Project note - Food Loss and Waste country profile for Kenya

Estimates of Food Loss and Waste, associated GHG emissions and nutritional losses

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Urgency and call for action on FLW reduction

Theoretically, the world produces enough food to nourish the growing world population. Although precise data remains scarce, according to most recent studies, globally each year possibly as much as 40 per cent of the food produced is being lost or wasted somewhere between farm and fork. This not only represents a threat to food security but also severely and negatively impacts our food systems and natural resources. Food Loss and Waste (FLW) accounts for around 8 to 10 percent of our global Greenhouse Gas Emissions (GHGEs). Approximately a quarter of all freshwater used by agriculture is associated to lost and wasted food. 4.4 million km² of land is used to grow food which is lost or wasted - farmland area larger than the Indian subcontinent - and FLW contributes to the degradation of natural ecosystems (FAO, 2019; WWF, 2021; Guo et al., 2020). The Sustainable Development Goal (SDG) Target 12.3 calls to 'halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses' (Lipinski, B. 2022). With only 8 years to go, the world is far from being on track to achieve this target. In 2011, the global amount of FLW was estimated at 1.3 billion tons (Guo et al., 2020), whereas the latest update on 2019 data estimates a total amount of FLW sitting at 2.5 billion tons - almost doubling the estimate from 2011 (FAO, 2021).

Way forward reducing FLW without baseline data

The UN and the Champions 12.3 Coalition launched the 'Target-Measure-Act approach' calling on all governments and companies to set FLW reduction targets, measure FLW, identify hotspots, and to take action to reduce FLW accordingly (Lipinski, 2020). However, with respect to primary data on FLW, much remains to be done. Just a handful of mainly western countries have taken action to systematically measure and reduce FLW. Lack of data makes it particularly difficult for low- and middle-income countries (LMIC), including Kenya, to specify the hotspot food products and chain stages, to define smart targets and to identify adequate interventions.

In order to contribute to this essential information we developed and used a mass flow model based on secondary data (see next section for details). This approach allows to present an indicative country profile showing per food product category and chain stage not only the amount of FLW but also the GHGEs related to producing the FLW and induced nutrient losses. The sum differs per product and chain stage. Focusing on food products and chain stages which largely contribute to FLW, FLW-induced GHGEs and nutrient loss can substantially lead to resource use efficiency and at the same time to climate mitigation action and nutrition security. This integrated approach towards FLW reduction can support policy makers and other food system actors taking informed decisions contributing to several sustainability objectives in parallel.

Food Loss and Waste (FLW) definition

FLW refers to all food intended for human consumption that is finally not consumed by humans. **Food Loss** is the decrease in the quantity or quality of food resulting from decisions and actions by food chain actors from the production stage in the chain, excluding retail, food service providers and consumers. **Food Waste** is the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food services and consumers (FAO, 2019). Under this definition, FLW does not include food that is consumed in excess of nutritional requirements nor food that incurs a decrease of market value due to over-supply or other market forces, and not due to reduced quality.

Modelling country data on FLW and impact of FLW on GHGEs and nutrition

FLW data was generated through a bottom-up, mass-flow model (Guo et al., 2020) that combines data on production and outputs as well as imports and exports at the country level. Estimates of losses per chain stage are derived from Porter et al. (2016) to calculate the FLW in the value chain according to the country's production and trade.
Furthermore, a Protein and Nutrition Database developed by WUR (built on nutritional compositions derived from databases from FAO, USDA, Denmark and Japan) was used to calculate the nutritional value of the total consumed food in each country. The nutrient intakes are compared with estimated nutrition requirements per country (which is based on the composition of the population and per capita nutrient demand, according to WHO dietary recommendations).

FLW, GHGEs and nutrition country profile Kenya

Based the country data modelling, estimates on FLW-associated GHGEs were retrieved for Kenya and plotted with the FLW total tonnage and the associated protein loss (note: in a different unit) to visualize the three components in a comparative way (Figure 1).
Food categories were ranked according to the production of GHGEs. The five food products with the highest sum on FLW, FLW-associated GHGEs and nutrient losses (weighted as represented in Figure 1), the five hotspot products, for Kenya are: dairy products, bovine meat, maize, mutton & goat meat and vegetables.
From the dairy chains, 1.3 million tons of FLW represents 5.4 million tons CO_2-eq. of GHGEs. While from vegetables 2 million FLW tons generated 0.8 million ton GHGEs.
From another perspective, taking the percentages of FLW in relation to production percentages, indeed vegetables and fruits arise as the main hotspots showing average FLW of 65% along the chains and milk 24% (Figure 2).

