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Vietnam's transition to low-emission food systems

2025 country profile – 2nd Edition

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Summary

Food systems comprise 'all the 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 activities, including socio-economic and environmental outcomes' (HLPE 2014). This means the food system goes beyond land use to include the whole food value chain, from production and processing to preparation, consumption and disposal.

According to the latest IPCC assessment, the global food system is responsible for 23 to 42% of total net anthropogenic emissions (Babiker et al. 2022). This share is expected to increase in future, driven by the increasing needs of a growing population and by intentions, expressed in many global and national policy contexts, for progressive decarbonization of the other economic sectors. Without rapid and radical transformations in food systems, the Paris Agreement targets will therefore remain out of reach.

Following IPCC (2006) guidelines, data on greenhouse gas (GHG) emissions are generally collected and analysed across five economic sectors, namely: (i) Energy; (ii) Industrial Processes and Product Use (IPPU); (iii) Agriculture; (iv) Land Use Land Use Change and Forestry (LULUCF);¹ and (v) Waste. Hence, food system emissions, spanning across all these sectors, are not easy to identify and estimate. As a result, a sufficiently accurate and comprehensive overview of food system emissions at national level is still lacking.

This paper is a revised and expanded version of a previously published country profile of food systems emissions in Vietnam (Martius et al. 2023b). It provides an updated description of food system related GHG emissions in Vietnam. It successively examines land use, production from agriculture, fisheries and aquaculture, national food supply, diets and food systems emissions. It describes emissions in Vietnam's food systems, and identifies possible pathways to reduce emissions and achieve low-emissions development for Vietnam, by taking a food systems view. So far this analysis has mainly been based on FAO data.²

According to FAOSTAT, in absolute levels, Vietnam's food system emissions have increased over the past decade (from 113.7 to 149.6 MtCO₂eq/year between 2012 and 2022), while their share of national emissions has decreased (from 44.8% to 31.9%). In 2022, the largest emission sources generated from the food system were, by decreasing order of importance: rice cultivation (23.4% of total food system emissions); livestock emissions related to enteric fermentation and manure management (16.7%); food household consumption (12.7%); food processing (10.1%); synthetic fertilizers, manufacturing and application (10.0%); and food system waste disposal (5.8%). Together, these sources emitted 117.8 MtCO₂eq in 2022 and accounted for 78.8% of all food system emissions.

Based on this analysis, the following priorities for action emerge when considering how to reduce food system emissions in Vietnam: (i) reducing emissions from rice production;

¹ In some national inventories, following previous IPCC guidelines, Agriculture and LULUCF are merged into one unique sector called Agriculture, Forestry and Other Land Use (AFOLU).

² See <https://www.fao.org/faostat/en/#home>. In Section 1 we explain the use of FAO data. This paper is part of a series of papers analyzing various countries; using the same data source for country statistics was essential to take a comparative approach.

(ii) reducing livestock emissions related to enteric fermentation and manure management; (iii) reducing emissions from synthetic fertilizer production and use; (iv) improving the data situation to understand and pinpoint focus areas; and addressing emissions from food household consumption and food loss and waste (FLW).

In its latest Nationally Determined Contribution (NDC), Vietnam identifies the forestry and other land use (FOLU) sector as a national priority for climate change mitigation, highlighting its unique role as the only sector with negative net emissions – meaning the sector served as a carbon sink (Socialist Republic of Vietnam 2022). In the latest draft of NDC 3.0, the government reiterates its commitment to balancing economic growth with

emissions reduction, although the government's new focus on accelerating economic development is seen as a significant challenge to achieving this balance. Compared with 2022, national stakeholders now demonstrate a much greater understanding of the food system, not only as a key source of emissions, but also as a critical focus for mitigation actions – reflecting a notable shift in awareness and policy discourse.

In addition, to be able to identify and pursue so far overlooked options for climate actions, more comprehensive national data are needed on fisheries and aquaculture, an important sector for food production in Vietnam, as well as on food loss and waste (FLW) and household consumption.

1 Introduction: Food systems and their global emissions

The global food system provides critical food security and income to millions on the planet. The term ‘food system’ refers to the complex network of activities, processes and actors involved in producing, processing, distributing and consuming food.³ It encompasses all aspects of food production and consumption; from the supply of farming inputs like fertilizers, seeds and machinery; to the growing and harvesting of crops, livestock, fisheries and aquaculture; the packaging, transportation and sale of food products; as well as the preparation, consumption and disposal of food by individuals and communities. The food system also includes all the social, economic and environmental factors that influence food production and consumption, such as land use, labour practices, food policies and cultural preferences.

Annually, the global food system moves USD 7–8 trillion (EcoNexus and Berne Declaration 2013). Yet, it also generates externalities estimated at around USD 12 trillion annually (Nature 2019). Some of these externalities are worrying: some 33% of soils globally are degraded (FAO and ITPS 2015), with 52% of agricultural land affected by soil degradation; some 20% of the world’s aquifers are at risk of running dry (Jasechko and Perrone 2021); 34% of the world’s fishery stocks are over-depleted (FAO 2020); and agriculture is identified as a threat to 86% of species at risk of extinction (Benton et al. 2021).

Importantly, the global food system also generates substantial greenhouse gas (GHG) emissions. In 2018, according to the latest

assessment by the Intergovernmental Panel on Climate Change (IPCC) (Babiker et al. 2022), the global food system was responsible for emissions of 17 GtCO₂eq – that is 31% (accounting for a range of 23% to 42%) of the total global net anthropogenic emissions estimated at 54 GtCO₂eq. Agriculture, consisting of crop and livestock production, accounts for the largest part of these emissions at 6.3 GtCO₂eq/year, or 37% of food system emissions, and 12% of global emissions.⁴ This is followed by land use, land-use change and forestry (LULUCF, 24% of food system emissions), energy use (23%), waste management (10%), and industrial processes in the food industry (5%) (Babiker et al. 2022; see also Table 1).

LULUCF emissions are as high as emissions from energy use across the food supply chain, including electricity, heat and refrigeration. These sources are followed in size by waste management (food waste, wastewater and packaging waste) and the relatively low emissions of industrial processes in food systems. The latter, as well as transport emissions, comprises a large share of emissions related to refrigeration (Babiker et al. 2022).

It is worth noting however that when the last three GHG sources (energy use, waste management and industrial use) of the food system are taken together – arguably a good representation of pre- and post-farm activities – their joint emissions amount to

3 By the definition of the High-Level Panel of Experts on Food Security and Nutrition (HLPE 2014), a food system combines “all the 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 activities, including socio-economic and environmental outcomes”.

4 By another estimate, livestock (meat and dairy) directly and indirectly contributes 60% of global food system emissions (Pörtner et al. 2021). This value includes emissions from related land-use changes; feed production; enteric fermentation (digestion) in cattle, sheep and goats; manure management, processing and transportation of animal products; as well as waste management. Unlike the emissions from livestock within agriculture in Babiker et al. (2022), this estimate includes on- and off-farm activities along the whole value chain. This supports the role of the pre- and post-farm activities.

Table 1. Global greenhouse gas emissions and food system emissions overview

Sector	Subsector	Emissions (GtCO ₂ e/year)	Percent of total emissions	Percent of food system emissions	Range of global GHG emissions			
					in GtCO ₂ e/year		in percentage	
					Low	High	Low	High
Food system		17	31.5	100	13	23	23	42
	Agriculture (livestock and crop production)	6.3	11.7	37.1	2.6	11.9	5	22
	Land use, land use change and forestry (LULUCF)	4	7.4	23.5	2.1	5.9	4	11
	Energy use	3.9	7.2	22.9	3.6	4.4	7	8
	Waste management	1.7	3.1	10	0.9	2.6	2	5
	Industrial processes and product use (IPPU)	0.9	1.7	5.3	0.6	1.1	1	2
	Combined total of energy, waste and IPPU	6.5	12	38.2	5.1	8.1	9	15
Total global emissions		54	100					

Source: Babiker et al. (2022)

6.5 GtCO₂e/year. This accounts for 12% of global emissions, on a par with agriculture, and over one third of food system emissions.

Reducing these emissions is critical to mitigating climate change. Collectively, global food system emissions – which account for 31% of overall global emissions – are on a par with the total GHG emissions of China (31% of global emissions in 2020), and well above total emissions from the United States (13.5%) (data from GCP 2021;⁵ FAOSTAT). ‘Making the food system healthy for people and the planet’ has been identified in a recent report for the Club of Rome (Dixon-Declève et al. 2022) as one of only five major ‘turnarounds’⁶ urgently needed to put the planet on a trajectory towards prosperity for all, while keeping resource use within the planetary boundaries.

National GHG inventories and Nationally Determined Contributions (NDCs) are usually structured around the five economic sectors

identified in IPCC (2006, 2019) guidelines.⁷

As such, food system emissions, spanning across all these sectors, are not easy to identify and estimate. As a result, a sufficiently accurate and comprehensive overview of food system emissions at national level, as well as a coherent and holistic approach to food systems in most NDCs, are still lacking. Analysis of food system emissions across diverse countries is further complicated by lack of data on activities, missing specific emission factors, data overlap, a lack of overview across food system emissions as a whole, and a lack of systematic data collection across the system.

In negotiations at the United Nations Framework Convention on Climate Change (UNFCCC), some Parties and actors expressed concern that addressing food system emissions could threaten food security and nutrition, particularly for the most vulnerable, poor and hunger-stricken sectors of populations. Given the significant share

⁵ See https://www.globalcarbonproject.org/carbonbudget/archive/2021/GCP_CarbonBudget_2021.pdf

⁶ The other turnarounds being poverty, equality, gender empowerment and energy.

⁷ These five sectors are (i) Energy; (ii) Industrial Processes and Product Use (IPPU); (iii) Agriculture; (iv) Land Use Land Use Change and Forestry (LULUCF); and (v) Waste. In some national inventories, following previous IPCC guidelines, Agriculture and LULUCF are merged in one unique sector called Agriculture, Forestry and Other Land Use (AFOLU).

of emissions generated from food systems, as well as the fact that climate change has started to affect all aspects of human life, including food production, this position should be carefully reconsidered based on data. Striving for more holistic, low-emission, resilient, fair and sustainable food systems that provide food and nutrition to all, and livelihoods to many, is key to ensuring a more sustainable future for the planet and for the people and biota living on it. Such an approach will also help reconcile mitigation of and adaptation to climate change – two objectives often treated separately in climate talks, yet inherently interlinked.

While food systems form the basis of food security and nutrition as well as provide meaningful livelihoods and socioeconomic benefits, they remain key contributors to climate change, soil degradation, freshwater depletion and biodiversity loss. We have enough scientific evidence, technical and human resources to advance low-emission and sustainable food systems, and finance streams need to be redirected towards this goal. However, important knowledge gaps remain: in most countries reliable national primary data are missing for critical food system components like food loss and waste (FLW); reliable indicators and monitoring, reporting and verification (MRV) systems are missing; and our understanding of complex systemic interactions and feedback loops is still insufficient. All this must be addressed through further research at different

scales (from global to regional, national and local). Viable, cost-efficient actions that provide multiple benefits should be prioritized.

To foster the development of low-emission food systems in line with the Paris Agreement without compromising food security and nutrition and livelihoods, it is vital that the knowledge and information that reflect national contexts, and that the tools required for evidence-based decision making become available to civil society, governmental, academic and private sector actors.

To advance on this goal, this document offers novel perspectives on so far neglected, yet promising pathways to emissions reduction, by taking a view across sectors that are normally separated in national GHG inventories and NDCs, but which together relate to the food system, using publicly available global datasets (mainly FAOSTAT).

This paper provides an updated description of food system related GHG emissions in Vietnam⁸. It successively examines land use, production from agriculture, fisheries and aquaculture, national food supply, diets and food systems emissions. It describes emissions in Vietnam's food systems based on FAOSTAT data,⁹ and identifies possible pathways to reduce emissions and achieve low-emissions development for Vietnam, by taking a holistic food systems view.

⁸ This paper is the second edition, revised and expanded, of a first analysis of food system emissions in Vietnam (Martius et al. 2023a) realized by CIFOR-ICRAF in collaboration with the Vietnam Forest Certification Office (VFCO), Flinders University of Adelaide (Australia) and WorldFish (Penang, Malaysia). Similar country profiles have been, or are being developed for other countries: China, Colombia, Kenya (respectively: Song et al. 2023; Martius et al. 2023a, 2023c), as well as Cameroon, Côte d'Ivoire, Ghana, and Guinea (forthcoming).

⁹ See <https://www.fao.org/faostat/en/#home>

2 Vietnam: The national context

Vietnam is one of the ten richest biodiversity centres in the world. Because of its long coastline (3,260 km) situated in the ‘typhoon belt’ of Southeast Asia, and because of its large and densely populated river deltas, Vietnam, and particularly its aquaculture sector, is highly vulnerable to climate change impacts such as floods, storms, cyclones, sea level rise, disease outbreaks or algal blooms (Barange et al. 2018; WBG/ADB 2021; Tran et al. 2022; Chu et al. 2023).

The country spans 331,340 km², including 313,429 km² of land area. Total population increased from 89.5 million people in 2012 to 99.6 million in 2022. The 100 million mark was exceeded in 2023 with 100.3 million people. Population growth is expected to continue over the next decades, reaching a peak around 2050 at about 110 million people, before it starts declining in the second half of the 21st century at around 91 million in 2100 (based on the UN medium fertility variant scenario (UNDESA 2024)).

Despite rapid and continuing urbanization trends over the last decade, with the share of urban population increasing from 31.8% in 2012 to 38.8% in 2022, Vietnam remains a predominantly rural country. Ho Chi Minh City is the largest city in Vietnam with a rapidly increasing population, from 6.6 million in 2012 it rose to 9.1 million in 2022 and is about to reach 10 million in 2026.¹⁰ Next come Ha Noi, the capital, with about 8 million inhabitants and Hai Phong (about 2 million).¹¹

These three urban areas are driving urban population growth in Vietnam, but their development also triggers territorial disparity within the country (OECD 2020). These dynamics create a demographic imbalance between rural and urban areas. Women migrants account for more than 52% of all migrants going to urban areas. Indeed 80% of all workers in the garments and electronics industries – two key sectors for Vietnam’s industrialization and exports – are women. As people migrate for employment, elderly mostly live in rural areas, widening social disparities in Vietnam. However, remittances from urban to rural areas contribute to the improvement of living standards for rural family members left behind (Vo 2021).

With a GDP of 408.8 billion current USD in 2022, Vietnam is the fourth largest economy in Southeast Asia after Indonesia (USD 1,319 billion), Thailand (USD 495 billion) and Singapore (467 billion).¹² Over the past decade, Vietnam experienced rapid economic development: the Gross National Income (GNI) per capita, calculated in current USD with the World Bank Atlas method, increased from 1,980 USD per capita in 2012 to 4,110 in 2023. As a result, Vietnam is now considered by the World Bank as a lower-middle income country.¹³ Economic growth has been driven by manufacturing exports, strong domestic consumption and improved foreign direct investments (FDI).¹⁴ The contribution of agriculture, forestry and fishery to national GDP continuously decreased over the past decade,

10 See <https://worldpopulationreview.com/cities/vietnam/ho-chi-minh-city>

11 See https://en.wikipedia.org/wiki/List_of_cities_in_Vietnam#Largest_cities_by_population (sourced from the 2019 Vietnam Population and Housing Census, In Vietnamese).

12 See FAOSTAT: <https://www.fao.org/faostat/en/#data/MK> (last update: 12 June 2024).

13 See the World Bank World Development Indicators (WDI) database: <https://databank.worldbank.org/reports.aspx?source=world-development-indicators#> (last update: 24 March 2025).

