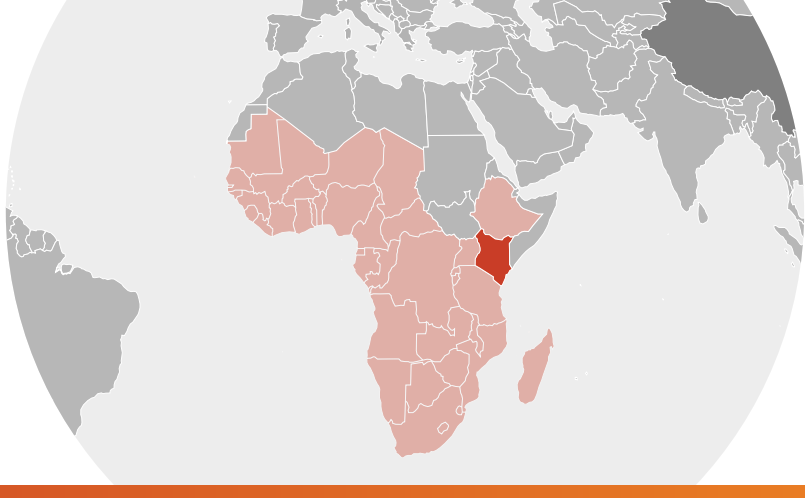
Food loss Solutions



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Mitigate+: Food Loss and Waste country profile Kenya

Estimates of Food Loss and Waste, associated GHG emissions, nutritional losses, land use and water footprints

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 30 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 the lost and wasted food. 4.4 million km² of land is used to grow food which is lost or wasted (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 7 years to go, the world is far from being on track to achieve this target.

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[1], 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

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 suppliers 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.

1 In this document hotspots are defined as food products or food (sub) categories, eventually in combination with a supply chain link, that show the highest scores with respect to a selected (sub)set of sustainability indicators: FLW, GHGEs, nutrition, land use and water footprint.
2 Mutton & Goat Meat is not considered for the land-use footprints due to the marginal land consideration.

mainly western countries have taken action to systematically measure and reduce FLW. Lack of data make it particularly difficult for lower-and-middle-income countries (LMIC), including Kenya, to specify the hotspot food products and chain stages, to define smart targets and to identity adequate interventions.

In order to contribute to this essential information we developed and used a mass flow model based on secondary data to derive the volume of FLW and the associated parameters accordingly (Guo et al., 2020). 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, the land-use and water footprints related to producing the FLW as well as induced nutrient losses. The sums differs per product and chain stage. Focusing on food products and chain stages which largely contribute to the aforementioned parameters 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 multiple sustainability objectives in parallel.

Modelling country data on FLW and FLW-associated GHGEs, land-use and water footprints and nutritional losses

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 supply chain according to the country's production and trade. The FLW-associated GHG emissions are calculated by using the GHG emission factors derived from Porter et al. (2016) to multiply the FLW at different supply chain stages.

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).

In calculating the land use footprint of plant-based food items, FAO's 'Crops and livestock products' database is utilized by combining data on yields and harvested areas. This gives a simplified estimate of how much cropland is needed to grow the produce. Country-specific land use estimates for animal-based food items are however scarce. Therefore, global estimates as published by Poore & Nemecek (2018) are used. Applying this non-differentiated data has a drawback that it not accurately takes into account country-specific farming practices. Lastly, for the water footprint the broadly recognized datasets of Mekonnen and Hoekstra are used. These cover the Green, Blue and Grey water footprint of crops and derived crop products (Mekonnen & Hoekstra, 2011), and of animals and animal products (Mekonnen & Hoekstra, 2010).

