Insight into Environmental Sustainability in Freetown Through Household Food Loss and Waste Management

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Abstract

Background: Food Loss and Waste (FLW) at the household level presents a growing threat to environmental sustainability across urban areas of Sub-Saharan Africa (SSA). This qualitative study examined the causes, patterns, and forms of FLW disposal in Freetown, Sierra Leone, and its environmental implications.

Methods: Twenty-one semi-structured interviews were conducted remotely among lower-middle-income households in Freetown. The study combined convenience and snowball sampling to reach thematic saturation. The data were analyzed using inductive thematic analysis.

Results: Food loss and waste in Freetown are not a consumerist behavioral problem but rather a problem of scarcity, insecurity, and infrastructure failure. While behaviors such as overbuying and cooking appear remarkably similar to those in high-income countries, the motivations differ significantly. Households used electric freezers for food preservation, but frequent blackouts led to significant food spoilage. In addition, food waste is mixed with general household waste and disposed of illegally.

Conclusion: This study highlights a significant gap in the localized FLW research in Sierra Leone. It emphasizes the need for integrated policy, infrastructure investment, community education, and awareness campaigns.

Keywords: Food loss and waste, environmental sustainability, urban Africa, municipal solid waste, Sierra Leone

Introduction

The world's population continues to grow rapidly and could reach approximately 8.5 billion in 2030 and is expected to increase to 9.7 billion in 2050 (United Nations Department of Economic and Social Affairs, Population Division, 2022; van Dijk et al., 2021). Feeding this growing population is a formidable challenge, exacerbated by food loss and waste (FLW), food produced but never consumed. According to a recent United Nations Environment Programme (UNEP) report, approximately 1050 million metric tonnes of food (19% of food available to consumers) is wasted or lost within the food system (farming, food service, and retail), with 60% of this waste originating from households (UNEP, 2024). These inefficiencies exert significant pressure on natural resources, such as land, water,

energy, and factors of production. Food loss and waste account for approximately 8-10% of global greenhouse gas (GHG) emissions each year, further underscoring their environmental impact (Crippa et al., 2021; UNEP, 2024).

Addressing FLW directly contributes to several Sustainable Development Goals (SDGs). One of the most prominent SDGs, 12.3, aims to cut global per capita food waste in half at both the retail and consumer levels, as well as reduce food loss throughout production and supply chains by 2030 (UN, 2015). Achieving this target also contributes to SDG 6.4, promoting sustainable water use, and SDG 13.2, which integrates climate action into national policies and strategies. Therefore, reductions in FLW at the household level are important not only for food security but also for environmental sustainability and climate mitigation.

Although FLW is a common challenge worldwide, its characterization and drivers differ greatly across contexts. This is particularly the case in low-income, fast-urbanizing African cities, where infrastructure has not grown at the same rate as the population (Jayne et al., 2018). In such contexts, systemic failures of urban planning and basic service provision (housing, sanitation, energy access, and waste management) conspire to create conditions that contribute to food spoilage (and loss). This apparent paradox of large amounts of food being wasted while people continue to go hungry and suffer from poor nutrition is reinforced by the underlying dysfunctionality of regional food systems (International Food Policy Research Institute (IFPRI), 2024).

Freetown, the capital of Sierra Leone, serves as an example of these intersecting challenges. Constituting nearly 30% of the national gross domestic product (GDP), Freetown is one of West Africa's fastest-growing cities and a major locus of urban poverty and environmental stress (Macarthy et al., 2024). The city, which is home to 15% of Sierra Leone's total population and nearly 30% of its urban population, generates more than 700 tons of equivalent municipal solid waste (MSW) per day. Yet, formal waste collection services serve at best 35% of the population, and the rest of the waste is either dumped illegally, openly burnt or decomposed in an uncontrolled manner, thus contributing to local pollution and greenhouse gas emissions (Kanty et al., 2024; Sankoh, 2013; Sood, 2004). Food loss and waste contribute to this unregulated waste; however, the details of how and why FLW enters these waste streams are largely unknown. A clear understanding of the specific causes, patterns, and disposal methods at the household level in this context would help design targeted interventions for environmental sustainability. This is the first empirical study to address these questions.