14 See <https://fulcrum.sg/vietnams-high-gdp-growth-rate-masks-its-economic-difficulties/>

from 16.2% in 2012 to 12.0% in 2022. Despite their declining importance in the national economy, agriculture, hunting, forestry and fishery still provide a large share of employment in Vietnam (33.5% in 2022 against 47.4% in 2012).¹⁵ Women represent 60% of the total labour force in the agriculture sector in Vietnam (World Bank 2021).

With a Human Development Index (HDI)¹⁶ value reaching 0.726 in 2022, Vietnam ranks 107 out of 193 countries and is classified within the 'High Human Development' group.¹⁷ This represents a significant improvement over the last decade from the 2012 HDI value of 0.684 (rank: 120). The mean number of years of schooling for adults aged 25 years and older was 8.5 years in 2022, while the expected number of years of schooling for children was 13.1 years and the life expectancy at birth was 74.6 years.

The country's economic development and improvements in living standards have mostly benefited the ethnic majority (i.e., the Kinh and Hoa peoples). A higher proportion of ethnic minorities live in poverty; while ethnic minorities account for just 14% of the total population, they represent up to 50% of the total poor population (Phung et al. 2016).

Women from ethnic minorities are further disadvantaged as they face greater social and economic inequalities, with lower education rates, child marriage and early childbirth contributing to high poverty amongst ethnic minority groups (World Bank 2022). Despite recent improvements, Vietnam continues to face significant problems with food security and chronic malnutrition among children, particularly in the uplands (Rocha et al. 2022).

Vietnam is currently undergoing a significant transitional phase marked by an ambitious government restructuring agenda. The reform seeks to enhance institutional efficiency and policy coherence in order to sustain economic growth and support the country's long-term vision of becoming a modern, high-income economy. A central component of this restructuring is the establishment of the Ministry of Agriculture and Environment (MAE), formed through the merger of the Ministry of Agriculture and Rural Development with the Ministry of Natural Resources and Environment in March 2025. This institutional integration is expected to have far-reaching implications for Vietnam's strategic direction in ensuring national food security and advancing a low-emission, climate-resilient development pathway.

¹⁵ See the World Bank WDI database.

¹⁶ HDI is a composite measure of three basic dimensions of human development: health (measured by life expectancy at birth), education (measured by years of schooling), and standard of living (measured by Gross National Income per capita). HDI ranges from 0 and 1. Maximum HDI value in 2019 was 0.957 for Norway; minimum HDI value in 2019 was 0.394 for Niger.

¹⁷ See <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI> (accessed on 3 April 2025).

3 Land use, agriculture and diets

3.1 Land use

According to FAOSTAT (Table 2), forest is the main land use¹⁸ in Vietnam in 2022, covering 47.2% of Vietnam's total land area. Naturally regenerating forests account for 69.8% of forestland. Forest area increased by 8.3% between 2012 and 2022, driven by a drastic expansion of planted forest area (+31.1%).

Agriculture, the second largest land use in Vietnam, covers 39.3% of the country's total land area. It is almost exclusively dedicated to cropland, which accounts for 94.8% of all agricultural land, while permanent meadows and pastures account for the remaining 5.2%. Agricultural land area increased by 14.1% between 2010 and 2020, mostly due to the increase in the area of permanent crops (+31.2%).

3.2 Agriculture

3.2.1 Agricultural inputs

According to FAOSTAT (Table 3), Vietnam currently uses significant amounts of agricultural fertilizers – nitrogen, phosphate and potash – about twice the world average per area of cropland in 2022. Vietnam's use of nitrogen fertilizers was already high in 2012 before it increased by another 48.8% over the last decade. By contrast, over the same period, agricultural uses of phosphate and potash respectively decreased by 6.5% and 16.9%. Interannual variability of fertilizer use may bias apparent trends, depending on the years chosen as start

and end points. That said, Figure 1 shows that these variations are inscribed in long-term increasing trends. Increases were particularly marked between 1982 and 2002 when nitrogen agricultural use was multiplied more than five-fold, while phosphate and potash uses were multiplied by more than 13.

This high use of fertilizers, however, translates into relatively high yields for the main crops compared to the world average, except for maize. In particular, rice yield in Vietnam increased from 5.6 to 6 t/ha between 2012 and 2022, against 4.7 t/ha for the world average in 2022.¹⁹

This high use of fertilizers is caused by various factors (including: excessive use of fertilizer beyond recommended levels, despite a shift to high-yield varieties; lack of education on proper fertilizer use, leading to incorrect timing of application; poor quality fertilizer products, contributing to significant waste of phosphate and potash in rice farming); and leads to overarching soil and water pollution (Nguyen 2017). Meanwhile, cropping intensity in Vietnam (i.e., the number of times a crop is planted per year across a given agricultural area) is among the highest in the world (Zhang et al. 2021), which contributes to explain these high fertilizer rates.

3.2.2 Harvested area for major crops

According to FAOSTAT (Table 4), Vietnam's cropland covered 37.2% of total surface land area in 2022, and 94.8% of total agricultural area. With 7 million ha (60.7% of total cropland area), rice is, by far, the most cultivated crop in Vietnam. Rice cultivated area in 2022 was 50% larger than the total area of the nine next most

¹⁸ Land use refers to the destination of the land, while land cover refers to the (bio)physical cover observed on the Earth's surface. For instance, after a clear cut, a forest remains a forest if its intended use does not change, even if the land cover has changed temporarily. Land-use changes include changes in land cover and changes in land management practices (FAO and ITPS 2015).

¹⁹ See FAOSTAT: <https://www.fao.org/faostat/en/#data/QCL> (last update: 27 February 2025)

Table 2. Land use in Vietnam (in 1000 ha)

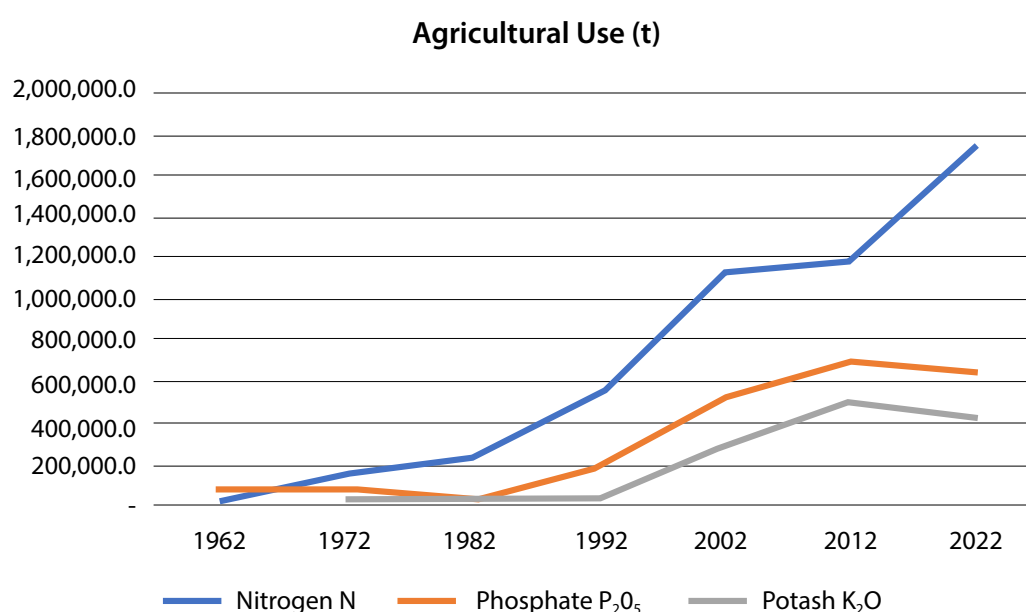
Land use in Vietnam	2012	2022
Land area	31,346	31,343
Agricultural land	10,793	12,315
Cropland	10,151	11,673
Arable land	6,401	6,754
Permanent crops	3,750	4,920
Permanent meadows and pastures	642	642
Forest land	13,658	14,795
Naturally regenerating forest	10,253	10,332
Planted forest	3,404	4,463
Other land	6,895	4,233

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/RL> (last update: 19 August 2024).

Table 3. Agricultural use of fertilizers in Vietnam over the last decade

Fertilizer use in agriculture	Vietnam				World average
	2012		2022		2022
	in metric tons	in kg/ha of cropland	in metric tons	in kg/ha of cropland	in kg/ha of cropland
Nitrogen N	1,185,980	116.2	1,764,702	151.2	65.4
Phosphate P ₂ O ₅	690,157	68.0	645,547	55.3	26.0
Potash K ₂ O	499,626	49.2	415,373	35.6	21.7

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/RFN> (last update: 11 March 2025)

**Figure 1. Agricultural use of fertilizers in Vietnam – long-term trends (1962–2022)**

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/RFN> (last update: 11 March 2025)

Table 4. Major crops harvested area in Vietnam (in ha)

Major crops and their harvested area	2012	2022
Rice	7,761,314	7,088,853
Other vegetables, fresh	705,619	885,940
Maize (corn)	1,156,102	885,435
Natural rubber	509,885	727,515
Coffee, green	572,600	655,921
Cassava, fresh	551,771	528,891
Total cropland	10,151,300	11,673,000

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/QCL> (last update: 27 February 2025).

Table 5. Animal products in Vietnam

Production	2012 (metric tons)	2022 (metric tons)	2012–2022 (%)
Pig meat on the bone, fresh or chilled	2,307,000	3,313,000	+57.5
Poultry (chicken and duck) meat	626,401	1,542,436	+146.2
Milk, total	425,193	1,184,738	+178.6
Eggs, primary	365,000	463,064	+26.9
Beef and buffalo meat, primary	210,300	331,200	+57.5
Sheep and goat meat	8,070	22,892	+183.7

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/QCL> (last update: 27 February 2025).

important crops. However, rice area decreased between 2012 and 2022, both in absolute terms (from 7.8 to 7.1 million ha) and in relative share of total cropland area (from 76.5% to 60.7%).

This shows a trend towards agricultural and nutritional diversification, illustrated by a decreasing consumption of rice and derived products from 245.1 to 228.1 kg/capita/year between 2012 and 2022.²⁰ While rice and maize areas decreased over this period, other major crops showed significant increases, confirming this diversification trend (Table 4). This trend is further supported by government policies promoting other crops and advising against triple rice cultivation (rice crops cultivated three times per year) as this aggravates climate change impacts. Indeed, triple rice cultivation requires irrigation during the dry season, including pumping groundwater. Combined with reduced river water flow, land subsidence and sea level rise, this aggravates salinity intrusion and droughts (Yuen et al. 2021).

3.2.3 Livestock

Animal-sourced food consumption increased sensibly in Vietnam over the last decade with protein supply from animal products increasing both in absolute terms (from to 32.9 to 39.3 g/capita/year between 2012 and 2022) as well as in proportion of the total protein supply (from to 37.8 to 39.9% over the same period).²¹ In this context, and in the context of increased exchanges (exports and imports) of animal products between Vietnam and international markets, all the major animal products in the country have experienced a sharp increase in production. With 3.3 million metric tons in 2022, pig meat, which has always been central in Vietnamese diet,²² remains by far the main animal product in Vietnam. However, as illustrated in Table 5, sheep and goat meat, milk and poultry experienced the sharpest increases in production between 2012 and 2022. This suggests

²¹ Ibid.

²⁰ See FAOSTAT Food Balance Sheets: <https://www.fao.org/faostat/en/#data/FBS> (last update: 19 July 2024).

²² See <https://e.vnexpress.net/news/travel/food-recipes/holy-hog-vietnam-s-culinary-love-affair-with-pigs-3582026.html>

that the diversification trend observed in crop production applies also in animal source food production and consumption.

3.2.4 Fisheries and aquaculture

According to FAOSTAT Food Balance Sheets,²³ with 70.8% of global production in 2022, Asia is by far the biggest producer of fish and seafood in the world. With around 35,000 fishing vessels over 90 hp²⁴ and 1.1 million ha of aquaculture area in 2020 (GSO 2021; Chu et al. 2023), Vietnam is a major actor in global fisheries and aquaculture. The country is the fourth biggest producer of fish and other aquatic plants and animals, just after China, Indonesia and India, with total production nearing 8.8 million metric tons in 2022, including 5.2 million metric tons from aquaculture, and 3.6 million metric tons from capture.²⁵ Since 2014, Vietnam has also been the third largest exporter of aquatic products, just after China and Norway, with the total value of exports reaching about USD 9 billion in 2021 (5% of the world total).²⁶ Vietnam exports seafood products to 164 countries, with major client markets including the United States, the European Union, Russia, Japan, China and South Korea.²⁷

The sector of fisheries and aquaculture is essential for the national economy in Vietnam, representing about 5% of national GDP in 2020 (World Bank 2021) and about 25% of the agricultural GDP in 2020.²⁸ The sector supports about 4.7 million direct and indirect jobs across the country. This is about 5% of the total national workforce, ten times more than the average 0.5% observed in OECD countries (World Bank 2021).

23 See FAOSTAT Food Balance Sheets: <https://www.fao.org/faostat/en/#data/FBS> (last update: 19 July 2024).

24 hp stands for horse power

25 See FishStat: https://www.fao.org/fishery/statistics-query/en/global_production/global_production_quantity (accessed on 4 April 2025).

26 See FishStatJ: <https://www.fao.org/fishery/en/statistics/software/fishstatj> (updated in July 2023)

27 See <https://www.globenewswire.com/en/news-release/2022/09/07/2511396/28124/en/Vietnam-Fisheries-Industry-Report-2022-Development-Environment-Supply-and-Demand-Imports-and-Exports-Market-Competition-Major-Enterprises-Outlook-to-2031.html>

28 Derived from data published by Vietnam's National Statistics Office (NSO). See, for example, <https://www.nso.gov.vn/en/data-and-statistics/2021/01/socio-economic-situation-in-the-fourth-quarter-and-the-whole-year-2020/>

Fisheries and aquaculture are an essential alternative source of livelihoods for small farmers, especially rice farmers, as well as rural communities. The sector represents the main source of income for about 4% of Vietnam's rural households; and for other households it offers additional opportunities to transition towards more efficient, resilient and sustainable agrifood systems (Chu et al. 2023). The sector ranks fifth in terms of export value, after telephone, textiles, electronics, and footwear (World Bank 2021) and accounts for almost 10% of national export value (GDC 2022; Chu et al. 2023).

Fisheries and aquaculture have experienced rapid development in Vietnam over the past two decades. Between 2000 and 2021, total captures more than doubled from 1.6 to 3.5 Mt, while aquaculture production increased almost tenfold, from 0.5 to 4.7 million metric tons. Since 2007, aquaculture production (in Mt) has exceeded total captures (FishStatJ). After centuries dominated by low-intensity traditional aquaculture practices, Vietnam has developed, since the 1960s, a more intensive and modern aquaculture sector. However, the real shift occurred after 2000, when farmers were encouraged by a Vietnamese government resolution²⁹ to convert low productivity saline rice fields, as well as uncultivated coastal areas and salt pans, into brackish-water ponds for aquaculture. This resolution encouraged public investments in infrastructure, as well as private investments in both production and processing facilities.

In terms of tonnage and export value, the two main aquatic species farmed in Vietnam are the striped catfish (*Pangasianodon hypophthalmus*) and brackish water shrimp (white-leg shrimp: *Penaeus vannamei*, and tiger shrimp: *Penaeus Monodon*). Ninety-five percent of catfish production and 80% of brackish water shrimp production are concentrated in the Mekong River Delta (GSO 2021; Le et al. 2022; Chu et al. 2023).

