Counting the Cost: An Analysis of the Economic Impacts of Food Waste in American Urban Cities

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This position paper delves into the intertwined challenges of food insecurity and waste within Charlotte, North Carolina. As the city's population nears 880,000, the urgency to ensure equitable food accessibility while managing the environmental and economic ramifications of food wastage becomes evident. Utilizing comprehensive data, the study underscores the pivotal role retailers can play in navigating these complexities. By implementing strategies such as offering discounts on nearing-expiration products, optimizing inventory management, and facilitating food donations, retailers stand poised to reduce waste, realize economic benefits, and bolster community well-being. Furthermore, the paper illuminates the economic, environmental, and societal implications of food waste, thereby highlighting the necessity for multifaceted solutions. Emphasizing the essentiality of collaboration among retailers, governmental entities, and community stakeholders, the research presents a compelling framework for cities globally.

Introduction

Research suggests that as the global population surges towards an estimated 9.8 billion, humanity is poised to face unparalleled challenges in sustaining such vast numbers. Ensuring food security, and addressing rising energy and housing demands, becomes crucial for ecological harmony and economic balance on our planet. Alarmingly, while 822 million individuals worldwide grapple with hunger annually, approximately 2.5 billion tons of consumable food is thoughtlessly discarded (Skaf et al. 2021). This magnitude of food waste implicates more than mere wastefulness, leading to severe environmental and societal repercussions, including deforestation, soil degradation, increased greenhouse gas emissions, water depletion, and augmented chemical pollution (Barrington et al. 2010). Considering the ecological harm, the economic cost of food waste rises from $1 trillion to a staggering $3 trillion annually. This waste not only raises consumer prices but also hinders many from accessing essential nutrition. The gravity of this situation is underscored by the fact that we're squandering not just vital resources like water, energy, and labor but also discarding nourishment

that could alleviate hunger (Recycle Track Systems 2023; UNC Charlotte 2018)

Over the years, the magnitude of discarded food has escalated at alarming rates. Today, it's not just about discarding an occasionally uneaten meal; it's about a staggering global accumulation of approximately 2.5 billion tons of wasted food. This vast wastage not only denies us crucial sustenance but also strains vital resources integral to food production—such as water, arable land, financial investments, and energy. Even the packaging materials involved in food distribution can skew the ecological balance between producers and consumers. By curtailing food waste, we can alleviate environmental burdens and foster a sustainable food system beneficial for all parties (Safdie 2023).

It’s startling to note that almost 30-40% of the food cultivated globally never graces a plate. Human errors and inadequate operational standards contribute over 10% to the issue of rendering food inedible. This waste is a major contributor to the global food waste crisis, leading to inefficient use of land, water, and energy resources. Market inefficiencies, supply chain issues, and consumer behaviors, such as discarding aesthetically imperfect or overstocked food, further compound the problem. Additionally, consumers buying more than needed contributes to excessive waste at home (Environmental Quality, N. C 2023).

In 2019, North Carolina's sizable food wastage translated to a staggering cost of $12.7 billion and left over 1.2 million people, including approximately 394,300 children, grappling with hunger. This stark reality accentuates the urgency of holistically and sustainably addressing food wastage (Environmental Quality, N. C 2023). A closer examination of Mecklenburg, one of North Carolina's most populous cities, is imperative to pinpoint specific contributors to this issue. Such an analysis will facilitate the deployment of targeted measures to minimize waste and combat food insecurity locally.

This segment offers a panoramic view of various sustainability and environmental facets in Mecklenburg. It encompasses discussions on living costs, food affordability, food waste, recycling dynamics, and the systemic hurdles impeding resolutions to these challenges.

In Mecklenburg County, almost 15% of residents face food insecurity, indicating inconsistent access to adequate nutrition. This can lead to severe health repercussions. Furthermore, an alarming two-thirds of adults in the county are either overweight or obese, hinting at challenges in accessing quality food (Best Places, 2019). In response, Mecklenburg County has undertaken various initiatives to enhance access to nutritious food, ensuring that residents can maintain diets essential for optimal health.

Comparative analyses with other states highlight distinct discrepancies, particularly concerning sales tax rates on qualifying food products. These rates notably affect the affordability of food, particularly

for those already facing financial and nutritional stress. (Karen Karp & Partners, 2018; North Carolina Department of Revenue, 2023). Presently, Mecklenburg County boasts a relatively low local tax rate of about two percent on eligible food items. In contrast, states like California have tax rates that can exceed ten percent on similar products (NCDOR, 2023). The 2022 State of Housing Instability and Homelessness Report further underscores the challenges faced by the county's residents. It presents evidence of growing concerns among vulnerable groups, particularly those experiencing homelessness. These individuals confront compounded challenges as food insecurity worsens their already precarious situations, underscoring a persistent issue in Mecklenburg County over the years (Best Places, 2019; Leshner, 2023).