This study addresses this gap by investigating how household behaviors, socio-economic characteristics, cultural food practices, and infrastructure gaps shape FLW generation and management in Freetown. By focusing on the micro-level dynamics within households, this

study aims to provide foundational evidence to inform policies and strategies that can reduce FLW and mitigate its adverse environmental impacts in rapidly urbanizing low-income African cities.

Literature Review

The conceptualization of food loss and waste has developed, shifting from a simplified focus on measurable amounts to an understanding of it as a complex phenomenon embedded in social, economic, and contextual factors (Spang et al., 2019). Early definitions made sharp distinctions between 'losses', which occur upstream at the production and processing levels, and 'waste,' which is largely associated with the retailing and consumption levels (Griffin et al., 2009; Parfitt et al., 2010). However, these binary distinctions are increasingly viewed as inadequate in low-and middle-income settings, where households often play dual roles as both food producers and consumers (Bellemare et al., 2017). Considering this complexity, this study adopts a broader definition consistent with the works of Xue et al. (2017) and Spang et al. (2019), who defined FLW as any edible food originally intended for human consumption that does not ultimately reach the consumer or is discarded while still fit for its intended use.

Globally, FLW presents a massive environmental and economic burden. Alexander et al. (2017) estimate that nearly half of all food produced for human consumption is lost or wasted, a figure that now includes previously neglected losses from livestock feed conversion inefficiency and overconsumption by some populations. Additionally, there are obvious gaps in terms of per capita FLW generation, with high-income countries generating between 281 and 296 kg per person per year, which is more than twice that of low-income regions, with an average annual value ranging from 126–167 kg per capita (Thi et al., 2015; Xue et al., 2017). This discrepancy reflects fundamental differences in where along the food supply chain losses predominantly occur. In Sub-Saharan Africa, for example, significant losses occur during post-harvest handling, storage, and distribution, typically driven by underdeveloped infrastructure, pest infestations, and the lack of cold-chain systems (FAO, 2023; HLPE, 2014). Conversely, food waste in high-income countries can be largely attributed to consumption behavior, retail habits, and strict product aesthetics (Kummu et al., 2012; Min et al., 2021; Trotter et al., 2023).

Despite growing global interest, there is a dearth of integrated research on FLW in urban African contexts, particularly regarding the broader socio-economic and infrastructural forces influencing waste patterns. Studies from Dodoma, Tanzania, revealed a strong link between household FLW and food insecurity, in which resource limitations directly constrain effective food management (Silayo et al., 2025). In Zimbabwe, the environmental footprint of household FLW is significant, notably via methane emissions, which are potent greenhouse gases (Jerie et al., 2024). These results highlight the

importance of contextualizing local-level investigations but also reveal knowledge gaps in cities such as Freetown, where unique socio-infrastructural contexts necessitate tailored analysis.

Freetown is a typical low-income urban setting with a growing lower-middle-income population, marked by near-total reliance on an unreliable electricity grid and limited access to traditional food preservation techniques. The city's municipal solid waste (MSW) management is marred by limited formal waste collection (covering approximately 35% of households) and widespread illegal dumping, which disproportionately affects the organic waste streams (Kanty et al., 2024; Sankoh, 2013). In several African urban centers, including Freetown, organic waste from households decomposes in open, uncontrolled dumpsites, releasing landfill gas (LFG) comprised of roughly 50% methane and carbon dioxide (Kibler et al., 2018; U.S. Environmental Protection Agency (EPA), 2023). The global warming potential of methane is over 25 times that of CO_2 over 100 years, underscoring the critical climate implications of unmanaged organic waste (Crippa et al., 2021). Notably, household-level contributions to this dynamic remain under-quantified, reflecting a broader research gap that this study aims to address.

Moreover, the socio-economic vulnerabilities of urban Freetown households are major drivers of FLW. High levels of income instability, along with poor infrastructure, such as regular electricity shortages from the Electricity Distribution Supply Authority (EDSA) (The World Bank, 2025), force precarious food storage and preservation decisions, exacerbating spoilage risks. This is an example of a "refrigeration paradox," in which families possess refrigeration technologies but experience frequent blackouts, thereby mitigating the efficacy of cold storage (Candelise et al., 2021). These contextual conditions are in stark contrast to waste drivers in richer contexts characterized by overconsumption and consumerism.