With almost 1.5 million metric tons in 2021, Vietnam is, by far, the main global producer of

29 Government of Vietnam, Resolution No.09/2000/NQ-CP of 15 June 2000. See <https://english.luatvietnam.vn/resolution-no-09-2000-nq-cp-of-june-15-2000-on-a-number-of-undertakings-and-policies-on-economic-restructuring-and-consumption-of-farm-produce-15-5356-doc1.html>

Table 6. Agricultural production value of different commodities in Vietnam (in current thousand USD)

Gross production value	2012	2022
Rice	13,091,040	13,285,071
Pig meat, on the bone, fresh or chilled	4,811,844	8,253,620
Chicken meat, fresh or chilled	2,225,136	5,878,520
Cassava, fresh	1,212,057	2,726,373
Coffee, green	2,100,832	1,181,270
Agriculture, total	36,803,700	51,628,327

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/QV> (last update: 3 February 2025)

striped catfish. India comes next with less than 0.7 million metric tons. Since 2000, striped catfish production in Vietnam increased nearly 15 times (FishStatJ). However, national catfish production covers a relatively small area of 5,800 ha, reflecting highly intensive production methods (D-Fish 2022; Cao et al. 2023). The catfish sector is estimated to generate about 100,000 jobs in the Mekong Delta alone (Nguyen and Jolly 2017), as well as a national export value of about USD 1.5 billion (FishStatJ).

With its white-leg shrimp production reaching almost 0.7 million metric tons in 2021, Vietnam lands in fifth position globally, after China, India, Ecuador and Indonesia. Since 2002, when it was first recorded, white-leg shrimp production in Vietnam has increased by almost 70 times. Giant tiger shrimp (*Penaeus monodon*) is the second most cultivated shrimp and prawn species in Vietnam, with a production of around 270,000 metric tons in 2021 (FishStatJ). Shrimp farming in Vietnam covers over almost 750,000 ha, i.e. around two-thirds of the total area devoted to aquaculture (D-Fish 2021; Cao et al. 2023).

Shrimp farming systems in Vietnam are very diverse, from super-intensive, intensive and semi-intensive, to improved extensive, shrimp-rice or shrimp-mangrove integrated systems (Cao et al. 2023; Chu et al. 2023). Shrimps and prawns are the first export commodity of the sector, with a total value of USD 3.8 billion in 2021³⁰ (FishStatJ). Vietnam's government plans to rapidly expand this sector and reach

USD 10 billion of shrimp and prawn exports by 2025.³¹

3.2.5 Value of agricultural production

Agricultural gross production value FAOSTAT data series have been revised since the first edition of this country profile in 2023. The analysis below is based on the new series.

Vietnam's agriculture gross production value increased by 40.3% between 2012 and 2022 (Table 6). Rice remains by far the main agricultural product in Vietnam in 2022, not only by area (Section 3.2.2) but also by value, generating 13.3 billion current USD. However, despite its comparatively stable added value, its relative share in Vietnam's agricultural gross production value decreased from 35.6% to 25.7% over the same period.

Rice is both an important food source and export commodity for Vietnam. Food security and rice export rank high on the government's agenda. Although the amount of rice exported decreased by about 2% compared to 2019, mainly to enhance domestic food security, its export value increased by 11%. This is due to the higher price per ton of rice, largely contributing to increased benefits for rice farmers^{32,33}. Rice cultivation

31 Government of Vietnam, Decision No. 79/QĐ-TTg of 18 January 2018. See <https://english.luatvietnam.vn/decision-no-79-qd-ttg-dated-january-18-2018-of-the-prime-minister-on-introducing-the-national-action-plan-on-development-of-vietnams-shrimp-indust-158292-doc1.html>

32 Vietnam Ministry of Industry and Trade <https://vioit.org.vn/en/strategy-policy/vietnam-s-rice-exports--opportunities-and-challenges-4404.4144.html#:~:text=Rice%20is%20both%20an%20important,%2D6.5%20million%20tons%2Fyear>

33 FFTC Agricultural Policy Platform: <https://ap.fttc.org.tw/article/1176>

30 i.e., over 40% of the national total export value of aquatic food in Vietnam.

Table 7. National supply of food, fat and protein for the main food groups in Vietnam (2022 values)

Main food groups	Vietnam		World	
	in value	% of total	in value	% of total
Total food supply (kcal/capita/day)	3,072	100	2,985	100
Animal products , including meat	482	15.7	525	17.6
Meat only	293	9.5	210	7.0
Vegetal products , including cereals (excluding beer)	2,590	84.3	2,460	82.4
Cereals only (excluding beer)	1,616	52.6	1,279	42.8
Total fat supply (g/capita/day)	67.3	100	87.3	100
Animal products , including meat	33.7	50.1	36.0	41.2
Meat only	22.8	33.8	15.0	17.1
Vegetal products , including cereals (excl. beer)	33.6	49.9	51.3	58.8
Cereals only (excluding beer)	5.3	7.9	6.8	7.8
Total protein supply (g/capita/day)	98.4	100	91.5	100
Animal products , including meat	39.3	39.9	38.1	41.6
Meat only	22.0	22.4	18.8	20.6
Vegetal products , including cereals (excl. beer)	59.1	60.1	53.5	58.4
Cereals only (excluding beer)	34.1	34.7	33.3	36.4

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/FBS> (last update: 19 July 2024).

needs to be considered in the context of climate change mitigation and adaptation to ensure that domestic food security and export value are maintained, while the sector is transitioning towards low-emission rice cultivation systems.

According to FAOSTAT (Table 6), the gross production value of chicken meat more than doubled between 2012 and 2022, while pig meat's gross production value increased by 71.5%. In 2022, pig and chicken meat represent respectively the second and third main agricultural products in Vietnam. Considered together, their total gross production value (USD 14.1 billion) is higher than rice.

3.3 Diets

3.3.1 National food supply

Vietnam's total food supply, expressed in kcal/capita/day, is very close to the world average (Table 7). Yet, Vietnam's food supply is 31.1% higher than Vietnam's average dietary energy requirements (2,293 kcal/capita/day in 2021), and 68.6% higher than Vietnam's minimum dietary

energy requirement (1,782 kcal/capita/day) (FAOSTAT).³⁴

In Vietnam, calorie intake comes mainly from vegetal products (84.3%), much like the world average. However, the share of cereals is much higher in Vietnam, with 52.6% of average daily energy intake coming from cereals, compared to the global average of 42.8%. Rice (and its derived products) is central in Vietnamese diet, representing 85.1% of cereal caloric intake, and 44.7% of the daily calorie intake in Vietnam (1,374.6 kcal/capita/day). Calorie intake from meat in Vietnam is significantly higher at

³⁴ The minimum dietary energy requirement is derived from the results of a FAO/WHO/UN university expert consultation held in 2001 (FAO/WHO/UN 2004). This established energy standards for different gender and age groups with sedentary lifestyles and a minimum acceptable body weight for their height. The average energy requirement is the food energy necessary to maintain body weight, composition and suitable physical activity levels for long-term good health. Recommended dietary energy intake for a population group corresponds to the average energy requirement of healthy, well-nourished individuals within that group. Source: [https://www.who.int/data/nutrition/nlis/info/population-below-minimum-level-of-dietary-energy-requirement-\(undernourishment\)#:~:text=The%20average%20energy%20requirement%20is,with%20long%2Dterm%20good%20health](https://www.who.int/data/nutrition/nlis/info/population-below-minimum-level-of-dietary-energy-requirement-(undernourishment)#:~:text=The%20average%20energy%20requirement%20is,with%20long%2Dterm%20good%20health)

Table 8. Food security indicators compared between Vietnam and the world average (2022 values – average 2021–2023) (in %)

Indicator	Vietnam	World
Prevalence of undernourishment in total population	5.2	9.1
Prevalence of stunting in children under 5	19.3	22.3
Prevalence of overweight in children under 5	8.1	5.6
Prevalence of obesity in adult population (over 18)	2	15.8

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/FS> (last update: 27 March 2025).

293 kcal/capita/day, 39.5% more than the world average of 210 kcal/capita/day.

According to FAOSTAT (Table 7), total protein supply³⁵ in Vietnam (98.4 g/capita/day) is slightly higher than the world average. It is worth noting that Vietnam's protein supply is considerably higher than FAO recommended intake (which refers only to proteins actually consumed) of between 30 and 56 g/day for women and 37.5 and 60 g/day for men.³⁶ One study conducted at national level (Nguyen et al. 2013) found a mean of 82 g/day for protein intake. Total fat supply amounts to 67.3 g/capita/day, 22.9% lower than the world average. Animal products and meat also account for an important part of total fat supply in Vietnam, respectively 50.1% and 33.8%, against 41.2% and 17.1% for the world average.

3.3.2 Food from fisheries and aquaculture

Aquatic foods are increasingly being recognized as having an important role to play in an environmentally sustainable and nutritionally sufficient food system (Henriksson et al. 2021). Fish and seafood are very important in Vietnamese diet. In 2022, according to FAOSTAT Food Balance Sheets (FBS),³⁷ fish and seafood represented 11.6% of the total daily protein intake in Vietnam, against 6.1% for the world average. Aquatic foods provide essential amino acids, vitamins, phosphorus and minerals

(including iodine and magnesium), and are a primary source of heart-healthy omega-3 fatty acids (FAO 2022). This means they enhance food security and nutrition, as well as increase dietary quality and diversity.

3.3.3 Food security and nutrition

According to FAOSTAT (Table 8), and with the exception of overweight children under 5, food security indicators are sensibly lower in Vietnam than the world average. Vietnam's prevalence of obesity in the adult population is particularly low, standing at 2% of the adult population, about 8 times lower than the world average (15.8%).

However, Harris et al. (2020) show that Vietnam is at the start of its nutrition transition, with undernutrition falling, obesity rising and nutrition-related chronic diseases accounting for a more significant share of diseases and death. Cardiovascular diseases, cancers, chronic obstructive pulmonary disease and diabetes mellitus were major contributors to non-communicable diseases, which, in 2010, accounted for 318,000 deaths, that is 72% of total deaths in Vietnam (Nguyen and Hoang 2018).

Vietnamese diets saw a switch from animal to vegetable oils due to the latter's perceived health benefits and lower costs, with volume and value of edible oils raising by 30% between 2013 and 2019 (Harris et al. 2020). However, even though wet markets for daily fresh food purchases continue to dominate food purchasing behaviour (85% of grocery sales in 2016), the nutrition transition includes a drop in vegetable consumption and an increase in meat and milk consumption. The supply of sweets and sweetened beverages has risen in recent years – sugar and sweetener intake per

³⁵ Protein supply refers to the total amount of protein available for human consumption, resulting from the multiplication of the quantity of food available by its protein content. For this reason, it includes not only the protein actually consumed, but also the protein finally lost or wasted during the consumption phase. Source: FAO Statistics Division.

³⁶ See <https://www.fao.org/3/AA040E/AA040E09.htm#:~:text=For%20adults%20the%20protein%20requirement,digestibility%20of%20milk%20or%20egg>

³⁷ See <https://www.fao.org/faostat/en/#data/FBS> (last update: 19 July 2024).

capita has increased by 77% and sugar supply almost doubled (+96%) (Harris et al. 2020). The expenditure share of food eaten away from home, often associated with less healthy food, has also increased in both rural and urban areas. According to Harris et al. (2020), these

expenditure shares are larger in urban areas (30.4% in 2014, higher than 22.4% in 2002) than in rural areas (18.8% in 2014 compared to 8.7% in 2002). This category includes both processed fast foods, traditional restaurants and street foods.

4 Food system emissions

4.1 Economy-wide emissions

Vietnam's total GHG emissions across all sectors, including LULUCF, almost doubled over the last decade (+84.3% between 2012 and 2022, a much sharper increase than the world average growth of +10.8%). However, its share of global emissions remains very low at 0.9% in 2022 (Table 9).

In its Third Biennial Updated Report (BUR3, Socialist Republic of Vietnam 2020), Vietnam reported total national GHG emissions, including

LULUCF, of 316.7 MtCO₂eq in 2016. Vietnam's BUR3 further disaggregates GHG emissions sources and sinks by sectors (Table 10). The AFOLU sector (agriculture and LULUCF) ranks third, after Energy and IPPU. Table 10 shows the figures from BUR3 are consistent with FAOSTAT data, which are sourced directly from the UNFCCC data portal as submitted by countries in their national GHG inventories.

As illustrated by Table 11, despite a sharp increase between 2012 and 2022 (+65.5% and +56.1% respectively with and without LULUCF),

Table 9. Vietnam's economy-wide annual GHG emissions compared to global emissions totals (in MtCO₂eq/year)

Total GHG emissions	2012		2022	
	Vietnam	World	Vietnam	World
All sectors with LULUCF	254.1	48,303.6	468.3	53,510.7
All sectors without LULUCF	277.1	47,706.3	481.5	52,211.8

Note: FAOSTAT emission data are sourced directly from the UNFCCC data portal, and build upon the latest official data, as submitted by countries through their most recent national GHG inventories, or extracted from the countries' most recent national communications, biennial updated reports or biennial transparency reports.

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/GT> (last update: 14 November 2024).

Table 10. Vietnam's annual GHG emissions by IPCC economic sectors (in MtCO₂eq/year)

GHG emissions by sector	BUR3 2016	FAOSTAT	
		2012	2022
Energy	205.8	148.8	306.8
IPPU	46.1	34.1	72.1
AFOLU	44.1	-	-
Agriculture	-	71.5	73.0
LULUCF	-	-23.0	-13.2
Waste	20.7	21.6	27.0
All sectors with LULUCF	316.7	254.1	468.3

Sources: Vietnam's BUR3 (Socialist Republic of Vietnam 2020) and FAOSTAT: <https://www.fao.org/faostat/en/#data/GT> (last update: 14 November 2024).

Table 11. Vietnam's total GHG emissions per capita (in tCO₂eq per capita)

GHG emissions	2012		2022	
	Vietnam	World	Vietnam	World
All sectors with LULUCF	2.84	6.71	4.70	6.67
All sectors without LULUCF	3.10	6.62	4.83	6.51

Source: FAOSTAT.

For GHG emissions: <https://www.fao.org/faostat/en/#data/GT> (last update: 14 November 2024);

For population: <https://www.fao.org/faostat/en/#data/OA> (last update: 31 December 2024).

Table 12. Food system emissions in Vietnam and globally

Food system emissions	2012		2022	
	Vietnam	World	Vietnam	World
GHG emissions (MtCO ₂ eq)	113.7	15,951.4	149.6	16,240.2
Percent of total	44.8	33.0	31.9	30.3

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/GT> (last update: 14 November 2024).

Table 13. Food system emissions per capita in Vietnam

Food system emissions	2012		2022	
	Vietnam	World	Vietnam	World
in tCO ₂ eq per capita	1.27	2.22	1.50	2.02

Source: FAOSTAT.

For GHG emissions: <https://www.fao.org/faostat/en/#data/GT> (last update: 14 November 2024);

For population: <https://www.fao.org/faostat/en/#data/OA> (last update: 31 December 2024).

Vietnam's GHG emissions per capita (both with and without LULUCF) is still significantly below the world average, which remained quite stable over the same period.

4.2 Food system emissions

4.2.1 Total food system emissions

Even though Vietnam's food system emissions increased by 31.5% between 2012 and 2022, from 113.7 to 149.6 MtCO₂eq, their share in total national emissions (with LULUCF) decreased over the same period, from 44.8% to 31.9% (Table 12), close to the world average of 30.3%.

Despite a significant increase between 2012 and 2022 (+18.1%), Vietnam's food system emissions per capita remain sensibly lower (by 25.9%) than the world average, which decreased over the same period (Table 13).

4.2.2 Emissions from fisheries and aquaculture

Seafood has a much lower feed conversion ratio (FCR)³⁸ than terrestrial animals, meaning that they represent a much more resource-efficient source of food. FCRs have been estimated in the range of 6.0–10.0 for beef, 2.7–5.0 for pigs, and 1.7–2.0 for chicken, versus only 1.0–2.4 for farmed fish and shrimp (Le et al. 2022).³⁹ Based on feed consumption therefore, farmed fish species are estimated to have a lower carbon footprint than terrestrial animals:

38 i.e., the quantity of feed (kg) required to produce 1 kg of animal product. FCR has no unit.