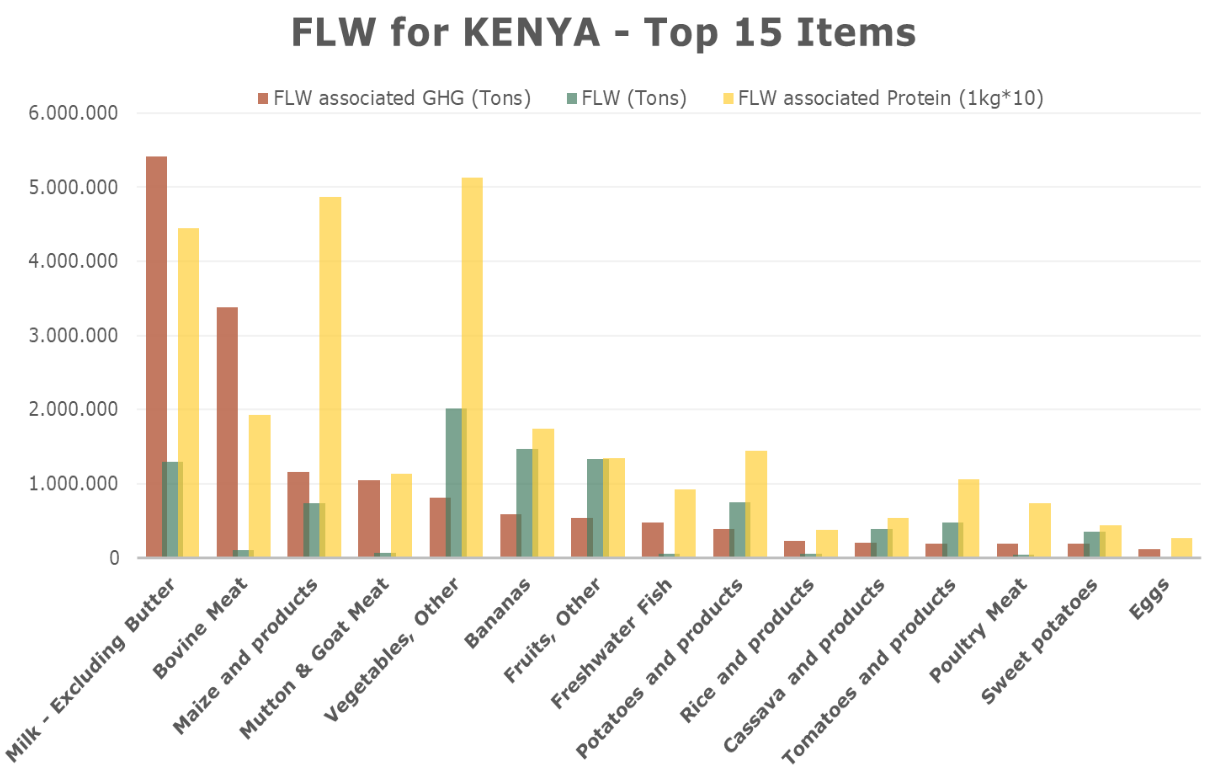

Figure 1. Top 15 Hotspot categories of food loss and waste in terms of volumes, loss of proteins and ranked on FLW-associated GHG emissions (in CO2-eq.).
Remark: Protein losses are depicted by 10kg to make the values visible and comparable. Other FLW total values are in tons.