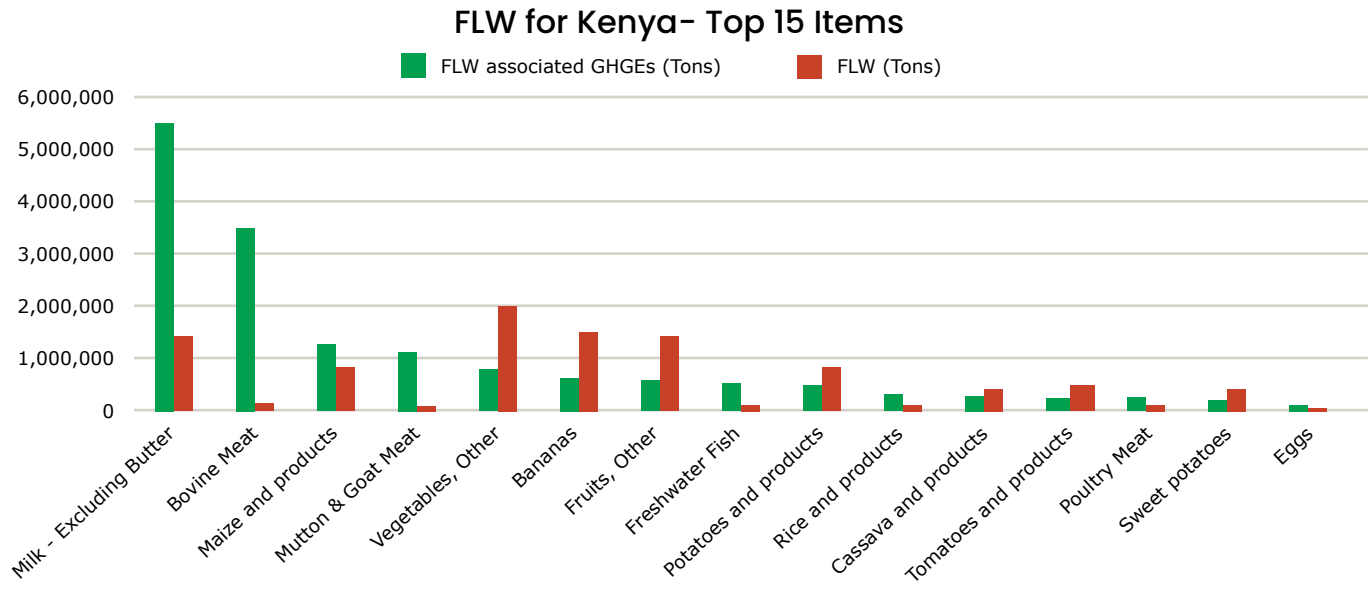

Figure 1 Top 15 hotspot categories of food loss and waste in terms of volumes and FLW-associated GHG emissions (in CO2-eq.).