39 For the same animal species, FCR estimations can vary a lot depending on the country, production system and calculation method. Online estimations include: <https://www.statista.com/statistics/254421/feed-conversion-ratios-worldwide-2010/>; <https://www.omnicalculator.com/biology/fcr>; and <https://www.navfarm.com/blog/fcr-guide/>. In 2002, FAO undertook a literature review to estimate FCR for various farmed fish species: <https://www.fao.org/3/y3781e/y3781e0a.htm>

respectively 87% and 49% smaller than beef and poultry (Poore and Nemecek 2018). MacLeod et al. (2020)⁴⁰ for instance, found that, for most finfish, emission intensity falls in the range of 4–6 kgCO₂eq/kg of carcass weight, against the average of 36 kgCO₂eq/kg of beef meat given by Poore and Nemecek (2018). Feed is often the main source of emissions in aquaculture, while energy and fuel used in motorized fishing vessels is the predominant source of emissions in fisheries (Cao et al. 2023).

On the other hand, the conversion of peatlands, mangroves and forested estuaries to shrimp aquaculture is known to produce enormous emissions in Southeast Asia (Kauffman et al. 2017). These are related to land conversion and the GHG emissions associated with the loss of enormous amounts of soil carbon, previously stored for centuries in organic soils acting as a carbon sink (Dung et al. 2016). Mangrove removal, and the strategy of interspersing shrimp ponds with partial mangrove conservation, seem to be questionable practices in terms of GHG emissions (Järviö et al. 2017). Kauffman et al. (2017) found that GHG emissions from shrimp produced on land that was formerly mangrove amounted to 1,603 kgCO₂eq per kg of shrimp, presumably due to the large CO₂ emissions from the mangrove soils. The carbon footprint of aquaculture thus needs more attention in the context of the overall life-cycle emissions of fisheries and aquaculture, and precise data need to be collected for Vietnam's aquaculture, particularly in the Mekong Delta. Peatland mangroves and forested estuaries are also central to address the very high vulnerability of Vietnam's low-lying coastal and river delta regions to sea-level rise, without forgetting their impact for local livelihoods, biodiversity and other ecosystem services. The World Bank Group and the Asian Development Bank (WBG/ADB 2021) estimated that, depending on the emission scenarios and with no effective adaptation strategy, between 6 and 12 million people could potentially be affected by coastal flooding by the end of this century (2070–2100).

40 Poore and Nemecek (2018) address the GHG footprint covering the whole food chain. MacLeod et al. (2020) “quantifies the main GHG emissions arising ‘cradle to farm-gate’, from the following activities: the production of feed raw materials; processing and transport of feed materials; production of compound feed in feed mills and transport to the fish farm; rearing of fish in water”.

Even though, they represent 14.5% of all animal proteins in the average human diet globally (FAOSTAT FBS),⁴¹ fisheries and aquaculture have been estimated to generate together about only 0.58 GtCO₂eq/year globally (Barange et al. 2018), i.e., less than 10% of global agricultural GHG emissions and just 1% of total GHG anthropogenic emissions. Because of this small share in global emissions, fisheries and aquaculture have so far not often been considered a priority sector for mitigation strategies. GHG emissions from this sector are rarely studied in the scientific literature, and thus detailed sectoral data and specific methods are largely lacking. The sector has not been covered in the IPCC (2006, 2019) guidelines. Consequently, it is often overlooked in national GHG inventories and mitigation strategies (Mbow et al. 2019), including in Vietnam (Cao et al. 2023).

FAOSTAT FBS can provide two alternative ways to calculate rough estimates of fish and seafood emissions, using a simple rule of three. First, in 2022, fish and seafood represented about 2% of Vietnam's total food supply, expressed in kcal. Considering that fish and seafood have a lower carbon impact than other animal products, related GHG emissions should be lower than 2% of total food system emissions, that is about 3 MtCO₂eq. Second, fish and seafood supply in Vietnam represents about 2% of worldwide fish and seafood supply, expressed in kcal. Global emissions from fisheries and aquaculture have been estimated by FAO at 580 MtCO₂eq (Barange et al. 2018). Therefore, as a first approximation, fish and seafood emissions in Vietnam should represent about 2% of global emissions from the sector, i.e., about 12 MtCO₂eq.

These two alternative approaches thus provide a realistic range (3 – 12 MtCO₂eq) for Vietnam emissions from fisheries and aquaculture that could be used as a basis for discussion with national experts of the sector. However, they do not consider the extreme diversity of emission factors across countries, species and production systems. This is why more accurate primary data need to be collected to better assess emissions from this sector. It would be also beneficial to better understand the extent to which emissions from fish and aquaculture value chains are included in the FAOSTAT data presented in Table 15.

41 See <https://www.fao.org/faostat/en/#data/FBS> (last update: 19 July 2024).

Table 14. Key categories of GHG sources or sinks linked to food system in Vietnam's GHG inventory for 2016

IPCC code	Key category (source or sink)	Gas	Emissions/removals (MtCO ₂ eq)
1A2e	Fuel combustion in food processing, beverages and tobacco	CO ₂	1.6
1A4c	Fuel combustion in agriculture, forestry, fisheries and aquaculture	CO ₂	8.2
3A1a	Dairy cows	CH ₄	6.9
3A1b	Buffalo	CH ₄	3.9
3A2h	Swine	CH ₄	1.0
3B1a	Grassland converted to forest land	CO ₂	-11.0
3B2a	Cropland remaining cropland	CO ₂	-1.0
3B2bi	Forest land converted to cropland	CO ₂	5.6
3B3bi	Forest land converted to grassland	CO ₂	1.2
3b6bi	Forest land converted to other land	CO ₂	5.3
3B6bii	Cropland converted to other land	CO ₂	1.4
3C1b	Biomass burning in croplands	CH ₄	1.2
3C3	Urea application	CO ₂	1.4
3C4	Direct N ₂ O emissions from managed soils	N ₂ O	7.8
3C5	Indirect N ₂ O emissions from managed soils	N ₂ O	3.8
3C7	Rice cultivation	CH ₄	49.7
4D1	Domestic wastewater treatment and discharge	CH ₄	4.8
4D1	Domestic wastewater treatment and discharge	N ₂ O	1.9
Total			93.6

Source: Vietnam's BUR3 (Socialist Republic of Vietnam 2020, Table 2.9 p46).

4.2.3 Disaggregated food system emissions

Vietnam's BUR3 (Socialist Republic of Vietnam 2020) does not provide a comprehensive overview of food system emissions. However, some key categories of the national GHG inventory, listed in the BUR3, are clearly linked (more or less directly or exclusively) with food systems (Table 14).

These figures from the BUR3 for 2016 can be compared with disaggregated food system emissions data from FAOSTAT for 2012 and 2022 (Table 15).

FAOSTAT splits food system emissions into three main categories: land-use change, farmgate, and pre-and post-production emissions. In 2022, farmgate activities were the largest source of GHG emissions from the food system in Vietnam

(83.6 MtCO₂eq; 55.9% of total food system emissions), followed by pre- and post-production activities (65.9 MtCO₂eq; 44.1%). While farmgate emissions increased slightly (+7.6%) over this period, emission beyond farmgate, from pre- and post-production activities doubled. FAOSTAT data on land-use changes does not appear very reliable for Vietnam and is mostly missing for 2022.

Rice cultivation remains by far the main source of farmgate emissions, representing 35.0 MtCO₂eq or 41.9% of farmgate emissions in 2022, despite a significant decrease (-8.7%) compared to 2012 level. The three other main sources of emissions at farmgate in 2022 were enteric fermentation (13.1 MtCO₂eq; 15.7% of farmgate emissions); manure⁴² (11.4 MtCO₂eq; 14.2% of

42 i.e., manure applied to soils, manure left on pasture and manure management.

farmgate emissions); and synthetic fertilizers (9.7 MtCO₂eq; 11.7% of farmgate emissions). Despite the increases shown by FAOSTAT in emissions from enteric fermentation and manure over this period (+9.7% and +8.5% respectively),

Vietnam did better than major global producers of meat and dairy in this regard (FAIRR 2023).

The sharp increase in emissions beyond farmgate, linked to pre- and post-production activities,

Table 15. Vietnam's food system emissions

Sources of GHG emissions	GHG emissions (MtCO ₂ eq)		Percentage of total food system emissions (2022)	Percentage change (2012–2022)
	2012	2022		
1. Land-use change	3.7	0.1	0.0	-98.1
Fires in humid tropical forests	0.3	0.1	0.0	-72.9
Fires in organic soils	-	-	-	-
Net forest conversion	3.4	-	-	-
2. Farmgate	77.7	83.6	55.9	7.6
Burning – crop residues	0.5	0.5	0.3	-12.9
Crop residues	2.7	2.6	1.7	-5.5
Drained organic soils	4.1	4.0	2.7	-4.0
<i>Drained organic soils (CO₂)</i>	4.0	3.8	2.6	-4.0
Drained organic soils (N ₂ O)	0.2	0.2	0.1	-4.0
Enteric fermentation	11.9	13.1	8.7	9.7
Manure applied to soils	1.6	1.9	1.3	16.1
Manure left on pasture	2.5	3.1	2.1	22.1
Manure management	6.8	6.9	4.6	1.7
On-farm energy use	2.3	6.8	4.5	199.5
Rice cultivation	38.4	35.0	23.4	-8.7
Savanna fires	0.3	0.1	0.0	-74.5
Synthetic fertilizers	6.5	9.7	6.5	48.8
3. Pre- and post- production	32.3	65.9	44.1	104.0
Fertilizer manufacturing	1.4	5.3	3.5	277.3
Food household consumption	7.7	19.0	12.7	147.1
Food packaging	1.1	3.2	2.1	190.3
Food processing	6.3	15.2	10.1	140.5
Food retail	3.4	8.6	5.8	156.6
Food system waste disposal	8.3	8.7	5.8	5.1
Food transport	3.4	4.6	3.1	36.8
Pesticides manufacturing	0.9	1.5	1.0	69.1
Food systems (= 1 + 2 + 3)	113.7	149.6	100.0	31.5

Note: In this table, 'food system' corresponds to FAOSTAT's term 'agrifood system'. The exact definition for each source of food system emissions is given in Annex 1.

Source: FAOSTAT: <https://www.fao.org/faostat/en/#data/GT>. (last update: 14 November 2024).

from 32.3 to 65.9 MtCO₂eq between 2012 and 2022, is driven by very large increases in fertilizer manufacturing (+277.3%) food packaging (+190.3%), food retail (+156.6%), food household consumption (+147.1%) and food processing (+140.5%). These sharp increases point to a need to identify and address inefficiencies in infrastructure and logistics along food value chains. The two most important sources of emissions beyond farmgate in 2022 were food household consumption (19.0 MtCO₂eq; 28.8% of emissions beyond farmgate) and food processing (15.2 MtCO₂eq; 23.0%). Food systems waste disposal comes third with 8.7 MtCO₂eq, along with food retail at 8.6 MtCO₂eq.

Overall, the largest sources of emission from the food system are, by decreasing order of importance: rice cultivation (23.4% of total food system emissions); livestock emissions related to enteric fermentation and manure management (16.7%); food household consumption (12.7%); food processing (10.1%); synthetic fertilizers, manufacturing and application (10.0%); and food system waste disposal (5.8%). Together, these sources emitted 117.8 MtCO₂eq in 2022 and accounted for 78.8% of all food system emissions.

4.3 Food loss and waste (FLW)

In FAOSTAT data (see Table 15), emissions relating to food system waste disposal do not include emissions associated with FLW throughout the distinct stages of food value chains. This is because in the FAOSTAT methodology the item 'food system waste disposal' covers just four categories: (1) solid waste disposed in landfills; (2) domestic wastewater; (3) industrial wastewater; and (4) incineration of materials used in food systems (Karl and Tubiello 2021). FLW meanwhile refers both to any decrease in quantities at production, processing and distribution stages – food loss –; as well as any decrease in quantities at retail and consumption stages – food waste (HLPE 2014; FAO 2019; Axmann et al. 2024).

Globally, about 30% of food is lost or wasted somewhere between farm and fork, with severe consequences not only for food security but also for ecosystems and natural resources

(Axmann et al. 2024).⁴³ Indeed, FLW accounts for around 8% to 10% of global emissions; a quarter of all freshwater used in agriculture; 1.4 million km² of land; 38% of the energy consumed in food system; and 23% of the fertilizers used in agriculture (FAO 2013, 2015; Mbow et al. 2019; Pingault and Martius 2023; Axmann et al. 2024). When food waste ends up in landfills, it also produces methane (CH₄), a potent GHG.⁴⁴

Consensus is growing around the fact that the world now produces enough food for everybody. This means eliminating hunger and malnutrition is more a distribution than a food production issue. Halving FLW, as suggested under Sustainable Development Goals (SDG) 12.3, would make a critical contribution to food security and nutrition while reducing the food system emissions overall.

Using a bottom-up mass flow model, based on secondary data (Guo et al. 2020), the University of Wageningen considered the main FLW hotspots across food value chains at country level in terms of GHG, land-use and water footprints, and nutritional losses associated with FLW. In Vietnam, the five main FLW hotspots, ranked according to associated GHG emissions, are rice (12.2 MtCO₂eq), vegetables (7 MtCO₂eq), freshwater fish (6.4 MtCO₂eq), pig meat (4.5 MtCO₂eq) and bovine meat (4 MtCO₂eq) (Figure 2). Vegetables become the main hotspot when considering FLW as a percentage of total production (54%).

There are claims that actual FLW in developing countries could potentially be lower than this, due to opportunities for capturing and re-utilizing lost and wasted food in the informal economy. However, there is a lack of data to confirm this. It becomes evident that a lack of accurate primary data at micro-, meso-, and macro-levels across food value chains, is significantly impeding a

43 Around 14% of food produced is lost between harvest and retail, and 17% is wasted (11% in households, 5% in the food service and 2% in retail). See <https://www.un.org/en/observances/end-food-waste-day> (accessed on 19 March 2023).

44 According to IPCC AR6 (Nabuurs et al. 2022), the global warming power of methane is 27 times higher than that of carbon dioxide over a 100-year horizon.

comprehensive understanding of emissions from FLW (HLPE 2014). Without knowing which products and which parts of their production chain must be predominantly addressed, interventions cannot be targeted and efficient. The collection of primary FLW data in key value chains – including seafood production – is essential to direct the formation of FLW interventions tailored to these chains.

Were such data to become available, it could help identify potential interventions to reduce FLW.

Such interventions would also contribute to sensibly reducing food system emissions. These interventions may include hardware solutions, like improved packaging and cooling systems; organizational solutions, like better arrangements in supply chains (so-called orgware in industry jargon);⁴⁵ and software solutions, like improved knowledge and information sharing. Comparing the supply chains of similar product categories could also help to identify best practices that can be adopted to improve efficiency (Axmann et al. 2024).

