A powerful method to minimize household food waste and its environmental impacts—information interactions via social media

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Abstract: Food waste poses significant economic, social, and environmental challenges, hindering sustainable development. Addressing this issue has become a topic of widespread societal concern. With the integration of social media into daily life, this study employs an agent-based model to construct a complex system of residents' food waste behavior decisions based on social media information exchange. The study simulates the dynamic evolution of residents' food waste behavior under three intervention strategies: an enhanced education strategy, an expanded communication strategy, and a combined strategy. Results reveal that social media significantly accelerates behavioral changes, reducing daily waste from 16.6g to approximately 6.0g. Carbon footprints decreased from 85g/day to 31g/day; water footprints from 70dm³/day to 26dm³/day; and ecological footprints from 60dm²/day to 23dm²/day. The combined strategy proved the most effective, demonstrating the fastest and most efficient attitude and behavior changes. Given the uncertain impact of education strategies due to residents' limited authority, the study concludes that combining education and communication is the optimal intervention strategy. This research validates the effectiveness of social media in reducing food waste and provides a foundation for policy development.

Introduction

In 2015, the United Nations established 17 Sustainable Development Goals, including "Zero Hunger" (Goal 2) and "Take urgent action to combat climate change and its impacts" (Goal 13) (UN, 2015), to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. It is estimated that one-third of global food is wasted or lost annually (FAO, 2011), leading to significant economic, social, and environmental impacts (Albizzati et al., 2021). Within the food supply chain, the consumption stage is a critical contributor to food waste, with a substantial amount occurring at the household level (Lucifero, 2016), accounting for one-third of total food waste in the supply chain (Alsuwaidi et al., 2022). In China, per capita household food waste ranges from 7.63 to 10.86 kilograms annually, with a national total of 10.56 to 15.02 million metric tons per year (Jiang et al., 2018). To identify effective interventions for reducing consumer food waste, many scholars have conducted comparative studies on the efficacy of various measures (Read and Muth, 2021). As of December 2023, China's social media industry has rapidly developed, with diverse platforms and formats. China has 1.079 billion internet users and an internet penetration rate of 76.4%. Information disseminated through social media has become a primary source of online content consumption. This study posits that, for Chinese residents, social media can be a pivotal tool for influencing consumer food waste behaviors. Exploring optimal intervention strategies based on social media information exchange holds significant potential for achieving food waste reduction goals.

Material and methods

This study employs an agent-based modeling approach and collects data through two rounds of questionnaire surveys, obtaining 501 valid responses containing information on residents' food waste behaviors and decision-making data related to food waste. A complex decision-making system for residents' food waste behavior was developed based on social media information exchange. This system encompasses three key processes: the food waste decision-making process, the community influence process, and the information exchange process. System parameters were established based on the survey results and further refined through real-world considerations and expert evaluations. Additionally, the study quantified the environmental footprints associated with food waste behaviors, including carbon footprint, water footprint, and ecological footprint.

Results and discussion

Regarding system evolution speed, the evolution rate under the social media information exchange scenarios (enhanced education, expanded communication and combined strategy) significantly surpasses that of traditional information exchange scenario (Baseline). Figure 1 illustrates the effectiveness of three governmental strategies to enhance education. The results indicate that all three strategies regulate food waste levels among the resident population, with the effectiveness ranking as (c) > (b) > (a). Figure 2 compares the average waste levels under different intervention strategies. From the system evolution speed perspective, the three strategies rank as follows: combined strategy > expanded communication strategy > enhanced education strategy. Regarding environmental footprints (Figure 3), all three scenarios show a reduction in environmental impacts. The enhanced education strategy achieves the most significant reduction in environmental footprint, followed by the combined strategy, while the expanded communication strategy demonstrates the least effectiveness.

