants be asked to do?

Volunteers will be asked to attend a 5-20 minute interview about their buying habits and experience in grocery stores.

Who can join?

We are looking for volunteers aged 18+ who travel to grocery stores twice a month or more.

Want to learn more?
Interested in an interview?
Please contact the study team at:

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or
twhilk@ksu.edu