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Mandate of the Special Rapporteur on the promotion and protection of human rights in the context of climate change

Annex III – Further insights from submissions and independent research

To the report of the Special Rapporteur on the promotion and protection of human rights in the context of climate change, Elisa Morgera, titled “Transforming food systems for a safe climate and health for all” (A/HRC/62/44)

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Considering the constraints of the word count of the main report, this Annex contains a wider set of key insights from the over 90 inputs received by the UN Special Rapporteur (https://www.ohchr.org/en/calls-for-input/2026/call-input-transforming-food-systems-protect-human-rights-and-prevent-climate) and independent research of the literature in different areas of science, which have shaped the analysis and recommendations of the main report.

1. AGRICULTURE

1.1 Negative impacts on the climate system

Agrifood systems currently generate about 30 percent of total greenhouse gas (GHG) emissions,[1] with the Intergovernmental Panel on Climate Change (IPCC) suggesting this number may be as high as 42 percent.[2]

The UN Food and Agriculture Organization (FAO) estimates farm-gate emissions from crop and livestock to amount to approximately 49 percent, land-use change (conversion of natural ecosystems to cropping and grazing lands) to approximately 19 percent, and pre- and post-

[1] Milne et al (eds). 2025. Update on scientific findings on the interactions between agriculture, food systems and climate change. Environment and Natural Resources Management Working Paper No. 110. Rome, FAO. https://doi.org/10.4060/cd6901en; Tubiello et al., Pre- and post-production processes increasingly dominate greenhouse gas emissions from agri-food systems (2022) 14 Earth System Science Data 1795, https://doi.org/10.5194/essd-14-1795-2022, at 1796.
[2] FAO Update 2025 (n 1).

agricultural production emissions to approximately 32 percent.[3] Overall, the FAO estimates that food-system emissions increased 21 percent from 2001 until 2023.[4]

Farm-gate emissions are emissions generated directly by agricultural production activities on farms. Data from 2023 shows that these emissions have remained the largest component (49 percent) of agrifood systems. Emissions produced within the farm-gate accounted for more than half of agrifood systems emissions across all regions except the Americas. For that same year, emissions were largest in Asia, followed by the Americas, Africa, Europe, and Oceania. In per capita terms, Oceania was the highest emitter, followed by the Americas, Europe, Africa, and Asia.[5] Emissions in Africa and the Americas had significant land-use change components of agrifood systems emissions (respectively 0.8 and 1.8 Gt CO2eq), representing 43 percent and 31 percent, respectively, of their total agrifood systems emissions.

Emissions from crops and livestock are expected to increase by 30–40 percent by 2050 under business-as-usual scenarios that include efficiency improvements as well as dietary changes.[6]

Crop production constitutes a significant share of agrifood system greenhouse gas emissions. Certain crops have been associated with higher emissions. Rice cultivation, for example, is one of the largest anthropogenic sources of methane within agriculture, accounting for approximately 22 percent of total agricultural methane emissions and 48 percent of total GHG emissions from croplands.[7] Emissions from rice production have increased in recent decades, reflecting the expansion and intensification of irrigated paddy systems, particularly in Asia.[8] Crop residue burning represents another important source of emissions in many agricultural regions, releasing carbon dioxide, methane, and nitrous oxide into the atmosphere and contributing to both climate change and local air pollution.[9]

The global food system generates GHG emissions primarily in the form of carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4).[10] Methane, a short-lived climate pollutant, has a significantly higher warming potential than carbon dioxide over shorter timeframes and contributes to the formation of tropospheric ozone, which directly damages crops and further amplifies warming.[11] In individual GHG terms, agrifood systems generate about 50 percent of anthropogenic CH_4 emissions, and nearly 80 percent of global N_2O emissions.[12]

While CO_2 emissions have caused about 0.8°C of present-day warming,[13] methane pollution from all sources is responsible for about 0.5°C. Methane from agricultural production is

[3] FAO (2025), Greenhouse gas emissions from agrifood systems: Global, regional and country trends, 2001–2023, https://openknowledge.fao.org/handle/20.500.14283/cd7300en.

