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

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Key messages

- The food system in Colombia contributes a significant proportion (62%) of total anthropogenic greenhouse gas (GHG) emissions, which is twice the global average (31%).
- The three primary sources of emissions in Colombia's food system, ranked in decreasing order of importance, are: (i) net forest conversion, accounting for 45% of total food system emissions; (ii) livestock management, including enteric fermentation and manure management (35% of emissions); and (iii) food system waste disposal (6% of emissions). Mitigation strategies in Colombia's food system should prioritize reducing emissions from these sources, and continue and expand actions to increase forest-related carbon sinks.
- Beyond-farmgate emissions, which represent a significant (13%) and growing share of total food system emissions, can be effectively reduced through improved energy efficiency and minimized food waste across food value chains, minimizing food waste in consumer households, and enhancing value chain integration, such as biomass management.
- Effective climate action planning should not only consider the size of sectoral emissions but also consider the cost and feasibility (referred to as the 'political economy') of implementing transformative measures. More data collection is needed to support this approach.
- 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 the efficient and effective implementation of Colombia'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 transformed, lowering their emissions while continuing to produce sufficient, nutritious and healthy food.

Food system emissions in Colombia

Overall, Colombia's food system emissions have remained stable over the past decade (2010–2020), at around 183 $MtCO_2eq$. Although their relative importance has decreased since 2010 following broader economy-wide development trends, in 2020 these food system emissions still represented 62% of total national emissions – twice the world average (31%) (Table 1). Addressing food system emissions is therefore of paramount importance to achieving Colombia's climate goals.

Colombia's food system emissions divide into three main categories (Table 2): (i) emissions from land-use change (83 $MtCO_2eq$ in 2020); (ii) farmgate emissions (77 $MtCO_2eq$); and (iii) emissions beyond the farmgate, from pre- and post-production activities (23 $MtCO_2eq$).[2] This corresponds to 45%, 42% and 13% of Colombia's food system emissions, respectively.

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2 The term 'farmgate emissions' refers to the greenhouse gas emissions produced directly from agricultural activities at the farm level. This includes emissions, e.g., from livestock, manure management, fertilizer use, rice production, and fuel combustion in agricultural machinery. The term 'beyond-farmgate emissions' refers to food system related emissions occurring in the various stages of the agricultural value chain, such as transportation, processing, packaging, and distribution of agricultural products, or emissions from the manufacturing and use of agricultural inputs such as seeds, fertilizers and pesticides.

Table 1. Annual greenhouse gas emissions from food systems in Colombia

GHG emissions	2010		2020	
	Colombia	World	Colombia	World
Food systems GHG emissions ($MtCO_2eq$/year)	182.7	15,921	183.0	16,138
Food systems GHG emissions (% of total GHG emissions)	68.7%	32.7%	62.3%	31.0%

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

Table 2. GHG emissions from the food system in Colombia

Colombia's food system emissions	2010 GHG emissions (Mt CO_2eq/year)	2020 GHG emissions (Mt CO_2eq/year)	% of total emissions (2020)	% change 2010–2020
Land-use change	88.8	82.9	45	-7
Farmgate	72.4	76.7	42	6
Pre- and post-production	21.6	23.5	13	9
Food system (total)	182.7	183.0	100	0

Note: Food system corresponds to FAOSTAT's term "agrifood system".

Source: FAOSTAT. Accessed 20 January 2023. https://www.fao.org/faostat/en/#data/GT.

Colombia's forests are a critical carbon sink and provide important ecosystem services such as water regulation, biodiversity conservation and soil protection. Over the past decade (2010–2020), cropland area (i.e. arable land and permanent crops) expanded rapidly from 3.3 to 8.7 million ha, at the expense of forests and other natural ecosystems, making net forest conversion the largest driver of food system emissions in Colombia. Land-use change emissions in Colombia represent 45% of food system emissions.

The second largest food systems emission source in Colombia – and the largest emission source within the farmgate category – comes from a combination of two factors connected to livestock production: enteric fermentation in the digestive systems of ruminants such as cows, sheep and goats, and manure management on rangelands. Together, these see the livestock sector contributing 33% of food system emissions in Colombia (Martius et al. 2023).

The third largest food system emission source in Colombia is food system waste disposal (6%). This refers to both waste (the decrease in quantities at production stage), and loss (the decrease in quantities through retail, food service provision and consumption) (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, by far, for the largest share of food system emissions: in Colombia, these are forest conversion and livestock production.

However, despite their relatively smaller scale, it is crucial not to ignore emissions occurring beyond the farmgate, which include pre- and post-production activities. Addressing these 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 the large emissions sources connected to land-use change and livestock production. They may also encounter fewer barriers to entry, and require less complex solutions than, for example, mechanisms like REDD+ or the intricate processes characterizing good animal husbandry. Consequently, these measures can be developed and implemented more easily, with easier training of individuals. In essence, adopting a comprehensive approach to emission reduction should mean considering not only the magnitude of emissions, but also the cost efficiency, and political, social, and institutional accessibility of pathways towards achieving efficient and effective transformation of food systems. This latter aspect is often referred to as political economy (focusing on the interaction of political institutions, policies, and power).

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

- **Net forest conversion:** Colombia can significantly enhance its natural carbon sinks by promoting more sustainable land management practices that reduce deforestation rates, reforestation, and forest restoration. Pushing sustainable land-use practices such as agroforestry and silvopastoral systems can also help sequester carbon in agricultural lands, improve soil health and hinder further carbon losses from the conversion of soils.

Cattle farming, a major driver of deforestation in Brazil.
Photo by Kate Evans/CIFOR

- **Livestock management:** Strategies to reduce emissions from livestock production include improving feed quality, optimizing animal nutrition, and reducing herd sizes. These strategies reduce emissions while also improving animal health and productivity. Manure management strategies (e.g., anaerobic digestion, composting and sustainable use of manure instead of synthetic fertilizers) can reduce emissions while also improving soil health, providing clean and renewable energy, and reducing fertilizer costs.
- **Food loss and waste:** Reducing food loss and waste reduces not only emissions linked to production, processing and distribution, but also those from the management and disposal of food that is lost or wasted along the supply chain. Strategies such as reducing food waste through improved storage, preservation and processing, composting food waste, and using food waste for animal feed, can reduce emissions while also saving money for consumers and reducing food insecurity. Technological, institutional, and organizational innovations can help improve energy- and resource-use efficiency at all stages of the food value chain.

Promoting these emission reduction pathways will require effective policy formulation, financial incentives, education and capacity building, technical and organizational innovations, and strong governance mechanisms involving multiple actors, sectors and scales. Colombia already supports the research and development of new technologies and practices to reduce emissions from all subsectors of the food system, and can collaborate with the Mitigate+ programme to strengthen emission reduction in food systems.

A significant obstacle that hampers progress in pursuing these pathways is the substantial data gap that exists. A considerable number of sectoral emissions have yet to be adequately quantified. The data available in FAOSTAT relies on national reporting, and there may be limited quantification of food loss and waste data, especially in countries lacking the capacity to comprehensively collect such information (Heike Axmann, personal communication 2023). Therefore, it is essential to prioritize greater transparency regarding the methodologies employed and to make increased efforts towards direct data collection. This is crucial for effectively preparing and designing climate action strategies based on reliable evidence.

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