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# Opportunities for a low-emission transformation of Kenya's food system

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## Key messages

- The food system in Kenya contributes a significant proportion (72%) to total national anthropogenic greenhouse gas (GHG) emissions – considerably higher than the global average (31%).
- The three primary sources of emissions in Kenya's food system, ranked in decreasing order of importance, are: (i) enteric fermentation, accounting for 56% of total food system emissions; (ii) manure management on pasture contributing 24% of total food system emissions; and (iii) food system waste disposal, responsible for 11% of emissions. Mitigation strategies in Kenya's food system should prioritize reducing emissions from these sources, and continue and expand actions to increase forest-related carbon sinks.
- Beyond-farmgate emissions represent a significant and growing share (13%) of total food system emissions. Within this sector, food system waste disposal is by far the main source of emission (83% of pre- and post-production emissions). Food loss and waste emissions can be effectively reduced through improving energy efficiency and minimizing food loss along food value chains, minimizing food waste in retail and consumer households, and enhancing value chain integration through actions like biomass management.
- Effective climate action planning should not only consider the size of sectoral emissions, but also the cost and feasibility (referred to as 'political economy') of implementing transformative measures.
- A comprehensive and integrated approach to reducing GHG emissions, encompassing the entire food supply chain from production to disposal, can be integrated across sectors to ensure efficient and effective implementation of Kenya's Nationally Determined Contribution (NDC).

## Background and introduction

A food system comprises "all elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these, including socio-economic and environmental outcomes" (HLPE 2014). The global food system produces substantial anthropogenic greenhouse gas (GHG) emissions. It is responsible for 23–42% of all net GHG emissions globally (31% on average) (Babiker et al. 2022). Food systems need to be radically transformed, lowering their emissions while continuing to produce sufficient, nutritious and healthy food.

## Food system emissions in Kenya

At absolute levels, food system emissions in Kenya have remained stable over the past decade (2010–2020). While their relative importance has decreased slightly since 2010 following development of the wider economy, food system emissions in 2020 still represent 72% of total national emissions – more than twice the world's average (31%). Addressing emissions from the food system is therefore of paramount importance to achieving Kenya's climate goals.

Kenya's food system emissions divide into three main categories, as shown in Table 2: (i) emissions from land-use change; (ii) farmgate emissions (55.1 $MtCO_2eq$); and (iii) emissions beyond the farmgate, from pre- and post-production ivities (8.2 $MtCO_2eq$).[2] This corresponds to 0%, 87% and 13% of Kenya's food system emissions respectively.

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2 Farmgate emissions' refers to GHG emissions directly produced from agricultural activities at the farm level. This includes emissions, e.g., from livestock, manure management, fertilizer use and fuel combustion in agricultural machinery. The term 'beyond-farmgate emissions' refers to food system related emissions not occurring within the boundaries of the farm, in the various stages of the agricultural value chain, like transportation, processing, packaging and distribution of agricultural products, or emissions from the manufacturing and use of agricultural inputs like seeds, fertilizers and pesticides.

**Table 1. GHG emissions from food systems in Kenya.**

| GHG emissions | 2010 | | 2020 | |
|---|---|---|---|---|
| | Kenya | World | Kenya | World |
| Food system GHG emissions ($MtCO_2eq$) | 63.5 | 15,921.0 | 63.3 | 16,138.0 |
| Food system GHG emissions (% of total GHG emissions) | 73.5 | 32.7 | 72.0 | 31.0 |

Source: FAOSTAT. https://www.fao.org/faostat/en/#data/GT (accessed 27 January 2023)

**Table 2. GHG emissions from the food system in Kenya**

| Kenya's food system emissions | 2010 GHG emissions ($Mt\ CO_2eq$) | 2020 GHG emissions ($Mt\ CO_2eq$) | % of total emissions (2020) | % change 2010–2020 |
|---|---|---|---|---|
| Land-use change | 15.0 | 0 | 0 | -100 |
| Farmgate | 43.1 | 55.1 | 87 | 28 |
| Pre- and post-production | 7.3 | 8.2 | 13 | 12 |
| Food system (total) | 65.3 | 63.3 | 100 | -3 |

Source: FAOSTAT. https://www.fao.org/faostat/en/#data/GT (accessed 20 January 2023). Food system corresponds to FAOSTAT's term "agrifood system".