[4] Ibid.

[5] Ibid.

[6] IPCC, Climate Change and Land (2022), https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, 481.

[7] FAO Update 2025 (n 1).

[8] Ibid.

[9] Ibid, 51.

[10] Clark et al (2020), 'Global Food System Emissions Could Preclude Achieving the 1.5 and 2 climate change targets' 370 Science 705, 10.1126/science.aba7357.

[11] https://www.ipcc.ch/srccl/chapter/chapter-5/.

[12] Clark et al (n 10); Tubiello et al (n 1), at 1796.

[13] Estimates of global average surface temperature increases from 2010-2019 compared to pre-industrial

responsible for about 0.2°C, most of which comes from livestock production. Methane's greatest impact on temperature levels occurs within the decade or so after its release (during which time it is 80x stronger than CO_2). This feature means that cutting methane emissions is one of the fastest ways to slow the speed at which the Earth heats up and to limit the maximum temperature the planet will reach before climate pollution is reined in. Deep and sustained cuts in methane emissions, including in the agriculture sector, are essential to keep warming to its lowest levels.[14]

In 2023, Asia was the largest contributor to regional agrifood systems emissions, followed by the Americas, Africa, Europe and Oceania, largely reflecting differences in region size.[15] On a per capita basis, however, Oceania and the Americas record significantly higher agrifood emissions than Asia and Africa.[16]

Without mitigation measures, food systems may contribute up to an additional 0.9 °C of warming by the end of this century.[17] Even if fossil fuel emissions were immediately stopped, current trends in global food systems would make meeting the 1.5°C target unachievable and, by the end of the century, threaten meeting the 2°C target.[18]

1.2 Climate change impacts on agriculture

Between 2008 and 2018, agricultural production loss caused by climate change amounted to $30 billion in Africa alone. The Intergovernmental Panel on Climate Change has projected that 10 per cent of the area that is currently suitable for major crops and livestock will be climatically unsuitable by 2050 under high-emissions scenarios. Temperature rise and extreme weather events are expected to reduce yields of staple crops, such as rice, wheat and corn, and the area and quality of farmland, especially in Africa. While a decline in food productivity leads, in general, to an increase in food prices, the increasing costs of fuel and fertilizers further drives up food prices, which have a negative impact on affordability. Owing to several factors, including the armed conflict in Ukraine, the coronavirus disease (COVID 19) pandemic and climate change, global food prices increased by 21 per cent between January and September 2022 compared with the same period in 2021. Children, older persons and pregnant women are among those that are most affected by the impacts of climate change on food accessibility (A/HRC/52/40).

Climate-related changes in agricultural productivity, infrastructure damage from extreme events, and disruptions to food supply chains are already affecting livelihoods and economic activity across regions. These impacts are unevenly distributed and often exacerbate existing inequalities. Smallholder farmers, pastoralists, low-income households, and communities in climate-exposed regions—including parts of Africa, Asia, Central and South America, Small

times (1850-1900). Temperatures have continued to rise since then.

[14] FAO Update 2025 (n 1); see also FAO (2023), Pathways towards lower emissions – a global assessment of the greenhouse gas emissions and mitigation options from livestock agrifood systems.

[15] FAO (n 3), at 5.

[16] FAO (n 3), at 6.

[17] https://www.nature.com/articles/s41558-023-01605-8, 300.

[18] https://pubmed.ncbi.nlm.nih.gov/33154139/.