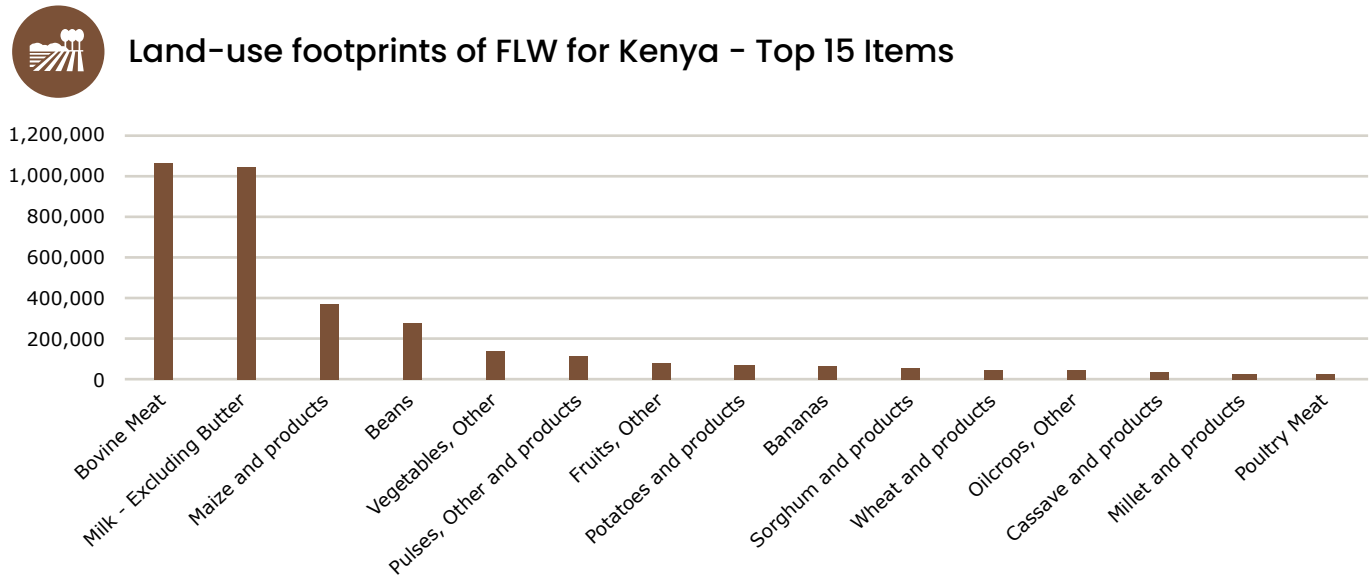

Figure 2 Top 15 hotspot categories of the land-use footprints of FLW (in ha)

FLW, GHGEs, nutrition, land use and water footprint country profile Kenya

Based on the country data modelling, estimates on FLW-associated GHGEs were retrieved for Kenya and plotted with the FLW total tonnage to visualize the two components (Figure 1). For FLW the five main hotspots products are: vegetables (others), bananas, fruits (others), milk and potatoes. However, ranking food categories according to the production of FLW-associated GHGEs the five hotspot products for Kenya are: milk, bovine meat, maize, mutton & goat meat, and vegetables (others).

From the milk chains, 1.3 million tons of FLW represents 5.4 million tons CO2-eq. of GHGEs. For the bovine meat chains, 3.4 million tons CO2-eq. of GHGEs are generated from 0.1 million tons of FLW.

Figure 2 presents the top 15 items with the largest land-use footprints of FLW. Bovine meat, milk and maize ranks the top 3.

With respect to the water footprints of the FLW, milk and maize are the top 2, followed by beans and bananas (Figure 3).

From another perspective, taking the percentages of FLW in relation to production percentages, the vegetable and fruit products arise as the main hotspots showing average FLW of 65% along the chains (Figure 4).

