POLICYBRIEF

Decarbonizing Food Systems through International Food Trade and Post-production Management

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Highlights

Food systems significantly impact the environment, contributing 23-42% of global greenhouse gas (GHG) emissions. The top ten economies with the highest GHG emissions from food systems include nine G20 countries, highlighting the need for these nations to implement effective climate change mitigation strategies. However, climate change mitigation measures have predominantly focused on agricultural production stages, with insufficient attention to post-production and imported food emissions.

Recommendations:
• Raise awareness of carbon footprints in the global food system and enhance scientific knowledge to support action on the issue.
• Promote evidence-based measures to reduce carbon footprints in post-production and imported food.
• Establish a comprehensive international assessment and reporting mechanism.
• Formulate international collaboration and policy integration and coordination.

Greenhouse Gas Emissions from Food Systems

Food systems have an important role in advancing progress on the SDGs. At the same time, they adversely affect the environment by generating a significant amount of greenhouse gases (GHGs) — accounting for 23-42% of global GHG emissions (IPCC 2022). Crippa et al. (2021) estimated that GHG emissions from the global food system amounted to 18 billion tons of carbon dioxide (CO_2) in 2015, representing 34% of total GHG emissions. Within the global food system, the largest contribution (71%) was from agriculture, forestry and other land use (AFOLU) activities (mainly methane and nitrous oxide emissions from agriculture, and CO_2 from forestry), while the remaining emissions (29%) were from supply chain activities — including processing, transport, packaging, retail, consumption and end-of-life stages. Significantly reducing GHG emissions in food systems is essential to achieve net-zero emissions globally, alongside climate change mitigation through energy decarbonization.

In 2023, Think7 — the official think tank engagement group of the Group of Seven (G7) countries — recommended that the G7 and the Group of 20 (G20) countries promote the just transition of energy and food systems through a systemic approach, not only through efforts in individual sectors

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(Matsushita et al. 2023). According to the EDGAR-FOOD food emission database, nine of the ten economies with the highest GHG emissions from food systems belong to the G20 (Crippa et al. 2021).

Against this backdrop, this policy brief examines climate change mitigation policies and measures in food systems implemented by the G20 countries. It identifies challenges and provides practical approaches for both developed and developing countries, particularly those of the G20, to achieve carbon neutrality in food systems.

The Carbon Footprint of International Food Trade

The top ten economies with the highest GHG emissions from food systems include nine G20 countries: China (13.5% of food system emissions), Indonesia (8.8%), the United States (US) (8.2%), Brazil (7.4%), the European Union (EU) (6.7%), India (6.3%), Russia (2.6%), Canada (2.1%) and Argentina (1.8%). In contrast, the food system emissions of the remaining G20 countries are relatively low: Mexico (1.3%), Japan (1.2%), Australia (1.1%), Turkey (0.7%), South Africa (0.6%) and Saudi Arabia (0.4%). This is partly because the statistics do not reflect the carbon footprints of imported food products. For instance, Japan has a low food self-sufficiency rate, importing a significant amount of staple food and meat from Brazil and the US — where GHG emissions amounting to billions of tons are generated by the production of food for export. In other words, even though Brazilian food products are consumed in Japan, the emissions of those products are not attributed to Japan under the framework of the Paris Agreement on climate change.

As a result, the statistics show that, in industrialized countries, the emissions of the land-based sector are lower than those of downstream energy-related sectors (53%), which include industry and waste (IPCC 2022). In contrast, the AFOLU sector accounts for the most emissions (73%) in developing countries (IPCC 2022). Therefore, this inflates the responsibility placed on food-exporting countries to reduce GHG emissions — many of which are developing economies.

Post-Production Emissions

Food-importing countries tend to manifest higher GHG emissions from post-production activities than production (EDGAR-FOOD). For instance, in Japan, the food production stage accounted for 32% (67 million tons CO2) of the total food emissions, while more than two-thirds (68%) of emissions were from the post-production stage, including retail (25%)

and packaging (14%). Globally, post-production emissions account for 29% of food emissions (Crippa et al. 2021).

However, climate change mitigation measures related to the post-production stage of the food supply chain are currently limited in volume and variety. For instance, in their latest Biennial Reports and Biennial Update Reports, G20 countries primarily discuss measures for reducing GHGs in the AFOLU sector, focusing on production stages (UNFCCC 2024a, 2024b). They contain little information on specific measures for other stages of the food supply chain, such as transport, packaging, retail, and consumption. Addressing these gaps is crucial for comprehensive climate change mitigation efforts.

Policy Recommendations

1. Raise awareness of carbon footprints in the global food system and enhance scientific knowledge to support action on the issue.
Due to the lack of recognition of international trade of food products under the Paris Agreement framework and the little attention paid to post-production emissions, there is insufficient awareness among policymakers and other stakeholders. Similarly, scientific knowledge on the topic is lacking. Moreover, significant variations in estimates of GHG emissions produced by food systems are mainly due to differences in the scope of estimations, including (i) stages of the supply chain, (ii) the inclusion of non-agricultural products, and (iii) the inclusion of emissions from deforestation and land use change, which accounted for the largest variations in GHG emission estimates (IPCC 2022; Ritchie 2021).