Related Work

Annually, approximately one-third of the food produced for human consumption never reaches the plate, underscoring the magnitude of this global concern. In the United States alone, food waste comprises 40% of total food loss, imposing an estimated economic burden of $218 billion and adding to greenhouse gas emissions. Yet, curbing food waste can unlock avenues for economic advancement, efficient resource and energy utilization, and significant strides in climate change mitigation. As outlined by the Business and Sustainable Development Commission, slashing food waste could unveil an economic potential ranging from $155 billion to $405 billion by 2030 (Albizzati, P. F., Tonini, D., Chammard, C. B., & Astrup, T. F., 2019). Embracing cost-effective strategies to combat food wastage promises not only substantial economic savings but also the dual advantages of diminished greenhouse gas emissions and potential job creation (EPA, & Chang, 2023).

Wastage of edible food, still suitable for human consumption, predominantly surfaces at the retail and consumer tiers. The chief culprits behind this wastage in medium to high-income nations often pivot around consumer behaviors, prevailing mindsets, and the nation's implemented food policies. The Food and Agriculture Organization (FAO) indicates that nearly one-third of global food undergoes degradation or ends up discarded. Quantitatively, this translates to an alarming 1.3 billion tons, amounting to nearly $990 billion. Zooming into the categories, fruits, vegetables, root crops, and tubers account for an approximate 45% wastage, followed closely by fish and seafood at 35%, and cereals at 30% (Seberini, 2020). Beyond the tangible economic and environmental toll, food wastage also casts profound social shadows.

Such wastage inadvertently fuels food insecurity and exacerbates hunger—particularly jarring given the food discarded could have been consumed. The crisis deepens in lower-income countries, where many grapple with inconsistent food accessibility. Ethically, squandering food challenges the tenets of sustainable development. Tackling this issue

necessitates a multifaceted approach, encompassing shifts in consumer behaviors, bolstering food-centric policies and regulations, and amplifying supply chain efficiencies. By instigating measures to curtail food wastage, we inch closer to realizing a more balanced and just food ecosystem (Food, 2016; EPA, & Chang, 2023).

Food Waste and Recycling

Addressing food waste and promoting recycling are vital efforts in Mecklenburg County, given the substantial volume of food waste as part of the overall municipal waste. A 2005 study on commercial waste in Mecklenburg revealed 63,000 tons of food waste in the stream. The study also identified recoverable materials like cardboard, mixed recyclable paper, office paper, newsprint, untreated wood, and wood pallets.

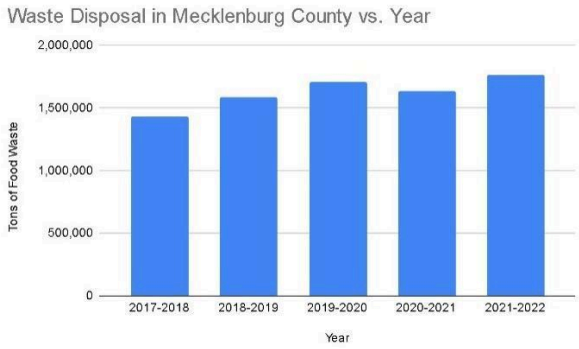

FIGURE 1. According to the NC DEQ report, Mecklenburg's total wastage, measured in tons, encompasses not only food and perishables but also includes various other waste materials which provide a comprehensive overview of the region's environmental impact.

Recognizing the gravity of the issue, the local government of Mecklenburg County initiated several strategies to encourage food waste reduction and recycling. Presently, there are two privately managed composting facilities available for food waste disposal: Wallace Farms and Tri-County Stanley Septic. These establishments convert food waste into compost, offering a sustainable alternative to traditional waste disposal while providing valuable soil amendments for agriculture. In addition to these initiatives, the county is exploring eco-friendly alternatives, like compostable utensils, in response to commercial inquiries for waste reduction solutions. Notably, these programs have contributed to a consistent decrease in per capita commercial waste (NOGUERA, 2021).