Kenya's livestock is the main contributor to total food system's emissions. Overall rangeland area has remained stable over the past decade (2010–2020); and although beef and buffalo meat production almost halved in this timeframe, sheep and goat meat production have risen (+82%). Milk production, the most produced animal product in Kenya, increased by 13%.

Overall emissions from enteric fermentation increased by 27%. Kenya's livestock sector is expected to grow exponentially over the next three decades in response to the increased demand for animal-source foods, due to population rise and economic growth. Consequently, associated GHG emissions will likely also increase.

The second largest food system emissions source in Kenya is manure management.[3] While manure has many benefits for crop production, it can also pose environmental challenges depending on how it is processed, and how and when it is applied to land. GHG emissions from manure are classified under three subcategories in FAOSTAT: manure management; manure left on pasture; and manure applied to soils. Together, these three activities contribute 27% of food system emissions in Kenya (Martius et al. 2023).

The third largest food system emissions source in Kenya is food system waste disposal (11%).[4] However, beyond end-of-life emissions produced during waste management and disposal, GHG are also emitted during the production, processing and distribution of food that then becomes lost (along the food supply chain) and wasted (at retail and consumption stages). Food loss and waste thus hold important potential for mitigation; however, the extent of this potential is currently difficult to quantify precisely due to a lack of primary data (FAO 2019; Axmann et al. 2022).

## How to address these emissions effectively?

Climate change policy traditionally focuses on the land-use and production segments (i.e., on agriculture and land-use change) which account for the largest share of food system emissions by far. In Kenya, livestock production (enteric fermentation and manure management) are at the top of food system emissions.

However, despite their relatively smaller scale, it is crucial not to ignore emissions occurring beyond farmgate, from pre- and post-production activities. Addressing these

3 Manure management is the process in which animal excretion is captured, stored, treated and used.

4 This item covers: (1) solid food waste disposed in landfills; (2) domestic wastewater; (3) industrial wastewater; and (4) incineration of materials used in food systems (Karl and Tubiello 2021).

emissions through climate action may prove to be more cost-efficient, politically acceptable and socially feasible. These actions could involve mitigation options that are technically, economically and politically more viable than interventions targeting larger emissions sources connected to livestock production and manure management. They may also encounter fewer barriers to entry, and require less complex solutions than, for example, the mastery of the intricate processes characterizing good animal husbandry. Consequently, these measures could probably be developed and implemented more easily, with easier training of individuals. In essence, adopting a comprehensive approach to emissions reduction should mean considering not only the magnitude of emissions, but also cost-efficiency and the political, social and institutional accessibility of diverse pathways towards low-emission food systems. This is often referred to as 'political economy' (focusing on political institutions, policies, their power and interactions).

Reducing emissions from the three main sources identified above could make a substantial contribution to mitigation strategies in Kenya, while presenting multiple co-benefits for farmers, consumers and the environment:

i. **Livestock management** mitigation strategies include: improving feed quality, optimizing animal nutrition and reducing herd sizes. These strategies could not only reduce emissions but also improve animal health and productivity.
ii. **Manure management** mitigation strategies include: anaerobic digestion, composting and sustainable use of manure instead of synthetic fertilizers. Such strategies could reduce emissions while also improving soil health, providing clean and renewable energy, and reducing fertilizer costs.
iii. **Food loss and waste** mitigation strategies include: improved storage, preservation and processing; composting food waste; and using food waste for animal feed. These strategies could reduce emissions, save money for producers and consumers, and reduce food insecurity. Technological, institutional and organizational innovations can help improve energy- and resource-use efficiency at all stages of the food value chain.