Island Developing States, and the Arctic—face particularly high levels of risk. Indigenous Peoples and local communities whose livelihoods and cultures are closely tied to ecosystems are especially vulnerable to disruptions in seasonal cycles, biodiversity, and access to traditional foods. Women, agricultural workers, and marginalized populations may experience disproportionate impacts due to structural barriers that limit access to resources, decision-making, and adaptive capacity. At the same time, Indigenous and local knowledge systems have demonstrated important potential to strengthen resilience when integrated with broader climate and food system adaptation strategies.[19]

Together, these dynamics underscore the need for anticipatory and integrated responses that strengthen the resilience of food systems to both gradual and abrupt climate risks. At the same time, some responses intended to address climate change may themselves create new risks if poorly implemented, including land-use competition associated with certain mitigation strategies such as large-scale bioenergy production or poorly planned afforestation.
Access to food: climate-related declines in agricultural productivity can reduce food supply and contribute to rising food prices, thereby weakening purchasing power, particularly among low-income populations that spend a large share of their income on food. Projections suggest that climate change could increase global cereal prices by between 1 and 29 percent by 2050, with a median increase of around 7 percent under current demand projections. Higher prices may reduce calorie consumption and shift diets toward cheaper and less nutritious foods. As a result, climate change is projected to increase the global population at risk of hunger, with estimates suggesting that tens of millions of additional people could face insufficient energy intake by mid-century compared with a scenario without climate change.[20] When families are food-insecure, women and girls are at greater risk of sexual and gender-based violence, which in turn makes women and girls less likely to have access to food (A/HRC/52/40).

Food utilization (the nutritional value, safety, and biological use of food once it is consumed) is affected by climate change impacts on food safety, food quality, and human health. Changes in temperature, precipitation patterns, humidity, and the increasing frequency of extreme weather events can alter the distribution and activity of contaminating organisms, including foodborne pathogens and mycotoxin-producing fungi, increasing risks of contamination across food systems. Climate conditions can also influence storage and transport environments, affecting spoilage and microbial growth. In addition, rising atmospheric carbon dioxide concentrations and changing climatic conditions may alter plant and animal metabolism and affect the nutritional composition of food. Evidence indicates that elevated carbon dioxide levels can reduce concentrations of key nutrients—including protein, iron, and zinc—in some staple crops. Because many populations depend heavily on these foods for essential nutrients, these changes may have implications for nutrition and public health, particularly in regions already facing high levels of micronutrient deficiency. [21]

Food stability (the ability of food systems to provide reliable access to food over time without significant disruptions) is undermined by climate change increasing the frequency and intensity of extreme weather events, including droughts, floods, and heatwaves. Such events can disrupt

[19] https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf; FAO Update 2025 (n 1).
[20] https://www.ipcc.ch/srccl/chapter/chapter-5/; https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf.
[21] Ibid.

agricultural production, damage infrastructure critical to food distribution, and interrupt food supply chains and markets. Evidence indicates that countries exposed to frequent climate extremes tend to experience higher levels of undernourishment, particularly where agricultural systems are highly sensitive to climate variability and where livelihoods depend heavily on agriculture. Climate-driven shocks can also increase volatility in global food production and trade, contributing to fluctuations in food availability and prices. As climate hazards intensify, these dynamics are expected to heighten the risk of food supply disruptions and exacerbate food insecurity, particularly in regions with limited adaptive capacity.[22]

Food affordability: Extreme weather driven by climate change is already pushing prices higher through what economists call "climateflation," with a 2022 European heat wave boosting food costs and overall inflation. Researchers project that elevated temperatures alone could increase consumer prices globally by as much as 1.2% annually by 2035, with food prices rising up to 3% per year.[23]

Without effective adaptation, climate change will increasingly threaten food provision, nutrition, health, and livelihoods, while also disrupting regional and global trade patterns.[24]

FAO estimates that crop and livestock losses associated with climate-related disasters in least developed and lower middle-income countries between 2008 and 2018 correspond to approximately 6.9 trillion kilocalories lost annually.[25] These impacts disproportionately affect smallholder farmers, pastoralists, fishers, and Indigenous communities.[26] Nearly half of National Adaptation Plans (NAPs) report losses and damage in agrifood systems – more frequently than any other sector – highlighting the limits to adaptation.[27]

