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Editorial: Sustainable approaches to food loss and waste reduction in smallholder horticulture: from proof of concept to scale

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Editorial on the Research Topic

Sustainable approaches to food loss and waste reduction in smallholder horticulture: from proof of concept to scale

Horticultural food commodities (including fruits, vegetables, herbs, and spices) are relatively high-value, nutrient-dense dietary components that are essential for food and nutrition security. Despite their importance, these commodities are highly perishable and prone to rapid deterioration, resulting in high postharvest losses. As these commodities move along the often fragmented and informal supply chains, some level of quantitative and/or qualitative losses occur. Globally, the quantitative losses in the fruit and vegetable value chain are estimated to range between 40 and 50% (FAO, 2011). The extent of losses and the causes/drivers are influenced by a range of factors including the commodity, environment, and socioeconomic considerations – all of which are contextually dependent. Therefore, interventions for the reduction of food loss and food waste must be targeted and contextualized for them to achieve the desired impact.

Diverse interventions have been tested in different contexts to reduce food loss and waste (FLW) across crop value chains, including those for horticultural crops (Stathers et al., 2020). Many of the interventions are especially targeted at smallholder practitioners (farmers, processors, traders) who form the majority in resource-limited countries in Africa, Asia, and South America. While some of the interventions have been successfully adopted and contributed to FLW reduction, many have not moved beyond the proof-of-concept stage despite their great potential. This stagnation can often be attributed to several non-technical and systematic barriers. For instance, interventions can be misaligned with local needs and not sufficiently informed by evidence or reliable data. In particular, the lack

of robust data makes it difficult to identify, design, and scale effective approaches to reducing FLW (Axmann et al., 2022). Further, highlighted in this Research Topic, underinvestment in postharvest systems and research infrastructure, limited market integration for smallholders, weak partnerships for scaling, challenges in technology adoption and adaptation, and persistent equity gaps that exclude marginalized groups are some of the barriers to technology scale up and adoption.

This Research Topic of original research papers, case studies, a perspective, and a mini review, highlight the challenges and opportunities in scaling up innovative solutions for FLW reduction in smallholder horticultural value chains.

In their perspective article, Yumbya et al. underscore the need for collaborative action and increased investment in FLW interventions within the horticultural crops systems. They argue that neglected investment in postharvest initiatives in the horticulture crops aggravates global nutrition insecurity while diminishing resilience to climate change impacts, as scarce resources are used to produce food that goes to waste. The perspective advocates for locally led postharvest innovations that are context appropriate. This approach is expected to maximize the impact on FLW reduction while creating opportunities for improved livelihoods for those involved in postharvest activities, especially the marginalized groups, including women. Investment in FLW reduction interventions must be guided by the evidence/data that sheds light on the hot spots for FLW in various value chains and guide context-appropriate interventions.

Existing FLW data within horticultural value chains is both scarce and uneven, characterized by significant deficiencies across geographic regions, commodities, supply chain stages, and other critical dimensions. In their mini review, Ambuko et al. highlight gaps and skewedness in available food loss and waste data in fruit and vegetable value chains. The mini review concludes that policies and interventions to reduce FLW with the set targets will require addressing the glaring FLW data gaps as the first step. The review posits that blanket interventions that are not guided by reliable region-specific data will continue to be less relevant and fall short of their intended objectives, leading to wasteful utilization of resources with no ground impact.

There is a wide range of innovative solutions for postharvest management towards FLW reduction in horticultural crops. Some of the solutions such as 1-methycyclopropene (1-MCP) are aimed at extending the shelf life thereby prolonging the marketing period of the highly perishable horticultural crops. However, the effectiveness of the postharvest treatments depends upon the commodity and environmental factors, which must be considered in the treatment regimens. In their article, Chomba et al. demonstrate the influence of harvest maturity on the effectiveness of different formulations of 1-MCP applied at various concentrations and exposure periods in 'Tommy Atkins' mango fruits. The study showed that the different 1-MCP formulations (powder and inbox sachet) are both effective to slow down mango fruit ripening but have different dosing ranges. Fruits and vegetables must be harvested at the right maturity for the intended use. Poor harvest maturity has been cited as one of the drivers of postharvest losses in fruit and vegetables as they fail to meet the requirements for the target fresh market and processing. Most farmers use unreliable subjective maturity indices to determine the time of harvest. Over the years, new innovative methods of predicting maturity with precision have been developed. Owino et al. report the use of a portable near-infrared spectrometer (NIRS), which can non-destructively determine the internal quality of Cactus pears. The study demonstrates the effectiveness of NIRS in measuring maturity and quality parameters, such as total titratable acidity (TTA) and total soluble solids (TSS), in whole Cactus pears. Further research and application of this innovation in other horticultural crops is expected to greatly benefit farmers and processors by reducing the losses and associated expenses for quality assessment using destructive methods. Food processing through drying is an intervention that not only reduces postharvest losses in fruits and vegetables but also ensures their continued availability in shelf-stable forms. However, sub-optimal processing parameters can lead to low-quality products. Mina et al. demonstrated a combination of oven and freeze drying to enhance drying efficiency and product quality in carrot slices, which holds capacity for replication at a commercial scale for different commodities.

Scalable solutions for reducing food loss/waste, such as those highlighted above, require innovative approaches to develop and scale up. Owino et al. highlight the challenges faced in developing and scaling interventions for FLW reduction. The article also identifies successful strategies to overcome these barriers. The critical role of partnerships, comprehensive market research, and adaptive strategies in developing successful FLW solutions is highlighted. Similarly, Kajobe et al. demonstrate the application of embedded research translation (ERT), where research findings are integrated into practical application among smallholder farmers as an approach to enhance the adoption and scale-up of FLW reduction solutions. However, as articulated by Kilelu et al., understanding the bottlenecks in technology adoption and scale-up in smallholder horticulture is needed to guide targeted investments in interventions such as cold storage technologies and complementary cold chain management practices. System diagnostics are needed to capture value in market opportunities for smallholders and other value chain actors.

This Research Topic not only showcases examples of innovative solutions for FLW reduction but also reiterates the need to address the bottlenecks that hinder the adoption and/or scale-up of proven innovative solutions for FLW reduction.

Author contributions

JA: Conceptualization, Writing – original draft, Writing – review & editing. VT: Writing – original draft, Writing – review & editing. GE: Writing – review & editing. EM: Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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