Mounting Nutritional and Environmental Pressures of the Global Food Loss and Waste Calls for Urgent Policy Action

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Global food losses and waste (FLW) lie at the core of the transition to a more secure and sustainable food system. FLW generated along global food supply chains (FSC) contribute to climate change and natural resources depletion, threatening economic stability and endangering our path toward global food security. Tackling global FLW in line with United Nationsâ€™ Sustainable Development Goal (UN-SDG) 12.3 requires quantifying the magnitude, composition, and geographical location of lost and discarded foods, outlining where policy interventions may provide the highest socioeconomic and environmental benefits. Today, three significant barriers hinder the development of consistent policies for tackling FLW.

The first barrier is represented by the lack of harmonized global FLW estimates. As no reliable global measurement is available, most adopted estimates from Food and Agriculture Organization are considered broadly inconsistent but remain widely used in relevant studies illustrating significant gaps in the availability of data. On top of data limitations, a second barrier is generated by the presence of conflicting methodologies adopted to quantify FLW. Methodologies computing FLW estimates are circumscribed to the accounting agentâ€™s behavior and/or providing a consistent representation of physical biomass flows along global FSC. Technical studies rely on detailed physical mass flows to derive FLW amounts, but often ignore socioeconomic drivers of FLW, neglecting stakeholdersâ€™ interactions and value-chain dynamics. In a globalized food system, changing actorsâ€™ interactions and trade along global FSC affect demand for biomass, influencing spatial availability and composition of non-primary foods. As most available studies rely on poor global trade data, flows of traded biomass are often misrepresented but remain crucial for tracing food from farm to fork and accurately defining FLW along global FSC. Finally, a third barrier lies in the absence of a multidisciplinary framework able to address wide-ranging challenges around FLW. Currently, as available studies lack a consistent cross-check analysis between FLW and net/gross food intakes, no effective guidelines for nutritional security are provided. Several studies link FLW estimates with nutritional losses but report no information on how food and nutritional intakes are affected by FLW along the FSC. Expanding the nutritional analysis on FLW requires tracing flows of nutrients along global supply chains in order to quantify where interventions can best contribute to global food security. Additionally, as FLW and nutritional security directly link to the environment, a framework capable of merging nutritional analyses and embedded environmental footprint allows for defining policies from a broader multidisciplinary perspective.

In this paper, we attempt to address the main barriers and limitations of available FLW studies, compiling an up-to-date global FLW database based on a food supply-chain perspective. We align with the United Nations defining FLW as â€œfood (including inedible parts) lost or discarded along the food supply chain, comprising pre-harvest losses, and excluding food diverted to animal feed, seed or to other non-food material uses such as bio-based products''. Adopting a multidisciplinary approach, we merge technical and economic modeling of FLW to capture physical flows of lost or discarded food biomass along each stage of global FSC. Building on a recent development that incorporates physical and nutritional flows in a global economic framework, we define country-level gross food and nutritional supply across stages of global FSC, matching estimates provided in the FAO Food-Balance-Sheets (FBS). We collect from the literature the best available estimates on shares of lost and discarded foods along FSC remaining consistent with our definition of FLW. We merge the FLW estimates with gross food and nutrient supply to quantify net food and nutritional

intakes. With this, we explore county-level FLW developments across a ten-year time frame (2004-2014), using the Global Trade Analysis Project (GTAP) multi-region input-output (MRIO) framework. We quantify the magnitude, composition, geographical location, and nutritional contents of FLW, accounting for the economic interactions of the food system and global food trade. Finally, we integrate additional data on land use, water use, and greenhouse gas (GHG) emissions globally, quantifying the environmental footprint embedded in FLW generation along the FSC. Our analysis aims to bridge knowledge gaps on global FLW developments, providing an innovative link to nutritional security and environmental impacts. We aim to further embed FLW in the multidisciplinary framework of the Sustainable Development Goals, assisting future policies on FLW reduction and circularity.