Nonetheless, challenges persist. It is imperative to further study the sources of the recoverable materials highlighted in the initial waste characterization study. This aids in creating programs to efficiently capture and recycle more materials. Recognizing the economic impact of food

waste in Mecklenburg County is crucial. By evaluating disposal costs and the economic benefits of reduction and recycling, targeted interventions can be developed. Moreover, emphasizing food waste reduction can foster employment opportunities within waste management and agriculture sectors. Consequently, businesses might not only reduce disposal expenses but could also profit from compost sales (Zhorov, 2020).

Systematic Barriers to Solving the Issue

Despite the numerous regulations and initiatives aiming to reduce and manage food waste, several systemic barriers persist, hampering full realization of waste reduction goals.

- **Complex Legislation:** A myriad of regulations at both federal and state levels can complicate compliance. While some states like California and Massachusetts have clear food waste-related mandates, the patchwork of regulations across states can make it challenging for businesses operating in multiple jurisdictions to maintain consistency (Romero 2023; Massachusetts Department of Environmental Protection 2022).
- **Municipal Waste Management Costs:** While some cities, such as Raleigh, provide households with complimentary recycling carts, Mecklenburg County delegates this responsibility to individual municipalities (Johnson 2023). This decentralized approach can lead to inconsistencies in collection practices, confusing residents and potentially reducing participation rates.
- **Educational Gaps:** Even though North Carolina has pushed for recycling education in schools, there isn't a comprehensive, state-wide program ensuring that every child gets the same quality of instruction. Such disparities can lead to uneven recycling habits as children grow into adults (NC DEQ 2023).
- **Feeding Animals with Food Scraps:** Federal laws surrounding the use of food scraps as animal feed, particularly those containing animal-derived products, are stringent (EPA 2023; McBride 2021). While it might be cost-effective, the process demands rigorous heat treatments and stringent monitoring to ensure safety. Many businesses may find the necessary precautions too cumbersome or expensive to implement.
- **Economic Impediments:** For many businesses, especially small-scale ones, the initial setup cost for recycling programs can be prohibitive. Even if such programs can result in long-term savings, the upfront costs can act as a deterrent.
- **Consumer Behavior:** A significant portion of food waste happens at the consumer level. Changing ingrained behaviors, such as buying in excess or misunderstanding expiration dates, requires consistent public education efforts.
- **Infrastructure Limitations:** While there are organic recycling facilities in place, their number and capacity might not be enough to

handle the volume of food waste produced, especially during peak times (NOGUERA 2021).

- **Perceived Liability:** Retailers might be hesitant to donate unsold food due to fears of potential liability, even if laws such as the Good Samaritan Food Donation Act offer protections.

Addressing food waste effectively demands an integrated approach that encompasses clear and uniform regulations, robust infrastructure, public education, and economic incentives. It's essential for Mecklenburg County, and other regions alike, to identify and address these systemic barriers to achieve a more sustainable food system.

Economic Impacts

Food waste has a ripple effect, not only on the environment but also on the economy. Consumer-producer interactions underpin modern economies, and disruptions caused by increasing food waste can unsettle this delicate balance.

- **Consumer Inflation and Affordability:** Escalating food waste may drive demand at potentially unsustainable rates, resulting in higher prices for food products. When prices go up, economically vulnerable populations can suffer the most. Increased food costs squeeze low-income families, forcing them to cut back on quality, leading to potential nutritional deficits (rts 2023).
- **Health and Productivity:** Adults struggling with adequate nutrition due to economic constraints can face health challenges, leading to higher healthcare costs. When employees are not at their best health-wise, their productivity can decline, stifling economic growth. If children are deprived of proper nourishment, the long-term economic implications can be grave, as they are the future workforce (rts 2023).
- **Wasted Resources and Economic Consequences:** Wasting food means wasting the resources used in producing that food. This includes:
  - **Land:** Arable land is limited. Using it to produce food that is eventually wasted can cause soil degradation and erosion, reducing its availability and thus raising production costs and food prices.
  - **Water:** Water scarcity is a looming global threat. Inefficient use of water in agriculture, particularly when producing wasted food, exacerbates this problem and can lead to higher prices for both water and food.
  - **Energy:** Rising demand for energy in food production, to make up for wastage, can lead to higher energy prices. Furthermore, increased energy usage has environmental implications due to greenhouse gas emissions (Teshome 2017).
  - **Labor:** Wasting food is synonymous with wasting labor hours, which could have been utilized elsewhere in the economy.

- **Municipal Waste ManagementCosts:** Municipalities that partner with private garbage disposal companies bear the financial burden of waste management.

Costs can range significantly based on the capabilities of the disposal machinery and the nature of the contract. For instance, the Town of Weddington's contract with Active Waste Solutions details a multifaceted collection strategy with costs that can add up for residents (This Old House 2023; Active Waste 2023).