FLW for Vietnam - Top 15 items

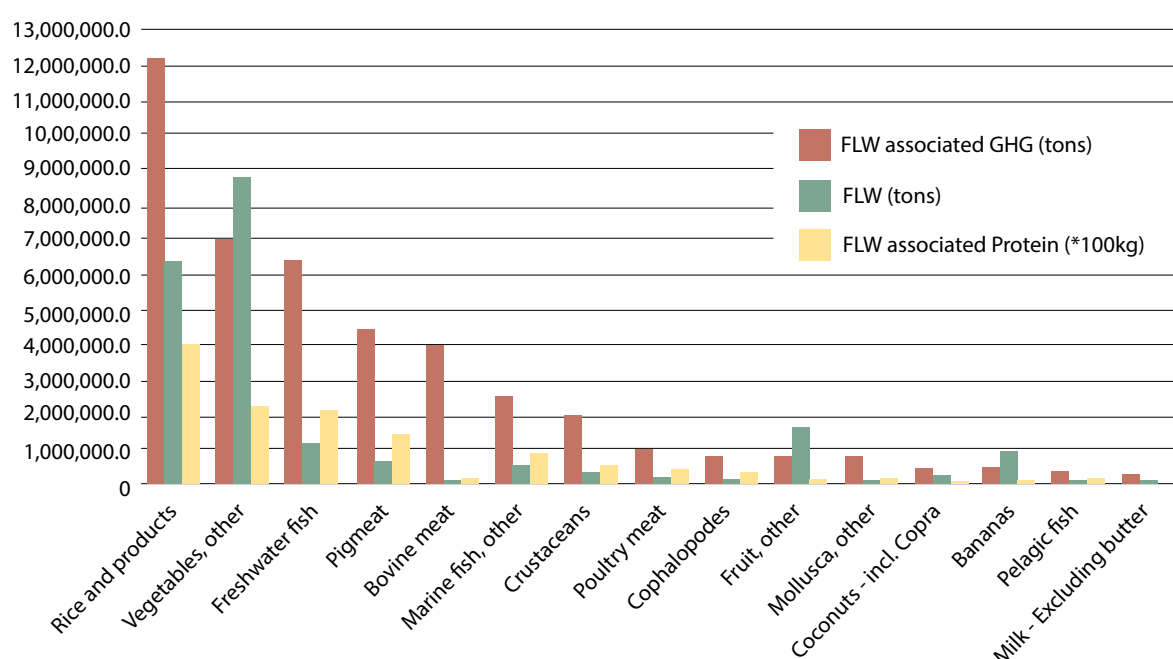


Figure 2. Top 15 hotspot categories of food loss and waste (FLW) in Vietnam, ranked on FLW-associated GHG emissions (in tCO₂eq/year), loss and waste volumes, and loss of protein.

Note: Protein losses are depicted by 100 kg to make the values visible and comparable; FLW total values are in metric tons.

Source: Figure taken from Axmann et al. (2022). Initial release of an evolving dataset, subject to ongoing elaboration and updates.

45 The “systems set of organizational, economical, legislative and managerial arrangements” (Dobrov 1979).

5 Vietnam's Nationally Determined Contribution (NDC) and climate policies

Vietnam released its Intended Nationally Determined Contribution in 2015, its first NDC in December 2020, and its updated NDC in October 2022 (Socialist Republic of Vietnam 2022). This updated NDC, and related national policies, are briefly analysed in the following sub-sections.

The country is now developing its NDC 3.0, which aims to foster economic growth while exploring different pathways to reduce emissions. In the ongoing discussions surrounding Vietnam's NDC 3.0, there has been growing interest in advancing the blue carbon agenda, with particular emphasis on sustainable mangrove conservation and aquaculture production as key components of the country's emissions reduction pathway.

However, the debate has also become increasingly contentious. As the forestry sector is the country's only remaining net carbon sink, its representatives have expressed concern over being given further reduction targets, particularly while other high-emission sectors lag behind in fulfilling their mitigation commitments.

5.1 Business-as-usual (BAU) scenario

Table 16 shows GHG emissions across the five IPCC economic sectors (Energy, IPPU, Agriculture, LULUCF and Waste). Under the BAU scenario, GHG emissions are expected to grow sensibly in all sectors, following industrialization, economic and population growth. The highest annual growth rates are expected in the Energy and IPPU sectors. The Waste sector will experience lower growth, and agriculture emissions are expected to remain relatively stable. In the business-as-usual scenario, these sharp increases in GHG emissions across the whole economy will not be compensated by equivalent increases in LULUCF carbon sinks, which are expected to grow at a moderate rate of +1.7% per year. This means strong additional efforts will be required to achieve Vietnam's unconditional and conditional targets across the economy (reducing GHG emissions by 15.8% and 43.5% respectively by 2030 when compared to the BAU scenario) and the corresponding sectoral targets set in the updated NDC.

Table 16. Vietnam's annual GHG emissions by sector under the business-as-usual (BAU) scenario (in MtCO₂eq/year)

Sectors	2014	2020	2025	2030	Annual growth rate (2014–2030) (%)
Energy	171.6	347.5	500.7	678.4	9.0
IPPU	38.6	80.5	116.1	140.3	8.4
Agriculture	89.8	104.5	109.2	112.1	1.4
LULUCF	-37.5	-35.4	-37.9	-49.2	1.7
Waste	21.5	31.3	38.1	46.3	4.9
Total (with LULUCF)	284.0	528.4	726.2	927.9	7.7

Source: Vietnam's updated NDC (Socialist Republic of Vietnam 2022, see Table 1 p6).

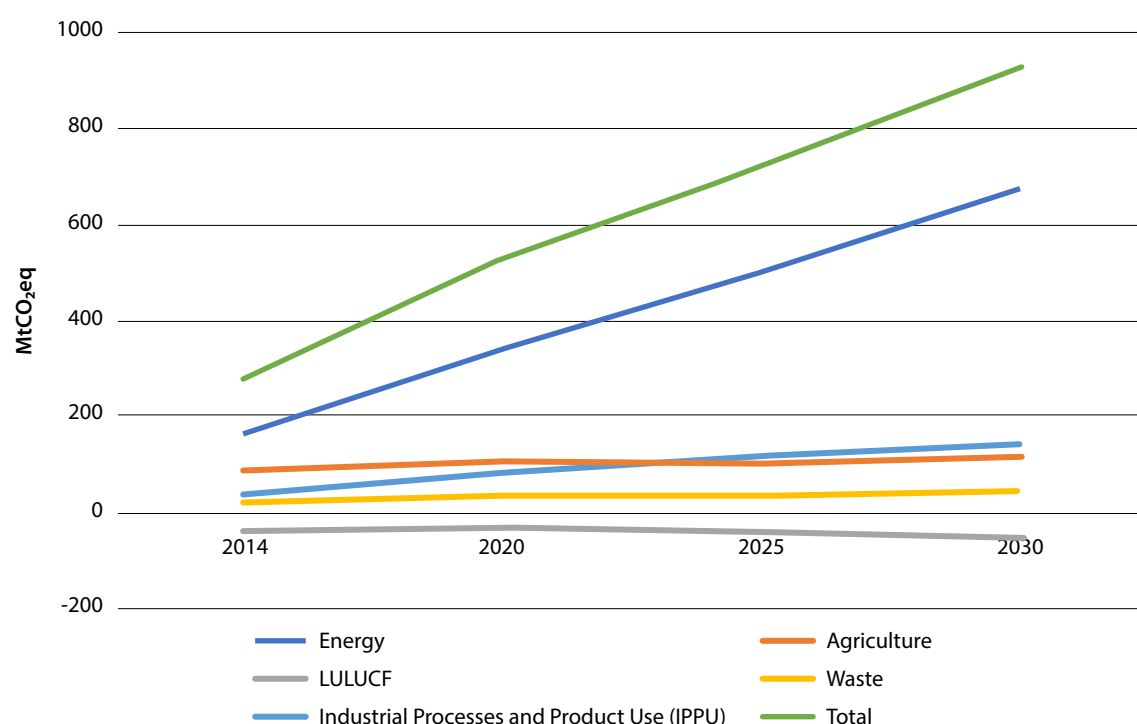


Figure 3. Annual GHG emissions under the BAU scenario (MtCO₂eq/year)

Source: Vietnam updated NDC (Socialist Republic of Vietnam 2022)

5.2 Emissions reduction targets

Following the Environment Protection Law (N°72/2020/QH14)⁴⁶ that came into force on 1 January 2022, Vietnam has developed a national legal framework to support GHG emissions reductions. Decree 06/2022/ND-CP (7 January 2022) on emissions reduction and ozone protection⁴⁷ sets specific emissions reduction targets across economic sectors and responsible ministries. 62% of the emissions reduction target allocated to the Ministry of Agriculture and Rural Development (MARD) derives from LULUCF while 38% of the target impacts agriculture. However, no distinction was made in this decree between conditional (i.e., depending on international support) and unconditional (i.e., based on national resources

only) targets. In its latest updated NDC (Socialist Republic of Vietnam 2022), submitted on 8 November 2022, Vietnam defined more precise economy-wide and sectoral, unconditional and conditional annual emissions reduction targets by 2030, with reference to the BAU scenario (Table 17). To support these unconditional and conditional NDC targets, the financial needs have been estimated as USD 21.7 and 86.8 billion respectively.

The 2022 NDC includes seven mitigation measures for the LULUCF sector, including emissions reduction and removals. Expected cumulative emissions reductions in this sector over 2021–2030 are estimated at 84.5 and 106.3 MtCO₂eq for unconditional and conditional measures respectively (Table 18). The financial needs for unconditional and conditional measures in the LULUCF sector are estimated at USD 3.9 and 5.5 billion respectively, with a unit cost of GHG mitigation measures ranging between 24 and 33 USD/tCO₂eq.

⁴⁶ See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/02/72.signed.pdf> (in Vietnamese).

⁴⁷ See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/01/06-nd.signed.pdf> (in Vietnamese).

Table 17. Conditional and unconditional annual emissions reduction targets set in Vietnam's updated NDC for 2030

Sector	Contribution to total emissions reduction			
	Unconditional		Conditional	
	%	MtCO ₂ eq	%	MtCO ₂ eq
Energy	7.0	64.8	24.4	227.0
Agriculture	1.3	12.4	5.5	50.9
LULUCF	3.5	32.5	5.0	46.6
Waste	1.0	8.7	3.2	29.4
IPPU	3.0	27.9	5.4	49.8
Total	15.8	146.3	43.5	403.7

Source: Vietnam's updated NDC (Socialist Republic of Vietnam 2022, Table 4 p10)

Table 18. Estimated expected emissions reductions in the LULUCF sector over 2021–2030

Mitigation measures in the LULUCF sector	Impacts	Estimated cumulative emissions reductions (MtCO ₂ eq)	
		Unconditional	Conditional
Conservation and protection of existing natural forest in mountainous areas (F1)	Reduced emissions from deforestation and forest degradation, conservation of forest carbon stock and enhanced carbon removal	67.9	85.2
Conservation and protection of existing coastal protection forests (F2)	Reduced emissions from deforestation and forest degradation, conservation of forest carbon stocks and enhanced carbon removal	4.8	6.3
Reforestation of protection and special use forests (F3)	Increased carbon sequestration, conservation of biodiversity and provided ecosystem services	0.4	0.5
Enhancing forest quality and carbon stocks of poor natural forests area (F4)	Increased carbon sequestration, conservation of biodiversity and maintained and enhanced ecosystem services	2.9	3.6
Enhancing forest productivity and carbon stocks of plantations for saw log supply (F5)	Increased carbon sequestration, conservation of biodiversity and maintained and enhanced ecosystem services	1.9	2.4
Replication of agroforestry practices for carbon enhancement and land conservation (F6)	Increased carbon sequestration from inter-planting woody tree species and enhanced soil conservation and water regulation	0.06	0.02
Sustainable forest management and forest certification (F7)	Reduced emissions, increased carbon sequestration and conservation of carbon stock, biodiversity and ecosystem services	6.6	8.3
Total – LULUCF sector		84.5	106.3

Source: Department of Climate change 2022. Technical report for 2022 updated NDC. (See [http://www.dcc.gov.vn/kien-thuc/1125/Bao-cao-ky-thuat---Dong-gop-do-quoc-gia-tu-quyet-dinh-\(NDC\)-cap-nhat-nam-2022.html](http://www.dcc.gov.vn/kien-thuc/1125/Bao-cao-ky-thuat---Dong-gop-do-quoc-gia-tu-quyet-dinh-(NDC)-cap-nhat-nam-2022.html) (in Vietnamese)).

Unconditional and conditional GHG mitigation measures are also provided for the agriculture sector in the updated NDC. Expected unconditional emissions reductions during 2021–2030 are estimated to be 69.9 MtCO₂eq. Unconditional mitigation measures will focus mainly on rice production land (dry and wet irrigation and system of rice intensification; conversion of ineffective rice area to other crops, integrated rice and crop management). The corresponding financial need is estimated to be USD 2.1 billion. Conditional mitigation measures include improved feed for cows and cattle, agricultural waste circulation and improved fertilizers. Expected emissions reductions during 2021–2030 are estimated to be 281.6 MtCO₂eq, and the corresponding financial need is estimated to be USD 16.1 billion.

Vietnam also claimed in its updated NDC to reduce CH₄ by 30% from its 2020 level, having joined the Global Methane Pledge. Looking longer term, Vietnam's 'net zero' pledge is described in the National Climate Change Strategy to 2050,⁴⁸ issued in September 2022, which sets emissions reduction targets across all sectors for 2030 and 2050. The target set for 2050 is 'net zero' emissions with an emissions peak expected in 2025. The following sectoral emissions reduction targets have been set to achieve 'net zero' emissions: -91.6% for the Energy sector; -84.8% for IPPU; -63.1% for Agriculture; -90% for emissions reduction and +30% for removal enhancement for LULUCF; and -90.7% for Waste. This strategy features specific measures to mitigate climate change, such as maintaining a 43% forest coverage and preserving 9% of total country's land area as inland conservation area.

5.3 National legal framework: Key climate policies, regulations and programmes

To achieve the planned emissions reduction targets presented in the previous section and support implementation of Vietnam's updated NDC, several national policies and regulations have been issued. The main policies and regulations impacting food systems are summarized in Table 19.

48 See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/07/896-ttg-signed.pdf> (in Vietnamese).

As well as the abovementioned national climate-related policies and regulations, other key programmes support implementation of Vietnam's NDC. These include:

Sustainable forest development programme 2021–2025⁴⁹

The primary objective of this programme is to protect and sustainably develop both existing forests and those planted between 2021 and 2025. The forestry production value is expected to grow at a rate of 5–5.5% per year. By 2025, the export value of timber and non-timber forest products is expected to reach approximately USD 20 billion, alongside increased income from planted and natural production forests, and the effective implementation of programmes and projects to conserve forest biodiversity.

Implementation plan of NDC in agriculture and rural development⁵⁰

This plan supports the implementation of mitigation measures in crop and livestock production and in the LULUCF sector. In LULUCF, mitigation measures focus on emissions reductions from preventing deforestation and forest degradation, conserving forest carbon stock and enhancing carbon removals. For cropping systems, the plan includes measures such as alternating wet–dry irrigation (AWD), system of rice intensification (SRI), '3 giảm 3 tăng' and '1 phải 5 giảm' techniques⁵¹, mid-season drainage, replacing urea with controlled-release or slow-release fertilizers, and expanding reuse of crop residues. For livestock, it proposes improved feed formulation (e.g., silage, inclusion of legumes, adoption of software-

49 See Prime Minister Decision 809/QĐ-TTg (2022): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/07/809-ttg-signed.pdf> (in Vietnamese).

50 See Decision 1693/QĐ-BNN-KHCN dated 28 April 2023, approving NDC implementation plan for Agriculture and Rural Development. <https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Quyết-dinh-1693-QĐ-BNN-KHCN-2023-giam-nhe-phat-thai-nha-kinh-nganh-Nong-nghiep-den-2030-585663.aspx> (in Vietnamese).

51 '3 giảm 3 tăng' (three reduce, three increase) and '1 phải 5 giảm' (one must, five reductions) are sustainable rice cultivation approaches promoted by MARD. In '3 giảm 3 tăng', three reductions include reduction of seeds, pesticide and nitrogen fertilizers. And three increases means increased productivity, quality and economic benefits. In '1 phải 5 giảm', the first part means one has to use the verified seed; the five 5 reductions are reduction of seeds, pesticide, nitrogen fertilizers, water for irrigation and reduced post-harvest loss.