In addition, the informal waste sector is critical yet neglected in shaping urban FLW dynamics in Freetown. Informal waste collectors often work without formal recognition, funding, or the capacity to manage organic waste sustainably (Macarthy et al., 2024). The marginalization of organics in this sector often results in environmental degradation and public health risks; however, it also shows potential for incorporation into formalized waste management systems if appropriately supported (Kwemoi, 2025). The point of convergence between informal sector limitations and infrastructural deficiencies presents a significant opportunity for intervention.

Drawing on this, this study presents household FLW in Freetown not primarily as a consumerist problem (common in high-income countries) but as a sign of structural underdevelopment and socio-economic instability. Therefore, this study offers an important case study within the broader literature on urban FLW in African cities and highlights the urgent need for holistic, context-

specific solutions to address supply chain inefficiencies and strengthen local capacity in both the informal and formal waste management sectors.

Methodology

Study Design and Sampling

This qualitative exploratory study was designed to understand the lived experiences of household FLW in Freetown, Sierra Leone, an understudied urban African context. A qualitative approach was chosen due to the limited prior research on locally specific causes and disposal practices of FLW at the household level in this setting. The primary goal was to generate rich, nuanced insights rather than produce statistical generalizations.

Convenience and snowball sampling were used. Contact was established with the first participating household with internet access for a remote interview. This process was made possible with the help of a local community member in Freetown, facilitating participant identification. Afterwards, each participant identified other possible participants from within his or her social network and the process was repeated until thematic saturation was reached at 21 households. According to Braun and Clarke (2006), 12–20 participants are often sufficient for initial saturation.

The sample was intentionally biased toward lower-middle-income households, defined by the possession of electric freezers and internet access, to participate in an online interview. Moreover, this income level is often underrepresented in national surveys, yet it is significant for understanding emerging consumption and food management patterns.

Study Setting

Freetown, Sierra Leone's capital city, was selected as the study site because it is a typical low-income urban area in Sub-Saharan Africa that experiences considerable municipal solid waste challenges, including food waste. The city produces approximately 700 tons of MSW daily, but formal collection services cover only approximately 35% of households (Kanty et al., 2024; Sankoh, 2013; Sood, 2004). Informal settlements (like slum communities) cover around 36% of the city's land, not only without clean water but also without sanitation (Macarthy et al., 2024). Energy infrastructure is erratic, and frequent blackouts are experienced due to a supply-demand gap (The World Bank, 2025). The daily income is unstable. Most households largely depend on informal labor (e.g., petty trading, construction or artisanal work) and overseas remittances

Notwithstanding, a growing lower-middle-to middle-income population has emerged, especially among civil servants, teachers, and small business owners. This group often lives in planned communities, such as Hill Station, Lumley, and parts of Central Freetown, including Sackville Street, Siaka Steven Street, and Wilberforce Street. Access to electricity and other social amenities is more common in these communities, though it remains unreliable. This complex

socio-economic scenario influences food consumption and waste in various ways.

All households eat rice and cassava-based dishes like "Fufu" (a dish prepared from pounded cassava, yams, or plantains worked into a smooth dough, and it is often formed into small balls and served with different kinds of soup), and "Yebeh" (a comforting stew made with cassava and sweet potatoes) as their main staple foods. They own electric freezers, a luxury not accessible to the urban poor population. Twelve Muslim and nine Christian households were interviewed for the study. This shows the demographic and geographic distribution of faith communities in Freetown. Sierra Leone is religiously diverse, with about 77% of Sierra Leoneans identifying as Muslims, 22% as Christians, and 1% adhering to indigenous or other beliefs (Statistics Sierra Leone, 2016).

Data Collection

Between May and June 2025, twenty-one semi-structured online interviews were conducted via Google Meet. All interviews were conducted in Krio (Sierra Leone's national lingua franca) to ensure the authenticity and depth of responses. Each interview lasted approximately 40–60 minutes and covered food purchase and storage behavior, reasons for food loss or waste, cooking and consumption lifestyle, and methods for disposing of waste. The interviewer, a native speaker of Krio, audio-recorded all interviews and transcribed them verbatim before translating them into English, while maintaining the original meanings and cultural terms (e.g., "fufu," "yebeh," "col res") by offering brief explanations.

