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Food Waste Is Not Evenly Distributed: Identifying High-impact Waste Events Through Long-term Quantification Across Multiple Food Systems

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Abstract

Food waste research has established that consumption patterns and daily routines significantly influence household and institutional waste generation. However, most quantitative studies rely on short-term monitoring, which may fail to capture the role of high-impact events concentrated in specific periods, particular groups, or operational disruptions in total waste generation. A few long-term studies have provided evidence that food waste concentrates in specific periods and populations (e.g. Malefors et al., 2026), yet this pattern requires validation across different contexts, settings, and populations. Understanding whether waste generation is driven primarily by routine behaviours or by concentrated extreme events has important implications for designing effective interventions. To test this further, we employed long-term automated monitoring of household and school food waste using a smart bin system, analysing different patterns to quantify the contribution of extreme events to total waste generation. This study employs a long-term monitoring and analysis of household and school food waste. A total of 11 households and 2 schools were monitored using a smart bin system (SvinnSon©), which continuously records the weight and pictures of disposed food waste. Data collection periods ranged from 78 to 289 days. Peak analysis was conducted to measure and analyse high-impact waste events where avoidable food waste significantly exceeds typical levels, indicating abnormal or event-driven behaviour. Three statistical methods were applied to detect peaks: the percentile method (P90), the interquartile range (IQR) method and the median absolute deviation (MAD) method. For school plate waste, Pareto analysis was applied to the distribution of waste events to identify whether a small proportion of events contributes disproportionately to total waste generation. The results reveal that although high-impact events occur infrequently, they account for a disproportionately large share of total avoidable food waste. The P90 method showed that 10% of peak days are responsible for an average of 72% avoidable food waste, while the IQR method, capturing a broader range of peaks, resulted in 5 – 25% of peak days are responsible for an average of 78% avoidable waste. Similarly, Pareto analysis reveals that 16 – 17% of students are responsible for 40 – 74% of plate waste. The analysis demonstrates that food waste generation is concentrated in high-impact events and specific periods or populations, rather than distributed uniformly across all days or groups. Long-term quantification was essential to reveal this concentration pattern, as short-term studies risk missing or misrepresenting these critical drivers. These findings have important implications for intervention design, as general population-level approaches or daily average-based strategies are unlikely to be effective when waste concentrates in specific high-impact events or groups. Instead, waste reduction strategies should target the periods, populations, or conditions that drive disproportionate waste generation, enabling more

efficient and context-dependent interventions.

Keywords: High-impact events, long-term quantification, automated monitoring, intervention design

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