Table 19. Key national regulations and documents relating to emissions reduction in food systems

Title	Summary
Law on Forestry (2017) approved by Vietnam National Assembly ^a	Sets regulations on forest management for production, protection and/or special use forests. Establishes a mechanism to support payment for forest ecosystem services, including carbon removals and emissions reduction (Articles 61–64).
The Environment Protection Law approved by Vietnam National Assembly (2020) ^b	Represents a significant milestone in the development of the legal framework for emissions reductions, the promotion of a low-carbon economy, and the establishment of a domestic carbon market in Vietnam. Specifically, Article 91 of the law mandates the following: (i) establishment of national and sectoral greenhouse gas (GHG) inventories every two years; (ii) implementation of GHG emissions reduction measures across all economic sectors; and (iii) development of a domestic carbon market.
Decree 06/2022/ND-CP (2022) approved by Vietnam government ^c	Details regulations for the implementation of emissions reduction targets and the development of a domestic carbon market, especially: Emissions reduction: defines the target groups (GHG emitters) required to reduce their emissions (Article 5); prepares and updates a list of emitters required to do a GHG inventory (Article 6); defines objectives and a roadmap for emissions reduction (Article 7) and enhancement of carbon sequestration (Article 8); establishes a national MRV system (Article 9) for the GHG inventory (Article 11); and allocates emissions reduction targets to the ministries managing the different economic sectors (Article 12). Domestic carbon market development (Article 16–20): the carbon market will be piloted until 2027 and should be fully operational by 2028. Procedures and requirements for exchange, trade and transfer of carbon credits are also provided (Article 18–19).
Decree 119/2025/ND-CP on revising Decree 06/2022/ND-CP ^d	The main revisions related to emissions reductions are: (1) amendments and a new clause (5a) requiring a mechanism for emissions reduction exchange according to Article 2 of Paris Agreement (Clause 2 Article 3); (2) revision of point b, clause 4 Article 3: for 2025–2030, entities with allocated emission quota have to develop and implement emissions reduction measures; and those who are not allocated emissions quota are responsible for developing and implementing emissions reductions according to the guidance of the ministry managing the sector (Clause 4 Article 3); (3) other revisions and amendments, referring to more specific requirements for GHG emission inventory and reporting, a roadmap for allocating emission quotas, validation and verification of GHG inventory results, and carbon credits exchange and offsetting in Vietnam's carbon market and other markets.
Vietnam's Forestry Development Strategy for 2021–2030 and vision to 2050 (2021) approved by the Prime Minister ^e	Provides strategic directions and key targets for forestry development, including: (i) maintaining forest cover at 42–43% of total land area; and (ii) contributing to GHG emissions reduction and carbon removal. The main focus areas are: (i) enhancing value added for plantations; (ii) emissions reduction and enhancement of carbon sinks; (iii) sustainable forest management; and (iv) forest-based solutions for natural disaster reduction.
National Climate Change Strategy approved by the Prime Minister (2022) ^f	Provides strategic actions for climate change mitigation and adaptation. Aims to achieve the net zero emissions target by 2050, aligning with the government's commitment made at COP26 in Glasgow. Defines key mitigation and adaptation objectives in forestry and land-use sectors including: (i) reforestation and sustainable forest management to mitigate natural disasters and combat land degradation; (ii) strengthened protection and development of coastal mangrove forests and wetland ecosystem; (iii) reduced forest-based carbon emissions; and (iv) enhanced carbon sequestration.

continue to the next page

Table 19. Continued

Title	Summary
National Strategy on Green Growth for 2021–2030 and vision to 2050 approved by the Prime Minister (2021) ^s	Defines the following focus areas for green growth: (i) reducing emission intensity per GDP; (ii) greening economic sectors and lifestyles; (iii) applying clean technologies in production and promoting sustainable consumption; and (iv) supporting friendly environmental development. Sets a target for stabilizing forest cover at 42–43% of total land area, and calls for investment in enhancing forest quality, reforestation, and the sustainable management of forests to reduce emissions and enhance carbon sequestration.
Strategy on Sustainable Agriculture and Rural Development 2021–2030 and vision to 2050 approved by the Prime Minister ^h	Aims to develop sustainable commodity agriculture for food security and contribute to social economic development, environment protection, natural disaster mitigation and low carbon emissions. Provides key strategic development objectives for crop and livestock production, forestry, fisheries and aquaculture.
Strategy for Development of Vietnam's Fisheries by 2030 and vision to 2045 approved by the Prime Minister (2021) ⁱ	Aims to increase production associated with industrialization, modernization, sustainable development and proactive adaptation to climate change. Key strategic areas of intervention include: aquatic resources, aquatic exploitation, aquaculture, fish processing and trading, and logistics service facilities for fisheries.
National Plan for Implementation of the Glasgow Declaration approved by the Prime Minister (2023) ^j	Aims to achieve actions agreed upon at COP26 and stated in the Glasgow Declaration, as well as contribute to sustainable agriculture development and meet national emissions reduction targets. Regarding the LULUCF objectives for 2030, the plan focuses on: (i) reversing deforestation and forest degradation; (ii) mitigating land degradation; and (ii) enriching poor natural forest area (including forest enrichment planting on approximately 20%).
Methane Emissions Reduction Action Plan to 2030 approved by the Prime Minister (2022) ^k	Aims to reduce by 30% CH ₄ emissions by 2030 compared to the 2020 level across the following sectors: crop and livestock production; solid waste management; oil and gas exploitation; coal mining; and fossil fuel consumption. Provides key tasks and measures to achieve this emissions reduction target.
Decision 13/2024/QĐ-TTg (replacing Decision 01/2022/QĐ-TTg) on the list of sectors and entities required to prepare GHG inventory approved by the Prime Minister (2024) ^l	Provides a detailed list of entities emitting GHG that are required to prepare an annual GHG inventory report. Covers the following sectors: energy; transportation; construction; industry processes; agriculture, forestry and land use; and waste. Under this decision, 2,166 entities in all provinces and eco-regions are required to prepare a GHG inventory report.
Plan for Implementation of the Paris Agreement on Climate Change approved by the Prime Minister (2016) ^m	Regulates key tasks supporting implementation of the Paris Agreement, including: GHG inventories; policies for solar energy; regulations and road map for emissions reductions; development of a carbon market; and implementation of GHG mitigation measures.

a. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2017/12/16.signed.pdf> (in Vietnamese).b. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/02/72.signed.pdf> (in Vietnamese).c. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/01/06-nd.signed.pdf> (in Vietnamese).d. See: <https://datafiles.chinhphu.vn/cpp/files/vbpq/2025/6/119-nd.signed.pdf>e. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/04/523.signed.pdf> (in Vietnamese).f. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/07/896-ttg.signed.pdf> (in Vietnamese).g. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/10/1658.signed.pdf> (in Vietnamese).h. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/10/1658.signed.pdf> (in Vietnamese).i. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/03/339.signed.pdf> (in Vietnamese).j. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2023/8/993-ttg.signed.pdf> (in Vietnamese).k. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/08/942-ttg.signed.pdf> (in Vietnamese).l. See <https://datafiles.chinhphu.vn/cpp/files/vbpq/2024/8/13-ttg.signed.pdf> (in Vietnamese).m. See Prime minister Decision 2053/QĐ-TTg (2016): <https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Quyet-dinh-2053-QĐ-TTg-ke-hoach-thuc-hien-thoa-thuan-Paris-bien-doi-khi-hau-2016-328065.aspx> (in Vietnamese).

based diet modelling), use of methane-inhibiting additives (3NOP, zeolite), and enhanced manure management using microbial treatment and separation of urine and faeces.

National REDD+ action programme⁵²

Since 2009, Vietnam has been actively engaged in various REDD+ programmes under UN-REDD and the Forest Carbon Partnership Facility (FCPF). These programmes have focused on REDD+ implementation, emissions reductions and results-based climate finance. In this context, the national REDD+ action programme aims to increase forest cover to 42–43% of total land area by 2020 and 45% by 2030, as well as works towards the emissions reduction targets set in the Intended NDC. It comprises 11 work packages, namely:

- Review and adjust master land-use plans to reach the target of 16.24 million hectares of forest land by 2020
- Promote sustainable and deforestation-free agriculture and aquaculture
- Improve forest governance and livelihoods for people living in and around forests
- Strengthen law enforcement
- Evaluate and replicate enhanced forest production through longer rotations and diversified business models
- Evaluate and replicate sustainable models for natural forest enhancement, protection and conservation
- Create an enhanced economic and financial environment for forests
- Finalize and upgrade the core REDD+ instruments, in accordance with the stepwise principle and in compliance with UNFCCC provisions
- Establish and implement financial management mechanisms for REDD+
- Strengthen international and regional cooperation to promote REDD+ and mitigate risks of displacement
- Effectively coordinate, backstop, communicate, build capacities and monitor the programme's implementation.

Programme for developing a sustainable and efficient wood processing industry for 2021–2030⁵³

This project aims to build and develop a strong reputation for Vietnamese wood products in the domestic and international markets, and to place Vietnam among the world's leading countries in producing, processing, and exporting wood and wood products. Specific objectives for 2030 are to: (i) reach an export value of USD 25 billion for wood-based products and non-timber forest products; (ii) reach a domestic consumption value of USD 6 billion, for wood-based products and non-timber forest products; (iii) meet advanced production technology levels and capabilities in over 80% of wood processing and preservation facilities; and (iv) ensure 100% of wood and wood-based products for export and domestic consumption come from legal wood raw materials and wood with sustainable forest management certificates.

Sustainable forest management and certification scheme⁵⁴

The key objectives of this scheme are to: (i) sustainably manage and use forest resources, conserve biodiversity, protect the environment and support forest environmental services; (ii) promote forest certification in Vietnam to meet the domestic and global market requirements around legal wood origins; (iii) meet at least 80% of the demand for exported wood products from sustainably managed forest plantations; and (iv) increase added value from the forestry industry, thus contributing to hunger eradication and poverty reduction for forest workers. The development of a national forest certification scheme, aligned with the Program for Endorsement of Forest Certification (PEFC), is required to promote sustainable forest management in Vietnam and enhance legality, sustainability and environment integrity.

52 See Prime Minister Decision 419/QĐ-TTg (2017): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2017/04/419.signed.pdf> (in Vietnamese).

53 See Prime Minister Decision 327/QĐ-TTg (2022): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2022/03/327-qd-ttg.signed.pdf> (in Vietnamese).

54 See Prime Minister Decision 1288/QĐ-TTg (2018): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2018/10/1288-qd-ttg.signed.pdf> (in Vietnamese).

Project to develop the seafood processing industry during 2021–2030⁵⁵

This project aims to: develop modern, effective and sustainable seafood processing to meet the needs and regulations of the consumer market; improve competitiveness and integration with global value chains; and ensure Vietnam is one of the top five seafood processing countries globally by 2030. Key objectives are to: (i) control and develop raw materials for seafood processing; (ii) attract investment, improve productivity, quality and efficiency of seafood processing; (iii) promote the processing of high value-added aquatic products; (iv) develop the fish consumption market; and (v) improve economic efficiency and competitiveness along production chains.

Organic agriculture development programme for 2020–2030⁵⁶

This project aims to develop sustainable, circular, environmentally friendly, organic agriculture with high added value, for both domestic consumption and export. Organic agricultural products will be certified in accordance with regional and global organic standards. By 2030, organic agriculture should meet the following targets: (i) 2.5 to 3% of total agricultural land; (ii) about 2% of total cropland area (across major crops like rice, legumes, fruit trees, tea, pepper, coffee, cashew, coconut); (iii) 2 to 3% of total livestock domestic production;⁵⁷ (iv) 1.5 to 3% of total aquaculture area; (v) over 10% of total nutritional salt production area; (vi) 95–98% of total output for medicinal products and non-timber forest products from natural forests; and (vii) 80–85% of total output for intensive farming (using the forest environment for production).

National scheme on sustainable production and consumption 2021–2030⁵⁸

This scheme aims to promote the sustainable production and consumption of resources, fuels and raw materials by: promoting a circular economy in Vietnam that encourages regeneration, reuse and recycling; supporting innovation and creativity; creating green jobs and developing stable and enabling job regulations; promoting sustainable lifestyles and improving people's quality of life. Key targets for 2030 are to: (i) reduce by 7–10% raw material consumption in the main manufacturing industries⁵⁹; (ii) raise awareness around sustainable production and consumption in all industrial zones, clusters and craft villages; (iii) disseminate and replicate cleaner production models as well as sustainable production and consumption models; (iv) raise awareness around sustainable lifestyles and consumption in all provinces and centrally-run cities; (v) use environmentally friendly packaging to replace single-use, difficult-to-decompose plastic packaging products in all supermarkets and shopping centres; (vi) develop action plans to implement the national action programme on sustainable production and consumption, and integrate actions into local policies and programmes in at least 90% of centrally-managed provinces and cities; and (vii) establish a unit in charge of implementing the programme in at least 70% of provinces and cities.

5.4 Assessing alignment between recommended actions and national policies

As mentioned in **Section 4.2.3** and based on FAOSTAT data, the main sources of GHG emissions in Vietnam's food system are, by decreasing order of importance: rice cultivation (23.4% of total food system emissions); livestock emissions related to enteric fermentation and manure management (16.7%); food household consumption (12.7%); food processing (10.1%); synthetic fertilizers, manufacturing and application (10.0%); and food system waste disposal (5.8%).

55 See Prime Minister Decision 1408/QĐ-TTg (2021): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2021/08/1408.signed.pdf> (in Vietnamese).

56 See Prime Minister Decision 885/QĐ-TTg (2020): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2020/06/885.signed.pdf> (in Vietnamese).

57 Certified organic livestock products include: milk, honey products, bird's nest products, meat and poultry.

58 See Prime Minister Decision 889/QĐ-TTg (2020): <https://datafiles.chinhphu.vn/cpp/files/vbpq/2020/06/889.signed.pdf> (in Vietnamese).

59 Including textiles, steel and cement, plastics and chemicals, paper, alcohol and other beverages, and seafood processing.

This suggests the following priorities for action to reduce food system emissions in Vietnam:

- (i) reducing emissions from rice production;
- (ii) reducing livestock emissions related to enteric fermentation and manure management;
- (iii) reducing emissions from synthetic fertilizer production and use; and (iv) improving the data to understand and pinpoint focus areas and address emissions from food household consumption, and food loss and waste.

Reducing emissions from rice will depend on various approaches to increase water-, fertilizer- and residue-use efficiency. These include alternate wetting and drying (e.g., Vo et al. 2023); aerobic rice cultivation ('dry rice'); systems of rice intensification; improved fertilizer management (e.g., slow-dissolving fertilizers); breeding of more resilient, less methane-emitting rice varieties; improved management of nutrients, cover crops and residues; and approaches such as conversion of unproductive rice areas into non-rice cropland or integrated rice-shrimp farming. Many of these strategies are already part of Vietnam's updated NDC (Socialist Republic of Vietnam 2022). More training and extension services integrating and supporting these approaches are now needed. Through co-benefits, these strategies could reduce emissions while also improving agricultural production efficiency and farm income, as well as reducing soil degradation and water pollution.

Beyond reducing meat consumption and therefore the number of living animals, a basket of approaches can be used to reduce livestock emissions intensity. This will contribute not only to reducing emissions from enteric fermentation and manure management, but also to improving productivity. These approaches include improving feed quality and animal health, as well optimizing animal nutrition, manure and livestock management practices. The use of dietary supplements – like feed additives, methane inhibitors, enzymes, probiotics and essential oils – can also help reduce enteric methane emissions. Alternative feed sources – such as legumes – can reduce the amount of methane produced from manure management. Manure management mitigation strategies also include anaerobic digestion and composting. Manure emits GHGs, but its sustainable use

can replace synthetic fertilizers. Such strategies could reduce emissions while also improving soil health, providing clean and renewable energy, and reducing fertilizer costs.