Data Analysis

Data were analyzed using inductive thematic analysis to generate codes and themes. The analysis was guided by Braun and Clarke's (2006) six-step framework: (1) familiarizing with the data through repeated reading of transcripts; (2) generation of initial codes; (3) generation of themes; (4) revision of themes; (5) defining and naming of themes; and (6) production of the final report. To optimize the credibility and consistency of the translation from Krio to English, a subset of transcripts was back-translated by an independent native Krio speaker, and discrepancies were clarified through discussion. The coding was manual to maintain context sensitivity and depth.

Ethical Considerations

Owing to the non-sensitive nature and remoteness of the study, voluntary participation and the right to withdraw were emphasized. Oral consent was obtained from all participants before the interviews. All data (recorded audio) were anonymized and stored securely on a password-protected device, and the confidentiality and anonymity of the participants were maintained.

Researcher's Reflexivity

As the only researcher conducting this study, I recognized that I was inevitably influenced at various stages of the research process, from topic selection and data gathering to analysis. This is

because I am a Sierra Leonean national with family ties to Freetown, and I have firsthand experience with the city's lack of infrastructure. I was familiar with the study area, which enabled me to gain cultural understanding and access to the local language, Krio, during the interviews. However, this strength also has the weakness of assumptive bias. For example, assuming certain behaviors, such as overcooking during religious and other festivals, were "normal" could have led to under-exploring their significance without conscious effort to remain open-minded.

During my current academic studies, I have developed a growing interest in environmental sustainability, which inspired this study. Although this curiosity led to a productive research exercise, it also meant that I approached the topic with an existing concern about waste management and its ecological impacts. To avoid potential confirmation bias, I maintained a reflexive journal while interpreting and analyzing participants' responses. This involved documenting the initial assumptions, participants' emotional reactions, and evolving interpretations. Additionally, my current affiliation with an international academic institution may have placed me in a higher social class than most participants. While households are lower-middle to middle-income, my position as someone engaged in formal research might have influenced their responses, possibly leading them to provide answers they thought I wanted to hear. I consistently reiterated in all my interviews that there were no 'right' or 'wrong' answers and sought only their lived experiences. This was done to minimize the existing power differential.

Finally, conducting this study remotely had practical and relational limitations. Remote interviews are considered cost-effective and feasible for participant engagement. However, remote interviews hindered the observation of participants' physical environments (e.g., kitchen spaces and storage), which could have contributed to a better understanding of the context. My physical distance also constrained my nonverbal relationship, although I attempted to build trust through respectful interaction and continuous reassurance about the privacy of their identities.

Results

The findings of this study revealed three main recurring themes relevant to household FLW in Freetown: overbuying and overcooking, food spoilage due to unreliable electricity, waste disposal practices and awareness. Each theme is described with illustrative excerpts from the interviews and contextual interpretation.

Overbuying and Overcooking

One of the major causes of FLW in Freetown is overbuying and cooking, especially during cultural and religious festivals or during periods when there is sufficient money. From the 12 Muslim households interviewed, several reported massive increases in food preparation during Ramadan (the Islamic month of fasting). In those days, a lot of rice was

cooked in homes, as well as local dishes such as "Fufu" and "Yebeh."

A 29-year-old Muslim housewife said her family intentionally cooked more than they could eat during Ramadan to meet the religious and cultural expectations of hospitality and generosity. Another participant described attempts to eat up leftovers; however, they shared that soups would often spoil and become sour or offensive, leading to discarding. Once food had been shared with neighbors or visitors, there was surplus food (sometimes uneaten due to inadequate storage facilities). The practice of cooking more than their household needed is not limited to wealthier households; even households with limited incomes felt social pressure to host and share food generously.

Christian households, while not observing a month-long religious fasting, reported similar overbuying and cooking during Christmas and Easter. One 50-year-old Christian woman stated that they get extra food so they can feed their neighbors who come visiting. Households with children also reported buying too much to accommodate their children's changing tastes and appetites. One parent described her children as picky eaters, prompting her to purchase a variety of food items to satisfy their appetites, some of which inevitably went uneaten. These trends were observed in both Muslim and Christian families, suggesting common cultural values regarding the over-provision of food on the table.