The comprehensive economic ramifications of food waste extend beyond mere monetary value. They permeate the health of the populace, the productivity of the workforce, the price of essential resources, and the vitality of the environment. Addressing the issue of food waste not only helps conserve resources but can lead to a healthier, more productive, and economically stable community.

The Dichotomy of Prosperity and Insecurity in Charlotte

Charlotte's growth paints a story of economic progress contrasted sharply by underlying socio-economic issues. Housing a burgeoning population, Charlotte is a testament to urban development, but the city's challenges, especially concerning food insecurity, offer a perspective that can't be ignored (Karen Karp & Partners 2018).

- **Demographics & Population Dynamics:** Charlotte's diverse age group ranging from young families to the elderly reveals a vibrant and multi-generational community (United States Census Bureau 2023). The demographic distribution indicates potential future workforce and the ones that need care and support. Young families might be looking for opportunities, infrastructure, education, and amenities, while the elderly population may seek healthcare, social services, and community support.
- **Economic Health vs. Ground Realities:** The juxtaposition of a strong economy and high median family incomes against the backdrop of significant food insecurity is alarming. A sturdy economy doesn't necessarily guarantee equitable distribution of resources or benefits. The fact that one in seven households in Charlotte struggles to provide regular meals is a stark reminder that prosperity has not reached every corner of the community (United States Census Bureau 2023).
- **Childhood Nutrition & Well-being:** Children are the most vulnerable when it comes to nutritional deficiencies. The absence of proper nutrition not only affects their physical growth but also their cognitive development, setting them up for potential long-term disadvantages (United States Census Bureau 2023).
- **The Food Waste Crisis:** The staggering figure of over two and a half million tons of food wasted annually in North Carolina exemplifies the incongruity of the situation. While many residents go hungry, a monumental amount of food goes to waste. Such waste also signifies

inefficiencies in the supply chain, lack of adequate storage or processing facilities, and absence of effective redistribution mechanisms.

- **The Role of Charities & Nonprofits:** Charities often bridge the gap between surplus and need. However, when resources are scarce or inadequately distributed, even these vital institutions find it hard to serve the community effectively. The mounting food waste coupled with rising food insecurity poses a daunting challenge to these organizations.

Charlotte's tale is one that mirrors many modern cities - outward signs of prosperity masking deeper societal issues (Karen Karp & Partners 2018). It's a tale of potential unfulfilled, of resources not optimally utilized, and of communities that could thrive even more with better resource management. The data presents a clarion call for policymakers, businesses, communities, and individuals to come together, realign priorities, and ensure that the benefits of Charlotte's growth are shared equitably amongst its residents.

Proposed Solutions

Retailers stand at a crucial juncture where business strategy and sustainability intertwine. The current global focus on sustainability, combined with technological advancements, offers retailers a unique opportunity to reimagine their operations. Implementing measures such as offering discounts on nearing-expiry products, repurposing food scraps, community-based donations, and employing sophisticated inventory systems not only strengthens the bottom line but also fosters a positive brand image in an increasingly eco-conscious market.

Providing discounts on products nearing expiration is not only a method to reduce waste but also a strategic marketing move. By making these items more appealing to budget-conscious consumers, retailers can efficiently move inventory, ensuring product freshness on shelves. Studies have shown that consumers are generally willing to purchase items that are closer to their expiration date if they're discounted, especially when they understand the environmental implications of food waste. However, clear communication about the safety and quality of these discounted items is essential to ensure consumer trust (Helmer 2021). Adopting such practices not only directly impacts the bottom line by reducing disposal costs but also resonates with the increasing segment of environmentally conscious shoppers (LS Retail 2022).

Utilizing food scraps transcends mere waste diversion; it embodies a more circular economy approach where waste is viewed as a resource. Converting these scraps into animal feed offers a dual benefit: it reduces the burden on landfills and provides an economical source of feed for farmers. Similarly, composting creates a closed-loop system, transforming waste into a valuable farming resource. Studies indicate that compost can

enhance soil health, boost crop yields, and decrease reliance on chemical fertilizers (Lazcano & Domínguez, 2011). This not only benefits the environment but can lead to healthier produce and potentially higher profits for farmers. Plus, as the climate implications of methane become more pronounced, businesses that act to reduce their greenhouse gas footprint will be seen more favorably in the public's eye and may even qualify for environmental credits or incentives (EPA 2023).