Climate risks to food systems are expected to increasingly compound and cascade. Higher levels of warming are projected to increase the probability of compound climate events—such as concurrent heatwaves and droughts—that can simultaneously affect crop yields, livestock productivity, and water resources. These events can interact with other stressors, including heat-induced labour productivity losses, damage to infrastructure and transport networks, and disruptions to global supply chains, thereby amplifying food price volatility and reducing household purchasing power. As climate hazards propagate through interconnected food, water, and energy systems, they may also generate transboundary impacts that spread through trade, markets, and natural resource flows.[28]

The IPCC highlights that climate risks affect all pillars of food security, with particularly strong impacts on stability, as extreme events can cause major fluctuations in food availability and access. Within food systems, multiple climate-related risks often occur simultaneously or reinforce one another, which complicates adaptation planning and requires integrated, multi-

[22] Ibid.
[23] Climate change is already showing up in the cost of living - Los Angeles Times, 12 May 2026; referring to https://journals.ametsoc.org/view/journals/bams/105/11/BAMS-D-24-0017.1.xml and https://www.nature.com/articles/s43247-023-01173-x#Abs1.
[24] FAO Update 2025 (n 1).
[25] https://www.fao.org/interactive/disasters-in-agriculture/en/.
[26] https://openknowledge.fao.org/items/ed331aea-c65e-4770-a096-d449cc50fcdf (Pande et al, 2024).
[27] Submission by PROFOREST.
[28] https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf, 98.

scale policy responses. regions are projected to experience an increase in the probability of compound events with higher global warming.[29] The integration of adaptation and disaster risk reduction has increasingly been promoted to reduce duplication and improve the effectiveness of policy interventions. At the same time, the IPCC notes that adaptation and mitigation measures themselves can introduce new forms of risk, including financial, political, or implementation risks. Risk management strategies therefore combine landscape-level approaches that enhance ecological resilience, such as agroecological and multifunctional land-use planning, with financial and institutional mechanisms including insurance schemes, disaster funds, and other risk-sharing instruments.[30]

Crop resilience (the crops' ability to withstand external forces, such as climate impacts or pests) is decreasing on farms, making crops more vulnerable to pests generally. Climate change is negatively affecting certain natural enemies of insect pests, further increasing crops' susceptibility to insect pest damage. For instance, climate change could cause insect pests to migrate to new areas where their natural enemies may be unable to follow, or the synchronisation between the life cycles of pests and their natural enemies may be disrupted. Pesticide applications are known to be harmful to beneficial organisms that control pest populations, and predicted increases in pesticide applications would further reduce these beneficial populations[31] (see section 1.6 on Pesticides below).

1.3 Biodiversity loss

According to the Intergovernmental Science-Policy Panel on Biodiversity and Ecosystem Services (IPBES), unsustainable agricultural practices have contributed to biodiversity loss, and air, water and land pollution, with some systems, such as fisheries, approaching tipping points (see section 7 below). IPBES also stressed that increases in unsustainable food production have been associated with land conversion and the expansion of unsustainable agricultural practices [...] leading to biodiversity loss, reduced water availability and quality, increases in the risk of pathogen emergence and increases in GHG emissions.[32]

The ongoing loss of intact ecosystems is predominantly driven by agriculture and is particularly high in tropical forests that are cleared for pasture, oil crops and soy production. 37% of the global land area (48 M per km²) is currently used for agricultural production, with croplands covering 33% and grading lands covering 67% (2025).[33]

Extensive monocultures are the primary drivers of both biosphere and ecosystem functional integrity loss,[34] by reducing actual net primary productivity through land conversion, biomass