Crucially, many households admitted to impulsive buying, particularly when prices were low or when they had enough money to spend. One participant, a petty trader, confessed to bulk purchasing during periods of price decline, regardless of whether the food was urgently required or not. This behavior is linked to income instability and panic about future shortages. Households receiving remittances reported bulk purchases after funds arrived, leading to waste if consumption did not match the supply. A 44-year-old participant described buying large quantities of food shortly after her brother sent money from the UK to protect herself from periods of scarcity.

Food Spoilage Due to Unreliable Electricity

Unreliable electricity was another reason for FLW at the household level. All twenty-one households relied on electric freezers for food preservation. However, frequent power outages cause significant spoilage. Blackouts were considered severe, mainly in the dry season (between November and April), when demand exceeded supply.

A 33-year-old single father described a day when he made several local Sierra Leonean sauces (e.g., peanut soup, potato leaf, and krain-krain soup) for the week. However, sudden power cuts spoiled these meals. Only three households had supplementary solar-based backup systems to augment the electric supply provided by the Electricity Distribution Supply Authority (EDSA), the country's national power supply agency. Others relied on traditional methods such as wrapping cooked food in blankets

overnight to keep it warm to form "Col Res" (a cold meal, normally rice and soup that will be eaten the following morning). Still, this sort of preservation was hardly sustainable.

Families were openly aware of the dangers of relying solely on electric freezers but did not seem to have any better alternatives. "We rely on our freezer to preserve or chill out food, but when the power goes off, it ruins fast," one person said. This overdependence on an unreliable power system represents an Achilles heel to urban food security, creating a paradox in which the intended solution to food spoilage becomes its primary cause.

Waste Disposal Practices and Awareness

None of the households had any form of waste source separation. Food waste was invariably mixed with general household trash. Disposal was done in one of three ways: placed in bags and left outside of their backyards for informal waste collectors to pick (for a fee of Nle5, approximately the price of 5 loaves of bread), dumped in gutters or roadside areas, especially at night, or given to pets or stray animals, if not spoiled.

"I toss everything, all household trash into a single bag," said a 42-year-old single mother while lamenting the inadequate municipal solid waste management system burdening residents of the city. Informal garbage collectors also frequently dumped trash in the nearby bushes and gutters, which, during rainstorms, created a deluge of garbage that flooded the streets and people's homes.

The participants recognized the environmental and health impacts of harmful disposal. One participant mentioned the awful smell associated with the illegal disposal of waste, which led to health problems for one of their relatives. More importantly, none of the participants were previously familiar with the concept of food waste. Nevertheless, all of them expressed interest in learning better practices in food preservation and waste management, with one participant reflecting, "I didn't know much about how much food I was throwing away until now."

Discussion

The results of this study challenge the prevailing narrative around FLW, which suggests that it is largely behavioral and linked to consumerism. In the context of Freetown, FLW is not a byproduct of abundance or overconsumption but rather of scarcity, economic instability, and infrastructural neglect. Although behaviors such as overbuying and cooking appear similar to those observed in high-income countries, their motivations are radically different. In high-income regions such as Europe and North America, food waste is influenced by market dynamics, overconsumption, and consumer choices (Min et al., 2021). In contrast, FLW behaviors in Freetown reflect survival strategies grounded in distinct socio-economic realities rather than personal choice.

For instance, the tendency to overcook stems from cultural and religious values that emphasize generosity and hospitality rather than consumer choices. Similar findings have emerged in Morocco and Tanzania, where religious hospitality norms drive over-preparation (Abouabdillah et al., 2015; Maduhu & Makori, 2019). In line with this, overbuying food items during periods of financial stability can be viewed as a precautionary response to unpredictable income and unreliable supply chains, repeating patterns observed in Nigeria and Kenya (Mwangi et al., 2023). Compared to most other SSA cities, a noteworthy exception is Freetown, where only electric freezers are considered for food preservation, with no other alternatives. Other SSA countries use traditional preservation processes and techniques, such as drying, smoking, and fermentation (FAO, 2023). The absence of such traditional practices in Freetown illustrates a departure from indigenous knowledge towards modern, erratic technical fixes.