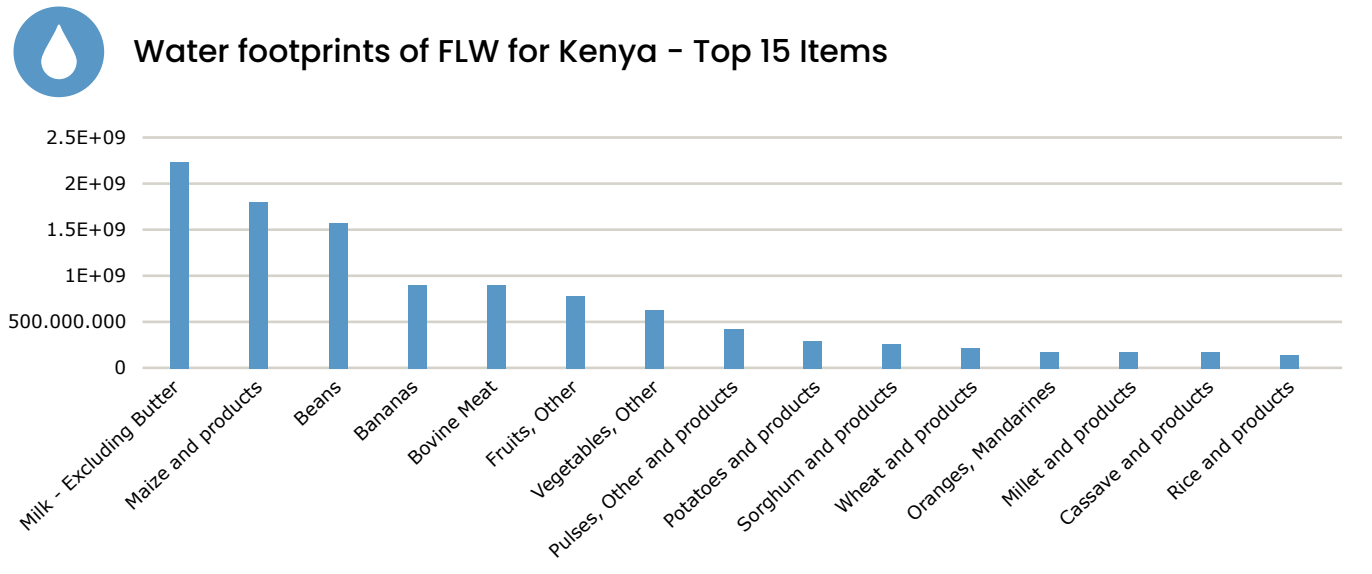

Figure 3 Top 15 hotspot categories of the water footprints of FLW (in m3)