[29] https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf, 101.
[30] https://www.ipcc.ch/srccl/chapter/chapter-5/.
[31] IPBES Nexus Assessment (2024), https://ict.ipbes.net/ipbes-ict-guide/data-and-knowledge-management/citations-of-ipbes-assessments/nexus-assessment
[32] Ibid.
[33] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1642.
[34] Biosphere functional integrity refers to the sum of net primary productivity from all ecosystems on Earth and is therefore used as a control variable for the Earth system. Ecosystem functional integrity refers to ecosystems' capacity to sustain nature's contributions to people.

harvesting and insufficient habitat retention within agricultural lands.[35] Food systems are major users of blue water, mainly via irrigation, which is responsible for around 70-90% of global consumptive water use.[36]

Forests are an important terrestrial carbon sink, but anthropogenic land-use and climate changes have significantly reduced the scale of this system.[37] Agricultural expansion accounted for approximately 90% of global forest cover changes between 2000 and 2018, making food production the leading driver of deforestation.[38] Worldwide, more than half of forest loss is due to conversion of forest into cropland, whereas livestock grazing is responsible for almost 40 percent of forest loss. Land-use change results in the immediate release of carbon stored in vegetation and soils, while simultaneously eliminating future sequestration capacity. CO2 fluxes from land use and land-use change are a major source of anthropogenic CO2 emissions, accounting for around one-third of cumulative CO_2 emissions since 1750 and about 12 percent of current annual emissions, primarily through deforestation.[39] The destruction of forests and other ecosystems for food and commodity production, and intensive monoculture generate the bulk of carbon emissions associated with land use change.[40]

The combined effects of agriculture and climate change are associated with significant declines in insect pollinators, with the tropics expected to face the greatest risks to crop production.[41]

The most recent scientific advances emphasize that the greatest vulnerability in the food system is the reliance on a narrow, genetically uniform base for major crops, creating an ecological tipping point risk. The loss of specific native plant species in converted agricultural landscapes removes the required habitat and food sources for specialized local pollinator species and beneficial soil microbiomes. This forces farmers into higher reliance on fossil fuel-derived chemical inputs (see section 1.6 below), accelerating climate change and resulting in a fundamental violation of the inter-generational equity principle, as future generations inherit a food system incapable of self-regeneration. The health of pollinators is the key indicator for ecosystem stability. States must prioritize legislation that mandates the use of indigenous plant varieties Ecosystem-based adaptation must focus on native genetic diversity [42]

On the other hand, according to IPBES, Indigenous food systems are "response options that are inherently similar to bundles in that they comprise multiple synergistic actions... based on holistic world views."[43] Further, IPBES pointed to biocultural regeneration to integrate new cultural values connected to nature that can simultaneously emerge in society and increase the biocultural value of diverse places where nature and cultural heritage can be jointly conserved by working with those who hold biocultural knowledge on the ground, promoting alternative relations between humans and more-than-humans that are not extractive, supporting high levels

[35] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1642-1643.
[36] Ibid, at 1644.
[37] https://www.nature.com/articles/s41586-023-06723-z#ref-CR1, at 92.
[38] https://www.nature.com/articles/s41598-024-65397-3, 1.
[39] FAO Update 2025 (n 1); Stavi, I. 2023. Urgent reduction in greenhouse gas emissions is needed to avoid irreversible tipping points: time is running out. All Earth, 35: 38–45. https://doi.org/10.1080/27669645.2023.2178127.
[40] UNCCD, Global Land Outlook (2025), https://www.unccd.int/resources/global-land-outlook/overview.
[41] https://www.science.org/doi/10.1126/sciadv.adh0756.
[42] Submission by Ritu Dhingra.
[43] Ibid.

of biodiversity. These biocultural regeneration approaches can either generate or regenerate living autonomous cultures with care-oriented values.[44]

1.4 Soil degradation and soil as a carbon sink

Soils contain about 1.8 times more carbon than the atmosphere and 2.3–3.3 times more than that stored in global terrestrial vegetation.[45] Soil erosion is projected to increase globally under climate change,[46] which reduces crop yields and the soil's ability to store and cycle carbon, nutrients and water.[47] Soil degradation further amplifies climate impacts. Intensive tillage, monocropping, and overgrazing reduce soil organic carbon stocks and diminish long-term sequestration potential.[5] Soil erosion from agricultural fields is estimated to occur at rates 10 to more than 100 times higher than natural soil formation.[48]