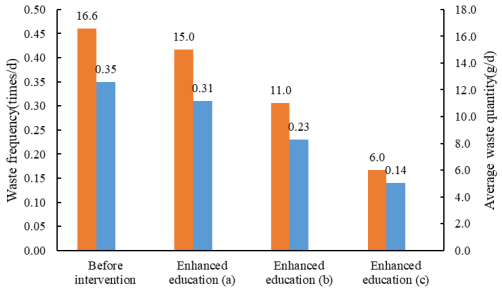

Figure 1. Simulation results of residents' food waste under the enhanced education strategy.

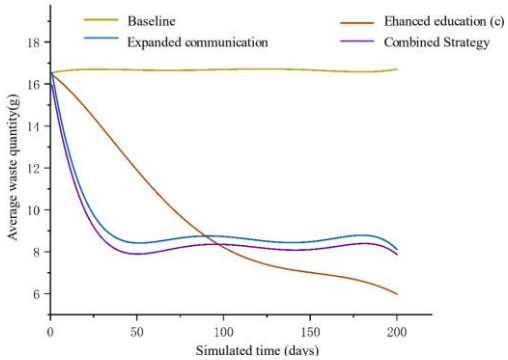

Figure 2. Comparative results of waste quantity across different intervention strategies.

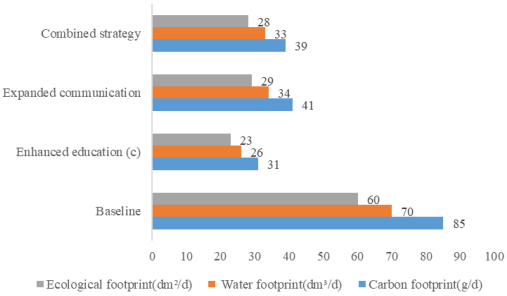

Figure 3. Environmental footprint comparison across different intervention strategies.

Conclusions

The system evolution speed under the social media information exchange scenario is significantly higher than in traditional information exchange scenarios. This indicates that in the context of social media, residents are influenced more rapidly, with faster and more efficient shifts in attitudes and behaviors. All three intervention strategies for reducing food waste behavior (enhanced education, expanded communication, and combined) effectively reduce food waste. In terms of overall effectiveness, the ranking is as follows: enhanced education strategy > combined strategy > expanded communication strategy. However, regarding system evolution speed, the ranking changes to combined strategy > expanded communication strategy > enhanced education strategy. Given that residents do not have the same level of authority as the government in the context of information exchange, the actual effectiveness of the enhanced education strategy may be uncertain. The combined strategy leads to the quickest and most efficient shifts in residents' attitudes and behaviors. Considering both aspects, this study believes the combined strategy shows the best overall performance in the simulation results.

References

UN. (2015). Transforming our world: the 2030 agenda for sustainable development. USA, https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

FAO. (2011). Global food losses and food waste-Extent, causes and prevention. Rome. http://www.fao.org/3/a-i2697e.pdf

Albizzati, P. F., Tonini, D., & Astrup, T. F. (2021). High-value products from food waste: An environmental and socio-economic assessment. *Science of the Total Environment, 755*, 142466. https://doi.org/10.1016/j.scitotenv.2020.142466

Lucifero, N. (2016). Food loss and waste in the EU law between sustainability of well-being and the implications on food system and on environment. *Agriculture and Agricultural Science Procedia, 8*, 282–289. https://doi.org/10.1016/j.aaspro.2016.02.022

Alsuwaidi, M., Eid, R., Agag, G. M., et al. (2022). Tackling the complexity of guests' food waste reduction behaviour in the hospitality industry. *Tourism Management Perspectives, 42*, 100979. https://doi.org/10.1016/j.tmp.2022.100979

Jiang, J., Yu, T. E., Huang, W., et al. (2018). Home Food Waste in China and the Associated Determinants. *Journal of Agrotechnical Economics, 9*, 88–99. DOI:10.13246/j.cnki.jae.2018.09.008

Read, Q. D., & Muth, M. K. (2021). Cost-effectiveness of four food waste interventions: Is food waste reduction a "win–win?" *Resources, Conservation and Recycling, 168*, 105448. https://doi.org/10.1016/j.resconrec.2021.105448

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