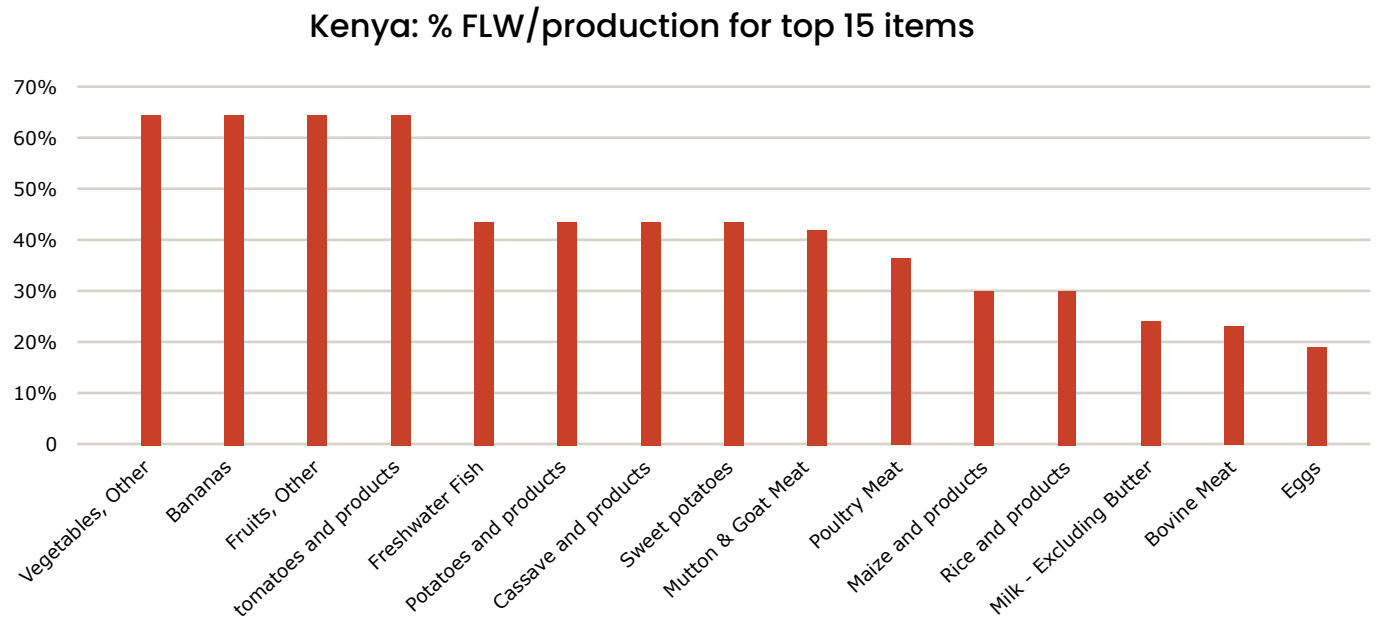

Figure 4 Percentages of FLW per product category

Further insights in hotspots are derived from estimated distribution of the FLW along supply chains for the top two hotspot product categories in the region (Figure 5). These data suggest that all the stages except for consumption for fruits and vegetables are hotspots. The postharvest handling and storage of freshwater fish is a bottle neck as