Reducing emissions from synthetic fertilizer manufacturing and application requires improving production processes, and reducing the use of synthetic fertilizer by optimizing application and increasing instead the use of organic fertilizers and promoting composting. Actions may include reducing the use of energy, hazardous chemicals and the amount of waste generated during production, implementing closed-loop systems, or capturing carbon dioxide and using it in other industrial processes.

Addressing food loss and waste (FLW) across food value chains, from production to consumption, will first require a better assessment of the situation with primary, disaggregated data collection to enable identification of priority areas. With more accurate data, it will become possible to devise technical solutions that address the largest FLW hotspots. FLW mitigation strategies could also include improving 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 production chain.

Reducing emissions from household food consumption requires significant changes in consumption patterns. Information and education campaigns, labels and certification schemes, taxes and economic incentives, more efficient logistic and cold chain at retail and consumption stages, are all strategies that can contribute to change individual and collective behaviours and support more sustainable consumption patterns.

Some of these priority actions are already addressed in the national documents supporting implementation of Vietnam's NDC. For instance, reducing methane emissions from rice production is set as an objective in the

National Climate Change Strategy to 2050. MARD is leading coordination of the provincial governments to implement this strategy, carrying out investments in irrigation and implementing mitigation options. These include management practices to reduce methane emissions in rice production, like alternate wetting and drying, sustainable rice intensification, and mid-season drainage practices. MARD is also leading the development and implementation of a plan to mitigate emissions from agricultural production which includes converting inefficient paddy rice into other models (such as rice/aquaculture and diversification with fruit trees).⁶⁰ The National Climate Change Strategy to 2050 also holds MARD responsible for developing an action plan for reducing methane emissions relating to crop and livestock production. MARD is further tasked to issue guidelines on feeding cattle to ‘create a sustainable and productive livestock industry while reducing methane emissions’.

Adjustments and shifts in the composition of livestock, crop, forestry and aquaculture production – with the aim of increasing quality, added value and competitiveness for more sustainable agriculture – is the key objective addressed in the National Strategy on Green Growth for 2021–2030. Restructuring agriculture (crop and livestock) production is also identified, in the National Plan for Implementation of the Glasgow Declaration following COP26,⁶¹ as one of the solutions for mitigating and adapting to climate change, strengthening resilience and improving rural livelihoods

Reducing emissions linked to synthetic fertilizer production and use is not mentioned in Vietnamese national documents supporting the implementation of climate actions. However, the

Organic Agriculture Development Programme for 2020–2030 includes important targets to develop organic fertilizers; increase their percentage in total fertilizer output to 15% by 2025 through research and development; and strictly manage the input materials used in organic production. The objectives of this programme also align with the objective to reduce food loss and waste, as it tasks the Ministry of Natural Resources and Environment (MNRE) to research and propose measures on the reuse of organic waste and by-products. The programme also promotes the development of organic gardens connected to waste collection.

Actions targeting the waste sector are mentioned in many national documents, including the National Strategy on Green Growth, the Organic Agriculture Development Programme for 2020–2030, and the National Action Plan on Sustainable Consumption and Production (2021–2030). However, these policies mostly concern management and technologies to handle municipal solid waste, including for energy production. The National Action Plan supports implementation of circular economy models for waste in the agriculture and fisheries sectors.

Enhancing carbon sinks has also been identified as a priority in Vietnam’s updated NDC (Socialist Republic of Vietnam 2022). To achieve this objective, Vietnam can reduce deforestation, increase forest restoration, and foster sustainable land management practices that reduce pressure on forestland. Rehabilitating and protecting areas of natural forests, including mangroves along the coast and in the Mekong Delta, are essential for Vietnam.

60 The Scheme on Development of Organic Agriculture for 2020–2030 (2018) mentions rice production, setting a target of 100,000–150,000 ha under organic farming before 2030 (which is a very small target given that harvested rice area in Vietnam amounted to 7.22 Mha in 2020).

61 See: <https://english.luatvietnam.vn/dat-dai/decision-993-qd-ttg-2023-national-plan-to-implement-glasgow-declaration-on-forests-and-land-use-264798-d1.html> (translated in English).

6 Conclusions

This country profile aims to provide an updated overview of Vietnam's land use, agriculture, pre- and post-production activities, food loss and waste, diets and related GHG emissions, identifying perspectives on how to reduce these emissions. This analysis is based primarily on publicly available data, such as those from FAOSTAT, with one aim being to facilitate cross-country comparisons. Our series of country-level analyses is completed by a global perspective on food system emissions reductions, provided in Martius et al. (2024).

Based on the present analysis, Vietnam's food system emissions have increased in absolute levels over the past decade (from 113.7 to 149.6 MtCO₂eq between 2012 and 2022), while their share in national emissions decreased (from 44.8% to 31.9%). The largest emission sources in the food system are, by decreasing order of importance: rice cultivation (23.4% of total food system emissions); livestock emissions related to enteric fermentation and manure management (16.7%); food household consumption (12.7%); food processing (10.1%); synthetic fertilizers, manufacturing and application (10.0%); and food system waste disposal (5.8%). Together, these sources emitted 117.8 MtCO₂eq in 2022 and accounted for 78.8% of all food system emissions.

The priorities for action emerging from this overview are therefore to reduce emissions from rice production; enteric fermentation and manure management; synthetic fertilizer production and use; household food consumption; and food loss and waste. These priority actions are relatively well aligned with national priorities. They focus on reducing food system emissions while also supporting food security and nutrition, health and economic development. Our holistic food system perspective has enabled us to identify some promising but so-far neglected emissions

reduction pathways, such as reducing food loss and waste, and fostering more sustainable consumption patterns.

Effective climate action planning should not only consider the size of sectoral emissions, but also the cost and feasibility (often referred to as the 'political economy') of implementing transformative measures. New light has been shed on GHG emissions related to FLW, household consumption and food transport – these are not the largest by size, but these sectors may provide accessible, viable, cost-efficient and effective emissions reduction pathways across food supply chains.

Avoiding and reducing emissions 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. Vietnam already supports research and development of new technologies and practices to reduce emissions from all sub-sectors of the food system.

These perspectives will need to be further analysed alongside available national data. Collecting additional primary data is crucial to better understand and address the priority areas for action identified above, putting them in the context of national efforts and plans. Such analysis will also need to better integrate forestry, the related net balance of emission sources and sinks, as well as assess more accurately the amount of emissions from fisheries and aquaculture. Careful analysis along these lines could help national government and non-government actors to shape national strategies and plans promoting low-carbon, efficient and sustainable food systems.

References

- Axmann HB, Guo X, Broeze J, Harbers C, Viquez-Zamora M, Soethoudt JM. 2024. *Mitigate+: Food loss and waste country profile Vietnam: Estimates of food loss and waste, associated GHG emissions, nutritional losses, land use and water footprints*. <https://hdl.handle.net/10568/139266>
- Axmann H, Guo X, Kok M, Viquez-Zamora M, Broeze J and Soethoudt H. 2022. *Food loss and waste country profile for Vietnam: Estimates of food loss and waste, associated GHG emissions and nutritional losses*. CGIAR, and Wageningen Food and Biobased Research. <https://hdl.handle.net/10568/127173>
- Babiker M, Berndes G, Blok K, Cohen B, Cowie A, Geden O, Ginzburg V, Leip A, Smith P, Sugiyama M, Yamba F. 2022. *Cross-sectoral perspectives*. In Shukla PR, Skea J, Slade R, Al Khouradajie A, van Diemen R, McCollum D, Pathak M, Some S, Vyas P, Fradera R, Belkacemi M, Hasija A, Lisboa G, Luz S, Malley J, 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 and New York: Cambridge University Press. <https://doi.org/10.1017/9781009157926.005>
- Barange M, Bahri T, Beveridge MCM, Cochrane KL, Funge-Smith S, Poulain F. 2018. *Impacts of climate change on fisheries and aquaculture: Synthesis of current knowledge, adaptation and mitigation options*. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome. 628 pp. <https://www.fao.org/3/i9705en/I9705EN.pdf>
- Benton TG, Bieg C, Harwatt H, Pudasaini R, Wellesley L. 2021. *Food system impacts on biodiversity loss*. Chatham House Research Paper. 75 pp. https://www.chathamhouse.org/sites/default/files/2021-02/2021-02-03-food-system-biodiversity-loss-benton-et-al_0.pdf
- Cao LQ, Hoang VC, Tran N. 2023. *Synthesis of baseline GHG emission data and estimation methods in aquatic food systems in Vietnam*. Working paper. Penang, Malaysia: WorldFish. <https://hdl.handle.net/10568/138094>
- Chu L, Tran N, Chan CY, Le L. 2023. *Modelling Vietnam's blue transformation under climate change: A conceptual framework*. Working paper. Penang, Malaysia: WorldFish. <https://hdl.handle.net/20.500.12348/5739>
- D-Fish (Vietnam, Directorate of Fisheries). 2022. *Annual fisheries sector report in 2021 and action plan for 2022*.
- D-Fish (Vietnam, Directorate of Fisheries). 2021. *Report on achievement of Agriculture and Rural Development sector in 2021 and the development plan for 2022*.
- Dixson-Declevé S, Gaffney O, Ghosh J, Randers J, Rockstrom J, Stoknes PE. 2022. *Earth for All: A Survival Guide for Humanity*. Gabriola Island, British Columbia: New Society Publishers. <https://www.clubofrome.org/publication/earth4all-book/>
- Dobrov GM. 1979. The strategy for organized technology in the light of hard-, soft-, and org-ware interaction. *Long Range Planning* 12(4): 79–90. [https://doi.org/10.1016/0024-6301\(79\)90124-9](https://doi.org/10.1016/0024-6301(79)90124-9)
- Dung LV, Tue NT, Nhuan MT, Omori K. 2016. Carbon storage in a restored mangrove forest in Can Gio Mangrove Forest Park, Mekong Delta, Vietnam. *Forest Ecology and Management* 380: 31–40. <https://doi.org/10.1016/j.foreco.2016.08.032>
- EcoNexus and Berne Declaration. 2013. *Agropoly: A handful of corporations control world food production*. 18 pp. https://www.publiceye.ch/fileadmin/doc/Saatgut/2014_PublicEye_Themenheft_1_EN_Agropoly.pdf

- FAIRR. 2023. *Meat and dairy giants failing to reduce emissions, with increase of over 3% ahead of COP28*. <https://www.fairr.org/news-events/press-releases/meat-and-dairy-giants-failing-to-reduce-emissions>
- FAO (Food and Agriculture Organization of the United Nations). 2022. *The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation*. Rome. <https://www.fao.org/3/cc0461en/cc0461en.pdf>
- FAO. 2020. *The State of World Fisheries and Aquaculture 2020. Sustainability in action*. Rome. <https://doi.org/10.4060/ca9229en>.
- FAO. 2019. *The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction*. Rome. <https://doi.org/10.4060/CA6030EN>
- FAO. 2015. *Food wastage footprint and climate change*. 4p. Rome. <http://www.fao.org/3/bb144e/bb144e.pdf>
- FAO. 2013. *Food wastage footprint. Impacts on natural resources*. Summary report. Rome. <http://www.fao.org/3/i3347e/i3347e.pdf>
- FAO and ITPS (Intergovernmental Technical Panel on Soils). 2015. *Status of the World's Soil Resources (SWSR)*. Main Report. Rome: FAO and ITPS. 650p. <http://www.fao.org/3/a-i5199e.pdf>
- FAO/WHO/UNU. 2004. *Human energy requirements. Report of a joint FAO/WHO/UNU expert consultation. Rome, 17-24 October 2001*. Rome: Food and Agriculture Organization of the United Nations. <http://www.fao.org/3/a-y5686e.pdf>
- GDC (Vietnam's General Department of Customs). 2022. *Statistics of Exports by Country/Territory - Main Exports*. April 2022. 37 pp. [https://files.customs.gov.vn/CustomsCMS/TONG_CUC/2022/5/6/2022-T04T-5N\(EN-PR\).pdf](https://files.customs.gov.vn/CustomsCMS/TONG_CUC/2022/5/6/2022-T04T-5N(EN-PR).pdf)
- GSO (General Statistics Office). 2021. *Exports and imports value by month of 2021*. <https://www.gso.gov.vn/en/data-and-statistics/2021/03/exports-and-imports-value-by-months-of-2021/>
- Guo X, Broeze J, Groot JJ, Axmann H, Vollebregt M. 2020. A worldwide hotspot analysis on food loss and waste, associated greenhouse gas emissions, and protein losses. *Sustainability* 12(18): 7488. <https://doi.org/10.3390/su12187488>
- Harris J, Nguyen PH, Tran LM, Huynh PN. 2020. Nutrition transition in Vietnam: Changing food supply, food prices, household expenditure, diet and nutrition outcomes. *Food Security* 12(5): 1141–55. <https://doi.org/10.1007/s12571-020-01096-x>
- Henriksson PJG, Troell M, Banks LK, Belton B, Beveridge MCM, Klinger DH, Pelletier N, Phillips MJ, Tran N. 2021. Interventions for improving the productivity and environmental performance of global aquaculture for future food security. *One Earth* 4(9): 1220–1232. <https://doi.org/10.1016/j.oneear.2021.08.009>
- 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*. Report. <https://www.fao.org/3/i3901e/i3901e.pdf>
- IPCC (Intergovernmental Panel on Climate Change). 2019. *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Accepted in May 2019. <https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/>
- IPCC. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston HS, Buendia L, Miwa K, Ngara T and Tanabe K (eds). Japan: IGES. <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>
- Järviö N, Henriksson PJG, Guinée JB. 2017. Including GHG emissions from mangrove forests LULUC in LCA: A case study on shrimp farming in the Mekong Delta, Vietnam. *International Journal of Life Cycle Assessment* 23: 1078–1090. <https://doi.org/10.1007/s11367-017-1332-9>
- Jasechko S, Perrone D. 2021. Global groundwater wells at risk of running dry. *Science* 372: 418–421. <https://doi.org/10.1126/science.abc2755>
- Kauffman JB, Arifanti VB, Hernández Trejo H, del Carmen Jesús García M, Norfolk J, Cifuentes M, Hadriyanto D, Murdiyarso D. 2017. The jumbo carbon footprint of a shrimp: Carbon losses from mangrove deforestation. *Frontiers in Ecology and the Environment* 15: 183–188. <https://doi.org/10.1002/fee.1482>