One outstanding finding is the paradox of food spoilage, directly linked to unreliable electricity. All households interviewed reported using electric freezers to store cooked food and other perishables. However, power outages are frequent due to instability in the national grid. This undermines efforts to preserve food and causes spoilage. This contradiction is largely absent in mainstream FLW literature, which typically addresses stable contexts and emphasizes behavior change. Systemic infrastructural failures render household efforts futile in Freetown. This emphasizes that behavioral interventions alone are insufficient without simultaneous investments in stable energy supply and cold-chain development. The consequence is heightened vulnerability among lower-middle-income households that can afford freezers but lack access to reliable power or solar energy. This 'refrigeration paradox' has repositioned FLW as a systemic problem of urban inequality and infrastructural deficits, in which energy-intensive technologies are adopted without adequate systemic support (Trotter et al., 2023).

Consistent with this broader systemic failure, no household practiced waste separation. Illegal dumping remains prevalent because of poor municipal solid waste management. Consequently, only 35% of households have access to formal waste collection services, leading residents to dump waste on streets and in water bodies, thereby increasing pollution, public health hazards, and urban flooding (Kanty et al., 2024; Sankoh, 2013; Sood, 2004). The absence of decentralized organic waste recovery initiatives, such as composting or biogas, reveals a missed opportunity for environmental and energy co-benefits in the region. Such small-scale interventions could significantly reduce emissions from uncontrolled decomposition while producing valuable fertilizers and renewable energy.

Despite their limited knowledge of FLW as a formal concept, participants expressed keen interest in learning more about sustainable ways to manage food.

This suggests a readiness for change, despite the overwhelming challenges they face. Previous research highlights the importance of community education in affecting positive behavior change (Amicarelli & Bux, 2021). As such, culturally relevant awareness campaigns (embedded in trusted places, including religious and educational institutions) may help mainstream waste reduction practices and close the existing gaps that are essential to ignite behavior change.

Conclusion

This study demonstrates that reducing household FLW in Freetown requires more than changes in individual consumer behavior. This calls for coordinated, systemic interventions across multiple socio-economic and infrastructural levels in the city. At present, FLW remains largely invisible in national policy, despite its contribution to greenhouse gas emissions through methane released from decomposing organic waste at uncontrolled dumpsites. Integrating FLW reduction explicitly into national climate and food security frameworks would help position Sierra Leone within global climate mitigation efforts, including progress toward achieving SDG 12.3.

The priority is investing in decentralized energy solutions, such as solar-powered refrigerators, microgrids, and other efficient appliances. Given the unreliability of the national grid (Electricity Distribution Supply Authority – EDSA), off-grid technologies can enhance food security and energy resilience while breaking the current cycle of freezer dependency and subsequent spoilage during power outages. In addition, community outreach programs are needed to promote low-cost, practical preservation and waste reduction strategies. These include solar drying, fermentation, and basic source separation. This should be implemented through schools, community organizations, and faith-based institutions to ensure cultural relevance and wide coverage.

Harnessing local indigenous knowledge and skills in composting and biogas production offers further potential for transforming organic waste into valuable inputs for urban agriculture and clean energy. Small-scale neighborhood facilities can convert household food waste into fertilizer and biogas. Simultaneously, this will reduce emissions and provide local co-benefits to the community. However, these initiatives must occur alongside broader reforms of the municipal solid waste system, including expanding collection coverage, clearer regulations, support for informal waste collectors, and investment in sorting and recycling infrastructure.

Finally, the findings underscore the need for more localized research in rapidly urbanizing African cities, which face the intertwined pressures of poverty, infrastructural fragility, and climate vulnerability. Context-specific evidence on how socio-technical systems shape FLW is essential for designing interventions that are environmentally effective, socially just, feasible, and enduring.

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AI Disclosure

During the preparation of this manuscript, the author used Grammarly to assist with language editing and proofreading. The tool was used solely for grammar, spelling, and sentence clarity checks. After using this tool, the author reviewed and edited the content as needed and takes full responsibility for the content of the published work.

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Conflict of Interest

None

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