Cropland soils offer major potential for carbon sequestration, particularly those with large yield gaps and/or large historic soil organic carbon losses.[49] Soil organic carbon accumulation can be enhanced through agricultural diversification practices that promote plant root formation, microbial activity and the return of organic matter to soils, but uncertainties remain regarding the permanence of soil carbon pools.[50] That said, the climate mitigation potential of soil organic carbon sequestration is context-specific.[51] The potential to increase soil organic carbon declines as climate change intensifies, given that soils have a lower capacity to sequester carbon at higher temperatures.[52]

Despite the central importance of soil health and below-ground biodiversity to food production, these systems have historically been neglected.[53] Of the nine planetary boundaries identified in Earth system science, four—climate change, biodiversity loss, land-system change, and geochemical cycles—have already been exceeded, and each is directly linked to the degradation of soil, water, and ecosystem integrity. If current land degradation trends persist, the risk of widespread, abrupt, or irreversible environmental change will continue to increase.[54]

As the UN Special Rapporteur on the Right to Food underscored, "Without fertile soil the world cannot eat – to abuse soil is a violation of the right to life itself. Yet approximately 33 per cent of land is classified as degraded because of erosion, salinization, compaction, acidification and

[44] IPBES Transformative Change Assessment (2024), https://ict.ipbes.net/ipbes-ict-guide/data-and-knowledge-management/citations-of-ipbes-assessments/transformative-change-assessment; E Gordon et al (forth), Conserving and regenerating the biocultural value of place: a key strategy for transformative change.
[45] https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter06_FINAL.pdf; https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 366.
[46] https://www.sciencedirect.com/science/article/pii/S0012825222000058.
[47] https://openknowledge.fao.org/server/api/core/bitstreams/ecb51a59-ac4d-407a-80de-c7d6c3e15fcc/content, at 23; see also A/HRC/53/47, para.15.
[48] https://www.ipcc.ch/srccl/chapter/summary-for-policymakers/.
[49] https://www.nature.com/articles/s41467-020-18887-7, 1.
[50] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1649.
[51] https://onlinelibrary.wiley.com/doi/10.1111/gcb.16570, at 2393.
[52] https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 36.
[53] https://www.unccd.int/resources/global-land-outlook/overview.
[54] Ibid, at 3.

chemical pollution. Land degradation has intensified over the past decades as a result of mounting pressures from industrial agriculture and livestock operations, including overcultivation, overgrazing and forest clearing. negative impact of corporate-led industrial agriculture on the human right to water" (A/79/190).

A Save Soil study warns that the ongoing decline in soil health is directly contributing to nutritional loss in food. Foods produced in soil rich in organic matter contribute to a healthy gut microbiome, which has been found to play an important role in mood, immune function, and health. Soil degradation also undermines access to healthy environments by contributing to air pollution, vulnerability to natural disasters, and urban heat islands[55] (see also Section below).

1.5 Food waste

About 1.3 billion tonnes of food is wasted each year. Producing food that is never eaten emits 3.3 billion tonnes of carbon dioxide annually. 54 percent of food waste occurs before reaching consumers (production, harvest, storage).[56] Producing, transporting and letting food rot, contributes more than 8 to 10 percent of global GHG emissions, nearly five times the total emissions from the aviation sector. Data on the breakdown between food and inedible parts wasted is available only in a few high-income countries, and shows a fifty/fifty split on average at the household level. Food that is produced but never eaten generates about 3.3 gigatonnes of CO_2-equivalent emissions annually. If food waste were a country, it would be the third-largest emitting country in the world.[57]

Even though 89 percent of national determined contributions (NDCs) across the world mention agriculture production and include agriculture emissions reduction targets, reduction of food loss and wastage or shifts to sustainable diets continue to be ignored even though they account for up to 37 percent of all GHG missions.[58]