well at the retail stage. These are focus points for more detailed data collection and analysis of causes to address 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.

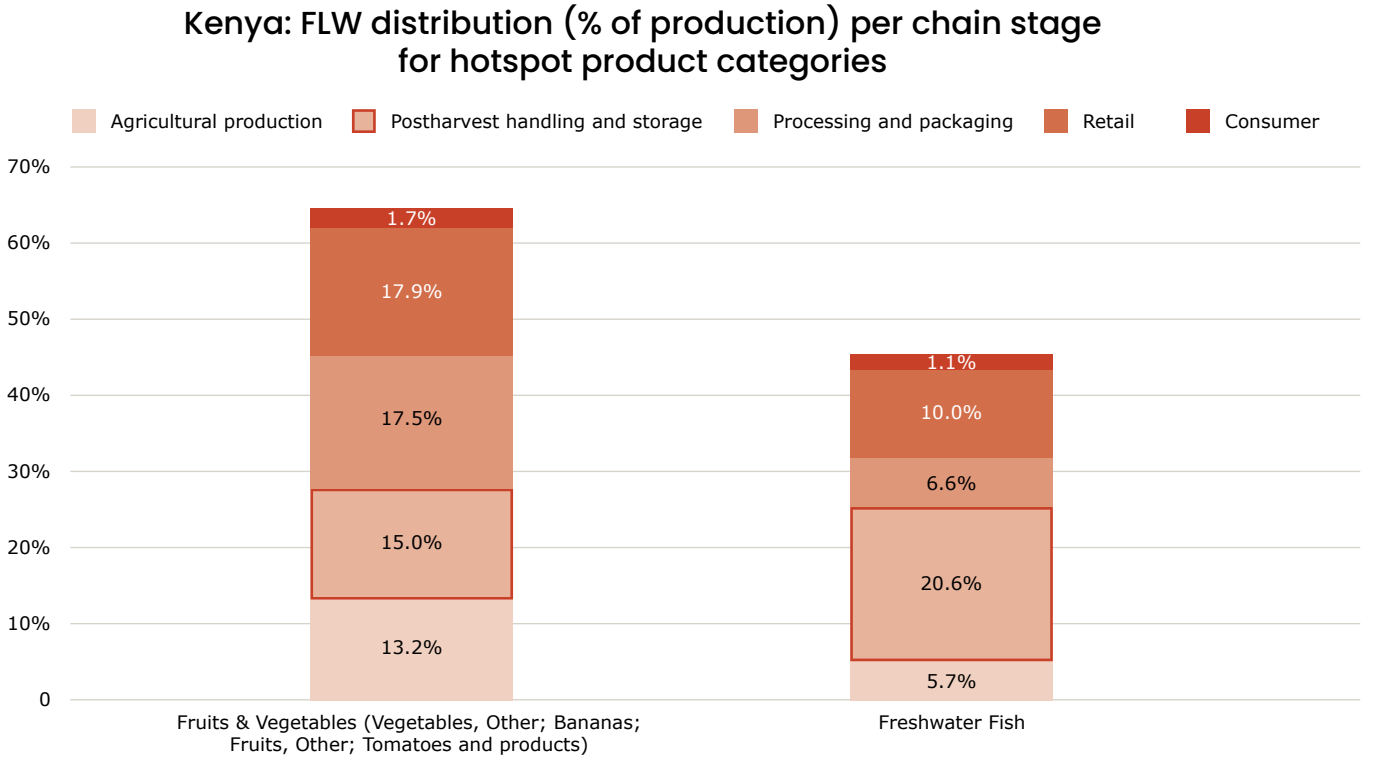

Figure 5 Percentages of FLW per stage in the supply chain for top 2 hotspot product categories
Remark: Agricultural production does not include any potential yield gaps and focuses on actual production and harvest losses.