- Karl K, Tubiello FN. 2021. *Methods for estimating greenhouse gas emissions from food systems. Part II: waste disposal*. FAO Statistics Working Paper 21–28. Rome. <https://www.fao.org/3/cb7028en/cb7028en.pdf>
- Le TL, Tran N, Dinh XL, Nguyen VQ, Le TPD, Nguyen TL and Hoong Y. 2022. *Promising technologies and innovations for scaling for low-emission transformation of aquaculture value chains in Vietnam*. Unpublished report. Penang, Malaysia: WorldFish.
- MacLeod MJ, Hasan MR, Robb DHF, Mamun-Ur-Rashid M. 2020. Quantifying greenhouse gas emissions from global aquaculture. *Scientific reports* 10(1): 1–8. <https://doi.org/10.1038/s41598-020-68231-8>
- Martius C, Pingault N, Mwambo FM, Guérin L. 2024. *Reducing greenhouse gas emissions in the global food system*. Info Brief No. 411. Bogor, Indonesia: Center for International Forestry Research (CIFOR); and Nairobi, Kenya: World Agroforestry (ICRAF). <https://doi.org/10.17528/cifor-icraf/009317>
- Martius C, Guérin L, Pingault N, Mwambo F, Wassmann R, Cramer L, Shikuku K. 2023a. *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>
- Martius C, Guérin L, Pingault N, Mwambo F, Wassmann R, Thuy PT, Nhung T, Yee CC. 2023b. *Food systems emissions in Vietnam and their reduction potential: A country profile*. Occasional Paper 12. Bogor, Indonesia: Center for International Forestry Research (CIFOR); and Nairobi, Kenya: World Agroforestry (ICRAF). <https://doi.org/10.17528/cifor-icraf/009048>
- Martius C, Wassmann R, Mwambo FM, Pingault N, Guérin L. 2023c. *Food systems emissions in Colombia and their reduction potential: A country profile*. Occasional Paper 4. Bogor, Indonesia: CIFOR (Center for International Forestry Research); and Nairobi, Kenya: World Agroforestry (ICRAF). <https://doi.org/10.17528/cifor-icraf/008864>
- Mbow C, Rosenzweig C, Barioni LG, Benton TG, Herrero M, Krishnapillai M, Liwenga E, Pradhan P, Rivera-Ferre MG, Sapkota T, Tubiello FN, Xu Y. 2019. Food security. In Shukla PR, Skea J, Calvo Buendia E, Masson-Delmotte V, Pörtner H-O, Roberts DC, Zhai P, Slade R, Connors S, van Diemen R, Ferrat M, Haughey E, Luz S, Neogi S, Pathak M, Petzold J, Portugal Pereira J, Vyas P, Huntley E, Kissick K, Belkacemi M, Malley J, eds. *Climate Change and Land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*. IPCC. <https://doi.org/10.1017/9781009157988.007>
- Nabuurs G-J, Mrabet R, Abu Hatab A, Bustamante M, Clark H, Havlík P, House J, Mbow C, Ninan KN, Popp A, et al. 2022. *Agriculture, Forestry and Other Land Uses (AFOLU)*. In Shukla PR, Skea J, Slade R, Al Khourdajie A, van Diemen R, McCollum D, Pathak M, Some S, Vyas P, Fradera R, Belkacemi M, Hasija A, Lisboa G, Luz S, Malley J, 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*. IPCC. Cambridge, UK and New York: Cambridge University Press. <https://doi.org/10.1017/9781009157926.009>
- Nature. 2019. Counting the hidden \$12-trillion cost of a broken food system. *Nature* 574: 296. <https://doi.org/10.1038/d41586-019-03117-y>
- Nguyen PH, Strizich G, Lowe A, Nguyen H, Pham H, Truong TV, Nguyen S, Martorell R, Ramakrishnan U. 2013. Food Consumption Patterns and Associated Factors among Vietnamese Women of Reproductive Age. *Nutrition Journal* 12(1): 126. <https://doi.org/10.1186/1475-2891-12-126>
- Nguyen TAT, Jolly CM. 2017. Macro-Economic and Product Challenges Facing Vietnamese the Pangasius Industry. *Reviews in Fisheries Science & Aquaculture*, 26(2): 183–194. <https://doi.org/10.1080/23308249.2017.1379948>

- Nguyen TH. 2017. *An Overview of Agricultural Pollution in Vietnam: The Crops Sector*. Prepared for the World Bank. Washington, DC. <https://documents1.worldbank.org/curated/ru/988621516787454307/pdf/122934-WP-P153343-PUBLIC-Vietnam-crops-ENG.pdf>
- Nguyen TT, Hoang MV. 2018. Non-Communicable Diseases, Food and Nutrition in Vietnam from 1975 to 2015: The Burden and National Response. *Asia Pacific Journal of Clinical Nutrition* 27(1). <https://doi.org/10.6133/apjcn.032017.13>
- OECD (Organisation for Economic Cooperation and Development). 2020. *A Territorial Approach to the Sustainable Development Goals: Synthesis Report*. OECD Urban Policy Reviews. <https://doi.org/10.1787/e86fa715-en>
- Phung DT, Nguyen VC, Nguyen CT, Nguyen TN, Tạ Thị KV. 2016. *Ethnic minorities and sustainable development goals: Who will be left behind?* Irish Aid, Uy Ban Dan Toc, United Nations Development Programme. <https://www.undp.org/vietnam/publications/ethnic-minorities-and-sustainable-development-goals-who-will-be-left-behind>
- Pingault N, Martius C. 2023. *Ten promising pathways to GHG emission reduction in the global food system*. Occasional Paper 3. Bogor, Indonesia: CIFOR (Center for International Forestry Research); and Nairobi, Kenya: World Agroforestry (ICRAF). <https://doi.org/10.17528/cifor-icraf/008836>
- Pörtner H-O, Scholes RJ, Agard J, Archer E, Arneth A, Bai X, Barnes D, Burrows M, Chan L, Cheung WL, et al. 2021. *Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change*. Bonn, Germany: IPBES Secretariat. <https://doi.org/10.5281/zenodo.4659158>
- Poore J, Nemecek T. 2018. Reducing food's environmental impacts through producers and consumers. *Science* 360(6392): 987–992. <https://doi.org/10.1126/science.aag0216>
- Rocha C, Mendonça M, Nguyen DH, Huỳnh NP, Do TBH, Yeudall F, Moraes A, Brown M, Yuan Y and Tenkate T. 2022. A food-system approach to addressing food security and chronic child malnutrition in northern Vietnam. *Journal of Agriculture, Food Systems, and Community Development* 11(4): 273–292. <https://doi.org/10.5304/jafscd.2022.114.019>
- Socialist Republic of Vietnam. 2022. *Nationally Determined Contribution (NDC) (updated in 2022)*. https://unfccc.int/sites/default/files/NDC/2022-11/Viet%20Nam_NDC_2022_Eng.pdf
- Socialist Republic of Vietnam. 2020. *Vietnam Third Biennial Updated Report to the United Nations Framework Convention on Climate Change*. Ministry of Natural Resources and Environment. https://unfccc.int/sites/default/files/resource/Viet%20Nam_BUR3.pdf?download
- Song Z, Zhang Y, Xiong W, Chen K. 2023. *Towards a low-emission agrifood sector in the People's Republic of China: A country profile*. Occasional Paper 5. Bogor, Indonesia: CIFOR (Center for International Forestry Research); and Nairobi, Kenya: World Agroforestry (ICRAF). <https://doi.org/10.17528/cifor-icraf/008865>
- Tran N, Chan CY, Aung YM, Bailey C, Akester M, Cao QL, Trinh TQ, Hoang CV, Sulser TB, Wiebe K. 2022. Foresighting future climate change impacts on fisheries and aquaculture in Vietnam. *Frontiers in Sustainable Food Systems* 6: 829157. <https://doi.org/10.3389/fsufs.2022.829157>
- UNDESA (United Nations, Department of Economic and Social Affairs, Population Division). 2024. *World Population Prospects 2024*, Online Edition. <https://population.un.org/wpp/>
- Vo H. 2021. *Understanding urban migration in Vietnam: Evidence from a micro-macro link*. ADBI Working Paper 1233. Tokyo: Asian Development Bank Institute. <https://www.adb.org/publications/understanding-urban-migration-viet-nam-micro-macro-link>
- Vo TBT, Johnson K, Wassmann R, Sander BO, Asch F. 2023. Varietal effects on Greenhouse Gas emissions from rice production systems under different water management in the Vietnamese Mekong Delta. *Journal of Agronomy and Crop Science* 00: 1–17. <https://doi.org/10.1111/jac.12669>

- WBG/ADB. 2021. *Climate Risk Country Profile: Vietnam*. The World Bank Group and the Asian Development Bank. <https://climateknowledgeportal.worldbank.org/sites/default/files/2021-04/15077-Vietnam%20Country%20Profile-WEB.pdf>
- World Bank. 2022. *From the Last Mile to the Next Mile: 2022 Vietnam Poverty & Equity Assessment*. Washington, DC. <https://documents1.worldbank.org/curated/en/099115004242216918/pdf/P176261055e180087097d60965ce02eb562.pdf>
- World Bank. 2021. *A Trade-Based Analysis of the Economic Impact of Non-Compliance with Illegal, Unreported and Unregulated Fishing: The Case of Vietnam*. Washington, DC. <https://doi.org/10.1596/36132>
- Yuen KW, Hanh TT, Quynh VD, Switzer AD, Teng T, Huay Lee JS. 2021. Interacting Effects of Land-Use Change and Natural Hazards on Rice Agriculture in the Mekong and Red River Deltas in Vietnam. *Natural Hazards and Earth System Sciences* 21 (5): 1473–93. <https://doi.org/10.5194/nhess-21-1473-2021>
- Zhang M, Wu B, Zeng H, He G, Liu C, Tao S, Zhang Q, Nabil M, Tian F, Bofana J, et al. 2021. GCI30: A global dataset of cropping intensity using multisource remote sensing imagery. *Earth System Science Data* 13: 4799–4817. <https://doi.org/10.5194/essd-13-4799-2021>

Annex

FAOSTAT food system emissions: Definitions and boundaries

The FAOSTAT data series on food system emissions was last updated on 22 May 2023. New items have been introduced and some methodologies have been refined. In this report we have kept data extracted before that date. The date of data extraction is given in each table and citation.

In FAOSTAT, food system emissions are disaggregated into three main categories and 24 items:

Land-use change emissions

- Fires in humid tropical forests
- *Fires in organic soils*
- *Net forest conversion*: Net contribution of CO₂ sources and sinks due to deforestation, reforestation and afforestation activities within countries.

1. Farm gate emissions

- *Burning – crop residues*: CH₄ and N₂O emissions resulting from the on-site combustion of a percentage of crop residues.
- *Crop residues*: N₂O emissions resulting from the decomposition of crop residues returned to managed soils.
- *Drained organic soils*: CO₂ and N₂O emissions.
- *Enteric fermentation*: CH₄ emissions resulting from enteric fermentation, which is a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream of an animal.
- *Manure applied to soils*: N₂O emissions from manure added to managed soils to enrich them.

- *Manure left on pasture*: N₂O emissions from manure left on pasture by grazing livestock.
- *Manure management*: N₂O and CH₄ emissions resulting from aerobic and anaerobic manure decomposition processes occurring during capture, storage, treatment and utilization of animal manure.
- *On-farm energy use*
- *Rice cultivation*: CH₄ emissions resulting from the anaerobic decomposition of organic matter in paddy fields.
- *Savanna fires*
- *Synthetic fertilizers*: N₂O emissions resulting from the application of synthetic fertilizers to managed soils.

2. Pre- and post-production emissions (beyond farm gate)

- *Fertilizer manufacturing*: CO₂ and N₂O emissions generated from energy use in fertilizer manufacturing. This covers the main fertilizer products, accounting for 85% of global fertilizer production quantity. Emissions from the extraction, transfer and supply of natural gas as an input into the manufacturing process (Haber-Bosch) are not considered.
- *Food household consumption*: CO₂, CH₄ and N₂O emissions resulting from energy consumption (electricity, fossil fuels, and non-renewable wood fuel consumption) in households (including small businesses and restaurants), for example for cooking, kitchen appliances and refrigeration. It is unclear whether this item includes emissions from four F-gases associated with domestic refrigeration.
- *Food packaging*: CO₂, CH₄ and N₂O emissions resulting from energy consumption for the industrial production of glass, plastic aluminium, tin, pulp and paper products

then used in food packaging. Energy used in facilities where food is packaged is not considered.

- *Food processing*: CO₂, CH₄ and N₂O emissions resulting from energy consumption in food processing (on-site combustion of fossil fuels and off-site electricity generation). It is unclear whether this item includes emissions from four F-gases associated with industrial refrigeration.
- *Food retail*: CO₂, CH₄ and N₂O generated by energy consumption in food retail facilities, such as for refrigeration and lighting. It is unclear whether this item also includes emissions from four F-gases associated with commercial refrigeration.
- *Agrifood systems waste disposal*: CO₂, CH₄ and N₂O emissions resulting from four categories of food systems waste disposal: (1) solid food waste disposed in landfills; (2) domestic wastewater; (3) industrial wastewater (generated by the production of food, nitrogen fertilizers and pulp production for paper products used in food systems); and (4) incineration of plastic and rubber materials used in food systems. Note that this excludes GHG emissions associated with the production, processing and distribution of food products that are finally lost or wasted.
- *Food transport*: CO₂, CH₄ and N₂O emissions resulting from the combustion and evaporation of fuel for all domestic food transport (including domestic aviation, road transportation, railways, domestic waterborne navigation and other transportation). This item excludes international transport (accounting for an estimated 2.5% of global food transport emissions). It is unclear whether this item includes emissions from four F-gases associated with food transport refrigeration.
- *On-farm electricity use*
- *On-farm heat use*
- *Pesticides manufacturing*: CO₂, CH₄ and N₂O emissions resulting from energy consumption during the energy-intensive processes of pesticide manufacturing.

Methodological sources used by FAO

FAOSTAT Domain Emissions Totals.

Methodological note, release October 2022. https://fenixservices.fao.org/faostat/static/documents/GT/GT_e.pdf

Flammini A, Adzmir H, Karl K, Tubiello FN.

2023. *Methods for estimating greenhouse gas emissions from food systems. Part V: Household food consumption*. FAO Statistics Working Paper Series, No. 33. Rome. <https://www.fao.org/3/cc3812en/cc3812en.pdf>

Flammini A, Karl K, Thacker D, Tubiello NF.

2023. *Methods for estimating greenhouse gas emissions from food systems. Part VI: Fluorinated gas emissions*. FAO Statistics Working Paper Series, No. 35. Rome. <https://www.fao.org/3/cc5403en/cc5403en.pdf>

Karl K, Flammini A, Tubiello FN. 2022. *Methods for estimating greenhouse gas emissions from food systems. Part IV: Pesticides manufacturing*. FAO Statistics Working Paper Series, No. 22-32. Rome, FAO. <https://www.fao.org/3/cc3583en/cc3583en.pdf>

Karl K, Tubiello FN. 2021. *Methods for estimating greenhouse gas emissions from food systems. Part I: domestic food transport*. FAO Statistics Working Paper 21-27. Rome, FAO. <https://www.fao.org/3/cb6754en/cb6754en.pdf>

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

Tubiello FN, Flammini A, Karl K, Obli-Laryea G, Qiu SY, Heiðarsdóttir H, Pan X, Conchedda G. 2021. *Methods for estimating greenhouse gas emissions from food systems. Part III: energy use in fertilizer manufacturing, food processing, packaging, retail and household consumption*. FAO Statistics Working Paper Series, No. 29. Rome. <https://www.fao.org/3/cb7473en/cb7473en.pdf>



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The global food system is responsible for 23 – 42% of total net anthropogenic emissions. This share will likely increase in the future, driven by population and economic growth and changes in lifestyle, as other economic sectors are progressively decarbonized. Without rapid and radical transformations in food systems, the Paris Agreement targets will likely remain out of reach. Data on GHG (greenhouse gas) emissions and removals are usually collected and analyzed across five economic sectors (energy, industry, agriculture, LULUCF (Land Use Land Use Change and Forestry) and waste). This makes it hard to identify and estimate food system emissions, which span across all these sectors.

This occasional paper is the second edition, revised, updated and expanded, of a previous analysis of food system emissions in Vietnam. It successively examines land use, agriculture (including fisheries and aquaculture), diets, and food system emissions in Vietnam, in the light of national climate engagements, policies and programs. It highlights the following largest sources of emissions from Vietnam's food system: rice cultivation (23.4% of total food system emissions); livestock emissions related to enteric fermentation and manure management (16.7%); food household consumption (12.7%); food processing (10.1%); synthetic fertilizers, manufacturing and application (10.0%); and food system waste disposal (5.8%). Together, these sources emitted 117.8 MtCO₂eq in 2022 and accounted for 78.8% of all food system emissions.

Based on this analysis, this paper identifies four priorities for mitigation action, well aligned with national priorities: (i) reducing emissions from rice production; (ii) reducing livestock emissions related to enteric fermentation and manure management; (iii) reducing emissions from synthetic fertilizer production and use; and (iv) improving the data situation to understand and pinpoint the focus areas and address emissions from food household consumption and food loss and waste.

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