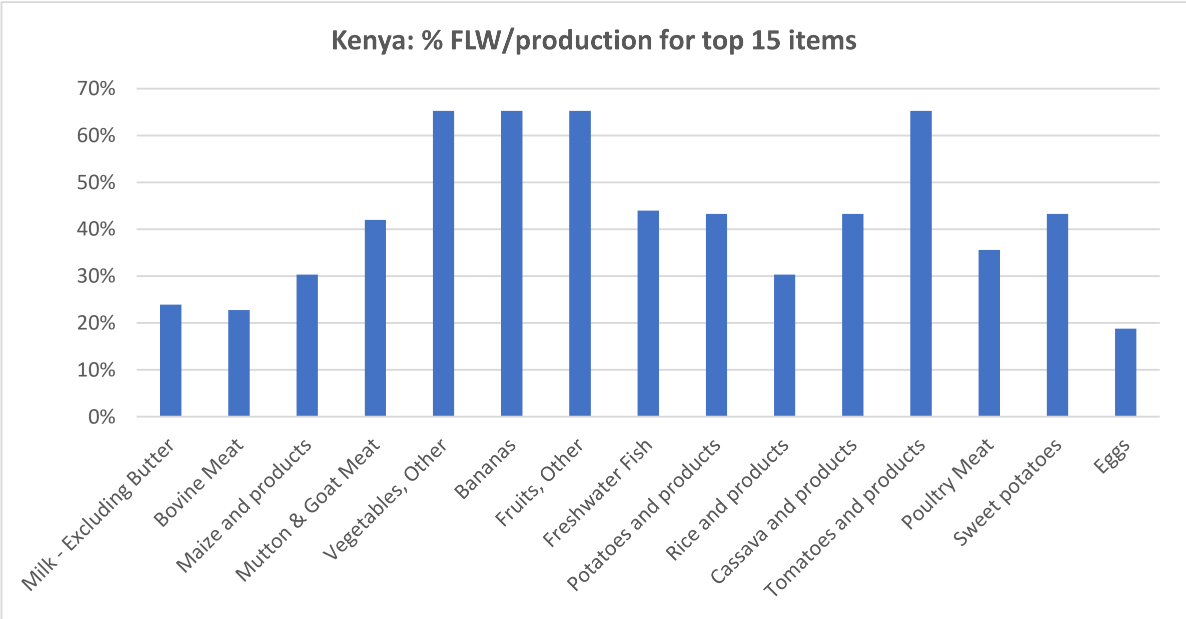

Figure 2. Percentages of FLW per product category

Further insights in hotspots is developed from estimated distribution of the FLW along supply chains for the top 5 hotspots in the region (Figure 3). These data suggest that the retail stage of fresh vegetables, meat and milk embodies bottlenecks. For milk and meat products the 'postharvest handling and storage' stage is also a hotspot for milk and meat products. These could be points for further data gathering and analysis of causes to identify potential interventions. Smart interventions in such 'hotspots' in food supply chains can substantially contribute to GHG emission mitigation of food systems. Analysis of specificities of such chains (e.g. comparing informal and formal supply chains, and urban and rural settings) including comparison with supply chains for similar product categories may reveal promising interventions. Interventions may combine hardware (packaging, cooling, etc.), orgware (e.g. arrangements in chains) and software (knowledge, information) elements.

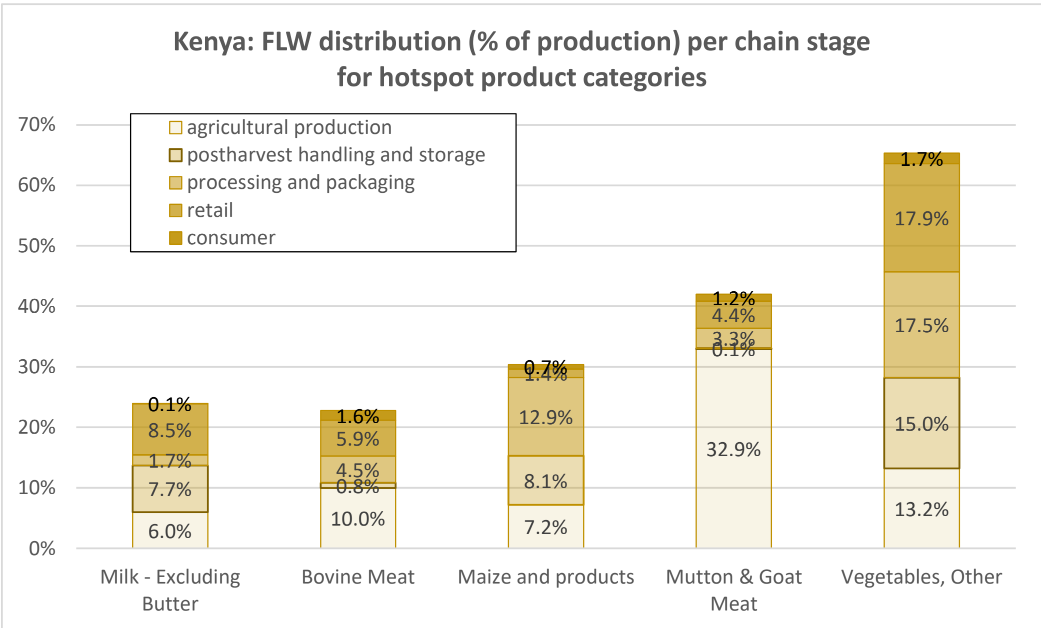

Figure 3. Percentages of FLW per stage in the supply chain for top 5 hotspots.
Remark: Agricultural production does not include any potential yield gaps and focuses on actual production and harvest losses.