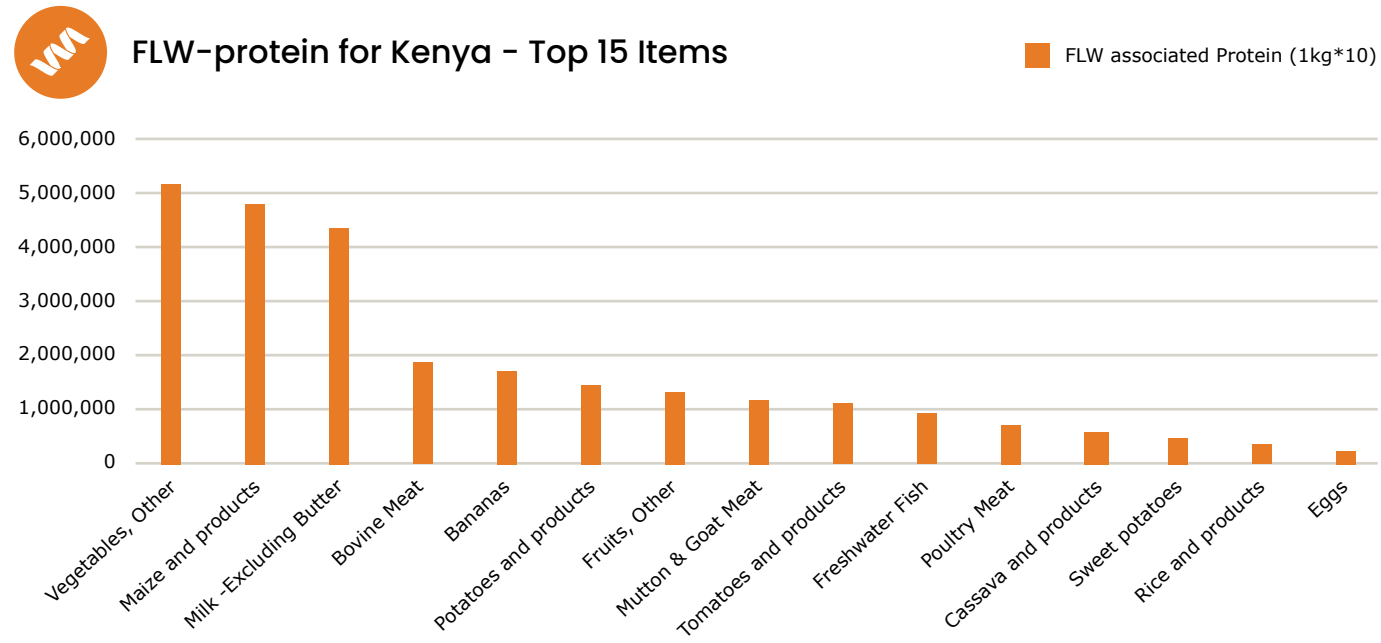

Figure 6 Top 15 hotspot categories of loss of proteins associated with FLW

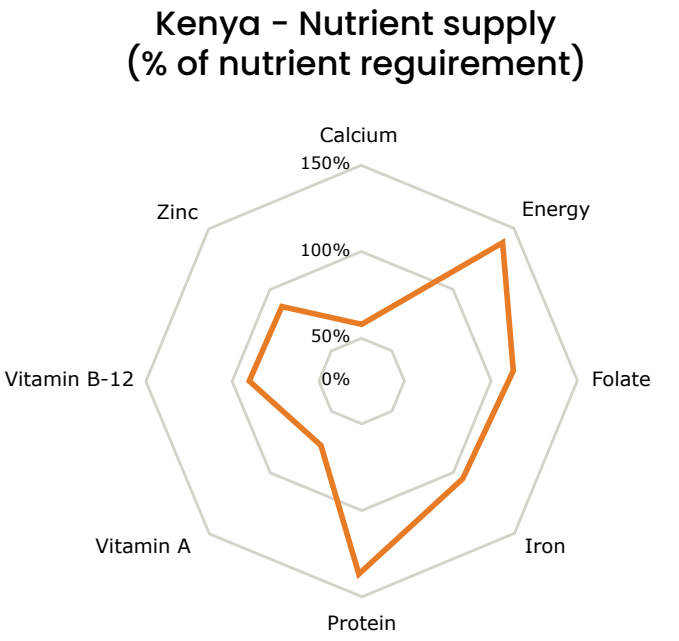

Figure 7 Average provision of nutrients per capita relative to WHO dietary recommendations
Remark: because of uneven distribution of food over the population, parts of the population will suffer more insufficiencies than this diagram implies.

Figure 6 shows the protein losses associated with FLW where vegetables, maize, milk, bovine meat, and bananas ranks the top 5. 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 7). These are average numbers, and it is not likely that nutrients are evenly distributed across Kenya. Hence, there will be parts of the populations that suffer insufficiencies of calcium, vitamin A, vitamin B12 and zinc.
From nutrition security perspective, efforts for mitigating FLW in milk/dairy, fresh vegetables, and bean chains would contribute the most to population nutrient gains (Table 1).

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, beans
Vitamin A	sweet potatoes, milk
Vitamin B-12	milk, bovine meat, mutton & goat meat
Zinc	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[2].

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

Figure 8 displays a comprehensive ranking of hotspot food products based on five criteria. While there are eight hotspot food products identified, a closer examination reveals notable variations in the ranking of the eight hotspot products across different categories. Milk and maize emerge as extremely critical food products, with milk taking the lead in this category and ranked as the most critical product. Bovine meat and vegetables follow closely, positioned as a hotspot for four categories and therefor classified as very critical products. In the next tier of hotspot products, banana stand out among the top five hotspots for three categories and belongs into the category of critical products. Whereas bean
is among the top 5 hotspot products in two categories and is classifies as a moderately critical product. Fruits and mutton goat meat are identified as a hotspot for one category each and are categorized as slightly critical.

It is suggested to develop FLW reduction actions, with synergy on GHGEs mitigation, nutrition, land-use and water footprints. The above analysis underlines that, if one considers sustainability in the context of these five selected indicators the greatest impact can be achieved by concentrating efforts on milk, maize, bovine meat and vegetables compared to focusing on other food products.

Since the results are not on product level, it is not immediately clear, where to start your intervention. Our suggestion to develop FLW reduction actions, with synergy on GHGEs mitigation, nutrition, land-use and water footprints, is to implement monitoring or/and gather primary data for hotspot-supply chains of the country. The results in this document guide stakeholders by focusing on the top four food (sub)categories in combination with the indicative results on FLW per supply chain link. To research interventions, it is necessary to go to product level, which can be based on production or trade data in the country. The next step is to identify business cases for FLW reduction. For this purpose, WUR's EFFICIENT protocol[3] and FLW cause and intervention tool[4] can be used.