Enhancing carbon sinks has also been identified as a priority in Kenya's Nationally Determined Contribution (NDC; Ministry of Environment and Forestry 2020). To do so, Kenya aims to:

iv. **Reduce deforestation, restore forest on degraded lands and increase in forest cover and agroforestry:** Reducing deforestation and forest degradation is achieved by rehabilitating and protecting areas of natural forests, including mangroves. Afforestation, reforestation and agroforestry, as well as the restoration of areas of forests on degraded landscapes (like arid and semi-arid lands or rangelands) have great mitigation potential.

Promoting these emission reduction pathways will require effective policy formulation, financial incentives, education and capacity building, technical and organizational innovations, and strong governance mechanisms that involve multiple actors, sectors and scales.

Mitigation actions in the livestock sector are very important due to the major share livestock emissions have in Kenya's food system emissions. Through two Nationally Appropriate Mitigation Actions (NAMAs) – for the dairy subsector and for solid waste management – Kenya has supported key efforts to measure subsector-related GHG emissions and implement adequate mitigation actions (Government of Kenya 2018). Kenya also supports the research and development of new technologies and practices to reduce emissions from all food system subsectors.

However, one significant obstacle hampering progress in pursuing these four pathways is the substantial data gap that exists; numerous sectoral emissions have yet to be adequately quantified, and we are missing information on their economic costs as well as on the social costs of implementation. FAOSTAT data relies on national reporting, but many countries lack capacity to comprehensively collect, for example, food loss and waste data (Heike Axmann, personal communication 2023). Therefore, it is essential to prioritize greater transparency regarding the methodologies employed and to make increased efforts towards direct primary data collection. This is crucial for effectively preparing and designing climate action strategies based on reliable evidence.

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## References

Axmann H, Guo X, Kok M, Broeze J, Víquez-Zamora M and Soethoudt H. 2022. *Food loss and waste country profile for Kenya: Estimates of food loss and waste, associated GHG emissions and nutritional losses.* CGIAR and Wageningen Food and Biobased Research. https://hdl.handle.net/10568/127172

Babiker M, Berndes G, Blok K, Cohen B, Cowie A, Geden O, Ginzburg V, Leip A, Smith P, Sugiyama M and Yamba F. 2022. Cross-sectoral perspectives. ***In*** Shukla PR, Skea J, Slade R, Al Khourdajie A, van Diemen R, McCollum D, Pathak M, Some S, Vyas P, Fradera R, et al., eds. *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, UK and New York: Cambridge University Press. https://doi.org/10.1017/9781009157926.005

FAO (Food and Agriculture Organization of the United Nations). 2019. *The state of food and agriculture 2019: Moving forward on food loss and waste reduction*. Rome. https://www.fao.org/3/ca6030en/ca6030en.pdf

Government of Kenya. 2018. *National Climate Change Action Plan (Kenya): 2018–2022*. Volume 3: Mitigation Technical Analysis Report. Nairobi: Ministry of Environment and Forestry. Accessed 10 July 2023. https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/10/8737_vol3.pdf

HLPE (High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security). 2014. *Food losses and waste in the context of sustainable food systems*. Rome: High-Level Panel of Experts on Food Security and Nutrition. https://www.fao.org/3/i3901e/i3901e.pdf

Karl K and Tubiello FN. 2021. *Methods for estimating greenhouse gas emissions from food systems. Part II: waste disposal*. FAO Statistics Working Paper 21–28. Rome: FAO. https://www.fao.org/3/cb7028en/cb7028en.pdf

Martius C, Guérin L, Pingault N, Mwambo F, Wassmann R, Cramer L and Shikuku K. 2023. Food systems emissions in Kenya and their reduction potential: A country profile. Occasional Paper 7. Bogor, Indonesia: Center for International Forestry Research (CIFOR); and Nairobi, Kenya: World Agroforestry (ICRAF). https://doi.org/10.17528/cifor-icraf/008997

Ministry of Environment and Forestry. 2020. *Kenya's Updated Nationally Determined Contribution*. United Nations Convention on Climate Change (UNFCCC). https://unfccc.int/sites/default/files/NDC/2022-06/Kenya%27s%20First%20%20NDC%20%28updated%20version%29.pdf