Food waste at the farm level is a major global issue, with around 1.2 billion tonnes, about 15 percent of all food produced, lost before it leaves farms. This waste is caused by a mix of environmental factors like pests, disease, and extreme weather, as well as human and systemic issues such as poor storage, inadequate technology, and inefficient harvesting practices. Market also plays a role; supermarkets often impose strict cosmetic standards and unpredictable orders, pushing farmers to overproduce and discard edible but 'imperfect' crops. As a result, vast

[55] https://earth.org/new-report-reveals-crucial-links-between-soil-quality-and-human-health-calls-for-global-action/; Submission by GCHA.
[56] https://www.wri.org/insights/whats-food-loss-and-waste-got-do-climate-change-lot-actually; https://www.unep.org/news-and-stories/press-release/food-waste-harms-climate-water-land-and-biodiversity-new-fao-report; www.unep.org/resources/report/unep-food-waste-index-report-2021.
[57] https://www.un.org/en/climatechange/science/climate-issues/food.
[58] Submission by UNEP; UNEP, *Enhancing Nationally Determined Contributions (NDCs) for Food Systems*, 2023.

amounts of land, water, and resources are used to grow food that is never consumed, contributing to environmental damage.[59]

In turn, food losses occur from production and post-harvest handling in developing countries, often due to limited infrastructure, storage, and technology and to retail and consumer levels in higher-income countries. In turn, inefficiencies in the food system led to substantial resource waste, including land, water, and energy, and contribute to food insecurity.[60]

The UN Working Group on Business and Human Rights has underscored that "Reduced access to financing, land tenure concerns, poor infrastructure, inadequate storage facilities, limited access to technologies, and the weak capacity of informal actors, among other factors, continue to exacerbate food loss and waste during the production, post-harvest and processing stages in the informal economy."[61]

FAO has identified global environmental hotspots related to food wastage at regional and sub-sectoral levels, for consideration by decision-makers wanting to engage into waste reduction:

- high carbon-intensity of rice production methods (e.g. paddies are major emitters of methane), combined with high quantities of rice wastage;
- waste of meat, even though wastage volumes in all regions are comparatively low, generates a substantial impact on the environment in terms of land occupation and carbon footprint, especially in high income regions (that waste about 67 percent of meat) and Latin America;
- fruit waste emerges as a blue water hotspot in Asia, Latin America, and Europe because of food wastage volumes;
- vegetables waste in industrialised Asia, Europe, and South and South East Asia constitutes a high carbon footprint, mainly due to large wastage volumes. [62]

The combined toll of food loss and waste on the global economy was estimated, in 2022, to be around USD 1 trillion annually.[63]

1.6 Links with fossil fuels and petrochemicals

Industrial agriculture has developed a significant dependency on fossil fuels for energy purposes, as well as fossil-based feedstocks, through the use of synthetic fertilisers and pesticides manufactured from petrochemicals, diesel-powered equipment, long-distance

[59] Earth.org. Food Waste on Farms and its Environmental Impacts (2022): https://earth.org/food-waste-on-farms/ and Sustainable Agriculture Network: https://www.sustainableagriculture.eco/post/addressing-food-waste-in-agricultural-supply-chains and WWF, Food Waste on Farms: https://www.wwf.org.uk/food/waste/farms.
[60] https://www.fao.org/4/mb060e/mb060e02.pdf.
[61] A/HRC/62/36, para 22.
[62] FAO (2013), Food Wastage Footprint: Impacts on Natural Resources: https://www.fao.org/4/i3347e/i3347e.pdf.
[63] https://unfccc.int/news/food-loss-and-waste-account-for-8-10-of-annual-global-greenhouse-gas-emissions-cost-usd-1-trillion.

refrigerated transportation and globalised logistics that prioritise volume over resilience.[64] Food system accounts for at least fifteen percent of fossil fuel and forty percent of petrochemical consumption.[65]