Finally, the food supply and FLW data were used to assess nutrient supply per capita in the Kenyan population in relation to recommended nutrient intake (Figure 4). The results imply that there are populations that suffer insufficiencies of calcium, vitamin A, vitamin B12 and zinc.

From nutrition security perspective, efforts for mitigating FLW in milk/dairy and fresh vegetables chains contribute the most to population nutrient gains (Table 1).

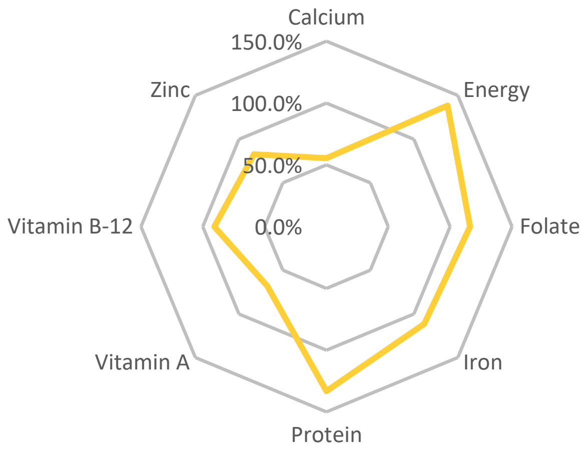

Figure 4. Average provision of nutrients per capita relative to WHO dietary recommendations
Remark: because of uneven distribution of food over the population, parts of the population will suffer more insufficiencies than this diagram implies.

Table 1. Food product categories for which the FLW have highest share for the most critical nutrients.

Critical nutrients	FLW categories with highest loss of the nutrient (highest first)
Calcium	milk, vegetables, fruits, beans
Vitamin A	vegetables, sweet potatoes, milk, fruit
Vitamin B-12	milk, bovine meat, mutton & goat meat, vegetables
Zinc	vegetables, maize, beans, milk

Value loss

According to Food and Agriculture Organization (FAO), an estimated KES 72 billion (578 million USD) is lost every season due to limited investment in addressing food waste and losses[1].

Validation

There was no literature found on FLW data for the whole country. Hence, the results on a national level, as described here, could not be validated.

Overall conclusions and suggestions for the next steps

This analysis indicates that overall hotspots of products with high FLW-GHGEs mitigation potential for Kenya are milk, beef meat, maize, mutton & goat and fresh vegetables.
Especially reducing FLW for milk/dairy and bovine meat can significantly contribute to reducing FLW-associate climate impact. Reducing vegetable losses is also very relevant to reducing malnutrition.
The collection of primary data is advised for chain-specific interventions. The focus of the data collection should particularly be on the hotspot chain stages of the priority products.

Then, our suggestion for an immediate next step forward to developing FLW reduction actions, with synergy on GHGE mitigation and nutrition, is to implement monitoring and gather primary data for hotspot supply chains of the country. This should particularly pay attention to the handling, storage and

[1] https://slowfoodkenya.org/food-waste-losses/#:~:text=Food%20Losses&text=According%20to%20Food%20and%20Agriculture,addressing%20food%20waste%20and%20losses. Viewed 6-1-2023

retail stages. Differences between supply chain typologies (specifically differences between informal and formal supply chains and differences between rural and urban situations) should be considered in order to generate understanding of specific systems, so that the information is useful for intervention development.
For this purpose, WUR's EFFICIENT protocol can be used https://sites.google.com/iastate.edu/phlfwreduction/home/efficient-food-loss-waste-protocol?pli=1.

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Colophon and notes on this version

Carried out by:	The research that is documented in this study reports on work carried out by Wageningen Food & Biobased Research under Mitigate+ in 2022. It was conducted in an objective way by the researchers.
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Next steps:	An improved version of this note will be published in 2023 following engagement with various stakeholders and including additional parameters and data and improved matching between food categories from various sources. With respect to hotspots, no change in priority is expected.
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