Thus, the scientific community should play a key role in raising awareness among governments and stakeholders on GHG emissions in food systems, and provide robust data to inform practical action at the national and international levels. Specifically, scientists can enhance knowledge of GHG emissions through life-cycle assessment, identifying the amount of food-relevant GHG emissions in each production stage up to end-of-life (post-production). For instance, Tubiello et al. (2021) proposed methods for estimating GHG emissions in five categories of energy use in agri-food systems: (i) fertilizer manufacturing, (ii) food processing, (iii) packaging, (iv) retail and (v) household consumption. There are also studies addressing emissions from specific stages, such as food transport (Karl and Tubiello 2021a), waste disposal (Karl & Tubiello 2021b) and on-farm energy use (Flammini et al. 2021).

2. Promote evidence-based measures to reduce carbon footprints in post-production and imported food.

The IPCC (2022) estimates that socio-cultural change — such as shifting to balanced and sustainable diets and avoiding food waste — has the potential to reduce global direct emissions by 1.9 billion tons of CO_2-equivalent. Good practices at the national and local levels should be compiled to enhance evidence-based measures by governments and other stakeholders to reduce carbon footprints both in food system post-production and for imported food products. Moreover, policymakers should implement education and awareness campaigns to inform consumers about the environmental impact of food choices and encourage behaviour change towards more sustainable consumption patterns through visualization of carbon footprints and food mileage. This includes promoting plant-based diets and nutritional diversity in aquatic food (von Bruan 2023), reducing food waste and selecting locally produced and seasonal foods to minimize emissions associated with transportation and storage.

There are many examples of good practices at the local level for climate change mitigation through supply chain management. Paris set a 50% sustainable food goal for all school lunches by 2020 under the Paris Sustainable Food Plan 2015–2020 (Mairie de Paris 2015). To achieve this goal, public school management organizations in Paris offer at least one organic or certified food or vegetarian meal each week. During 2018–2020, more than half of the organizations managing public school meals adopted the "Mon Restau Responsable" approach, implementing environmentally and socially responsible practices, such as sourcing from local, organic and sustainable producers, and encouraging food waste minimization through better inventory management, portion control and recycling. As a result, a 30% reduction in the carbon footprint of school lunches has been observed (Shirai, Takemoto & Maruyama 2023). In 2022, the Lifelong Learning Bureau of Seoul Metropolitan Government (SMG) (2023) launched the Eco-Friendly Free School Meal Program (FSMP), which promotes environmentally sustainable and safe food production, processing and distribution processes (Lifelong Learning Bureau of Seoul Metropolitan Government 2023). Through collaboration with local producers, SMG also promotes educational programs and initiatives designed to teach individuals, communities and organizations about sustainable food practices.

3. Establish a comprehensive international assessment and reporting mechanism.

Considering the significant impacts on GHG emissions in food systems, integrated measures are needed across sectors, including agriculture and forestry, manufacturing (e.g., food processing), wholesale and retail trade, transportation and storage, waste management and final consumption. Governments, particularly those of the G20, should implement a comprehensive international mechanism for assessment and reporting of GHG emissions from food systems, which includes both production and post-production stages. The mechanism should be standardized and integrated into national reporting frameworks, such as Nationally Determined Contributions (NDCs) and Biennial Transparency Reports, under the United Nations Framework Convention on Climate Change (UNFCCC), ensuring that emissions from all stages of the food supply chain are accurately measured and reported.

Some countries have incorporated climate mitigation actions in their food strategies that are synergized with their efforts on the SDGs. For instance, France promoted a low-carbon agricultural transition through its National Low Carbon Strategy, which included measures to decarbonize energy production, increase carbon storage and shift food consumption patterns. It also advocated measures in the post-production stage under the EGAlim legislation of 2018, supporting organic production systems by establishing a minimum share of quality and sustainable products served in public catering by January 2022 (Ministry of Agriculture and Food, France 2019). Another example is the food strategy under formulation by the United Kingdom, which supports the delivery of commitments on net zero, nature recovery and biodiversity. It aims to create food systems that incentivize farmers to produce high-quality, high-welfare food most sustainably and commit to eliminating food waste to landfills, which will reduce carbon emissions and meet the SDG 12.3 target of halving food waste by 2030.

4. Develop international collaboration through policy integration and coordination.

The G20 governments should strengthen international collaboration to address the challenges of GHG emissions from food systems and reduce the excessive burden of GHG emission reductions on developing economies, which tend to be food exporters. This could involve establishing bilateral or multilateral agreements between developed and developing economies to reduce emissions from food production and trade. For example, the Emirates Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action, which was adopted at UNFCCC COP28, is a multilateral commitment endorsed by more than 150 countries to integrate agricultural and food systems into climate action — including through the integration of agricultural and food systems into NDCs and other national plans submitted under UN conventions (UNFCCC 2024c).

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