Corporate social responsibility has never been more relevant. Aligning waste reduction strategies with community upliftment allows retailers to foster positive brand perception and customer loyalty. Donating surplus food not only shows a commitment to community well-being but also positions the brand as one that values more than just profits. There's evidence suggesting that companies that engage in charitable activities and showcase sustainability initiatives can experience increased customer loyalty and even higher spending per transaction (Bhattacharya & Sen, 2004). Furthermore, in many countries, businesses can receive tax benefits for charitable donations, which can provide an additional financial incentive to donate rather than dispose of surplus food (EPA 2023).

Modern inventory management systems, powered by artificial intelligence and machine learning, can predict demand with impressive accuracy, allowing retailers to order optimal quantities of stock. By minimizing overstock scenarios, the chance of food going to waste due to unreliability is drastically reduced. Research indicates that utilizing such advanced systems can lead to significant reductions in inventory holding costs, waste disposal costs, and even carbon footprints (Rekik et al., 2018). Moreover, by maintaining optimal inventory levels, retailers can ensure product freshness, leading to improved customer satisfaction and repeat business.

By pioneering these practices, retailers pave the way for a more sustainable, community-focused, and profitable future.

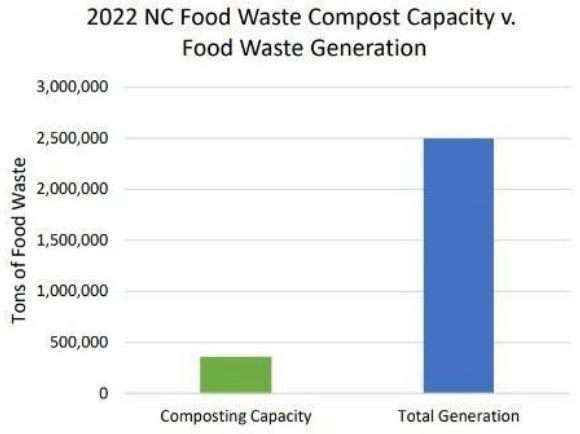

FIGURE 2. The composting capacity for food waste in North Carolina was estimated by DEACS through a survey that permitted composting facilities. The data utilized an estimation derived from EPA.

Discussion

The presented research offers a comprehensive examination of the food-related challenges faced by Charlotte—a city housing nearly 880,000 residents. Notably, the challenges of food insecurity are magnified given the city's demographic profile, encompassing a significant elderly population and a considerable young demographic (United States Census Bureau 2023). Concurrently, the environmental implications of food waste, especially methane emissions, underscore the gravity of the problem.

The research unveils a silver lining: the potential role of retailers as pivotal agents of change. By implementing inventory management systems and donating unexpired surplus foods, retailers can not only address food insecurity but also improve operational efficiencies and enhance their reputational standing. When implemented astutely, these strategies cater to the dual objectives of environmental stewardship and fiscal prudence.

Furthermore, the transformative power of sustainable business practices cannot be understated. Firms that champion these practices not only broadcast their allegiance to environmental and social causes but also establish a foundation for long-term economic viability. As an ancillary benefit, the cost savings realized from efficient waste management can be channeled into other strategic initiatives, such as employee capacity-building or community outreach programs (EPA 2023).
In essence, this research underscores a pivotal takeaway: the journey towards a sustainable and equitable food ecosystem necessitates collaborative endeavors, with retailers poised to lead the charge.

Conclusion

Examining the complex landscape of food insecurity and waste in Charlotte reveals that while these challenges are daunting, they are surmountable. The city, with its diverse demographics and rapid population growth, stands at a crucial juncture where proactive interventions can bring about transformative changes.

The data elucidated in this research underscores the potential of retailers to act as catalysts in this transformation. By embracing sustainable practices, championing efficient inventory management, and endorsing community-oriented initiatives like food donations, they can significantly diminish food waste and concurrently ameliorate food insecurity.

Moreover, the economic and environmental synergies emanating from these practices serve as compelling incentives for broader industry adoption. The financial prudence attained through reduced disposal costs, coupled with the reputational elevation achieved by championing

sustainable practices, makes a compelling case for businesses to align with these strategies.

As we look ahead, it's evident that Charlotte's trajectory towards a sustainable food ecosystem relies heavily on multi-stakeholder collaboration. Retailers, government agencies, community organizations, and the citizenry must coalesce around a shared vision—one that prioritizes both people and the planet. Through collective resolve and strategic action, Charlotte can set a precedent for other cities, highlighting the nexus between sustainability, economic growth, and societal well-being. The challenges are significant, but with concerted effort, a more sustainable, equitable, and prosperous future for Charlotte is within reach.

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