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

3 https://edepot.wur.nl/556214 and https://sites.google.com/iastate.edu/phlfwreduction/home/efficient-food-loss-waste-protocol

4 The FLW cause & intervention tool (the-efficient-protocol.azurewebsites.net)

Kenya: Hotspot food products evaluated across five criteria

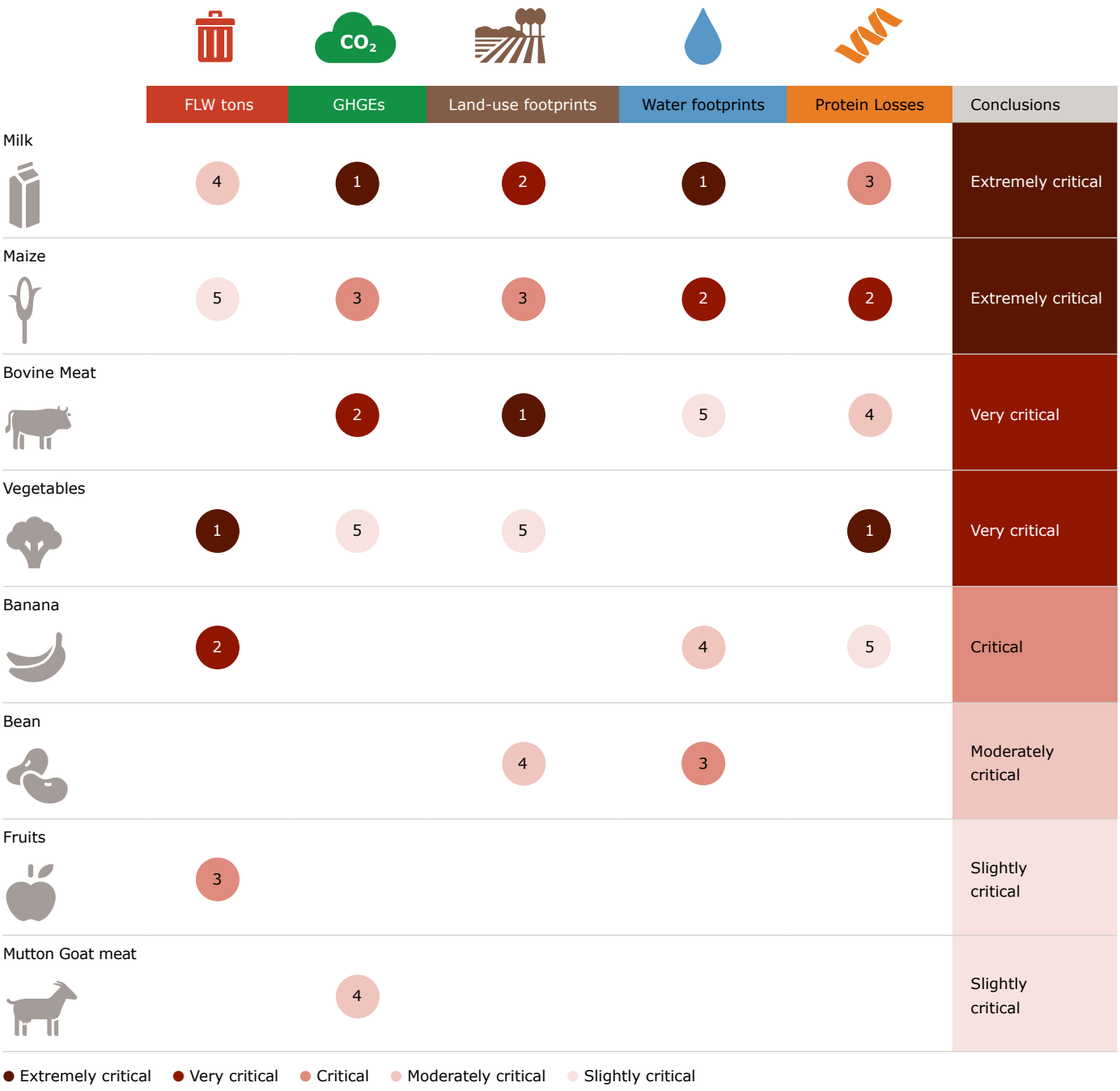

Figure 8 Ranking of hotspot product across five criteria

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Colophon

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Carried out by
The research that is documented in this study reports on work carried out by Wageningen Food & Biobased Research under Mitigate+ in 2022-2024. It was conducted in an objective way by the researchers.

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