The rise of corporate power in food systems correlates with the increasing industrialisation of food production. Corporate-led industrial food systems have increased rates of GHG emissions, biodiversity degradation, pollution, and systemic human rights violations.[66] Corporate capture and monopolistic power enable companies to externalise environmental and social costs associated with their activities, such as GHG emissions and worker exploitation, to farmers, consumers and rural communities.[67] Large-scale land acquisition and consolidation within the agribusiness sector also solidifies fossil-based export-oriented production models, thus limiting government's policy options for diversified production models, seed sovereignty and low input production models (A/80/213).[68]

In effect, industrialized food systems are closely tied to the fossil fuel economy through a combination of ownership ties, shared investors and technologically dependent relationships, particularly petrochemical based fertilisers, pesticides, plastic packaging, mechanised agriculture, long distance refrigeration and industrial food processing. The majority of large agribusiness companies have originated from fossil fuel-based conglomerates or are partners with these same entities which provide critical inputs.[69]

The chemical industry has been co-evolving with the energy system: the use of chemical feedstock has followed the trajectory of the energy system, using new sources of feedstock as they became available at low cost, reinforcing their extraction and use. In this sense, the two generalized uses of hydrocarbons—as feedstock and as fuels—are mutually dependent.
petrochemicals are necessary to build out renewable energy infrastructure. When justifying current production and ongoing expansion, industry actors foreground the use of petrochemicals for carbon fiber in wind turbine blades while framing out the co-dependence of feedstock and fuels.[70]

Petrochemicals are considered in the literature as "the means through which oil has become woven into the very fabric of our social existence, yet this ubiquity has made them almost invisible to our everyday consciousness."[71] The term “fossil fuel” itself is incomplete; it obscures the role of oil, gas, and coal as foundational feedstocks for synthetic materials. Understanding this “non fuel” sector is essential to challenge the industry’s primary area of expansion – three-quarters of petrochemical production (by volume) is dedicated to plastics (including synthetic fibres) and nitrogen fertilizers, but also the expansion of petrochemicals into fuel applications. In recent years, petrochemical feedstock use has accounted for almost

[64] Jiang et al (2024), ‘Tracing Fossil-Based Plastics, Chemicals and Fertilizers Production in China’ 15 Nature Communications 3854; Submission by Ekhator and Lalude.
[65] Tilsted et al (2022), ‘Petrochemical Transition Narratives: Selling Fossil Fuel Solutions in a Decarbonizing World’ 94 Energy Research & Social Science, doi.org/10.1016/j.erss.2022.102880.
[66] Submission by the Global Climate & Health Alliance (GCHA).
[67] Submission by Ekhator and Lalude.
[68] Ibid.
[69] Ibid.
[70] Tilsted et al. (n 62).
[71] “Petrochemical Empire,” New Left Review 130 (2021), doi.org/10.64590/kbq.

all of oil demand growth, comprising 15.8 percent of oil demand in 2024, with the IEA projecting demand will increase to 17.4 percent by 2030. During this same period, the production of ammonia — a key primary chemical and the chemical base of all nitrogen fertilizers — saw a more modest increase of 3.7 times.[72]

Petrochemicals are a key driver of fossil fuel demand growth, effectively anchoring the industry's future even as other sectors transition away from fossil fuels. The IEA 2025 World Energy Outlook, which highlights that under the Current Policies Scenario, where no additional policy action is taken to curb fossil fuel consumption, oil use for petrochemical feedstocks and industrial activities will represent among the largest demand increases through 2035. Even when accounting for announced climate pledges, the IEA projects that a surge in petrochemical production, as well as growth in aviation and other industrial activities, will more than offset the reductions achieved in power and passenger vehicle sectors.[73]

Emerging-economy petrochemical corporations are becoming partners for a very resilient and integrated network of European and North American companies through joint ventures and spatial interlocks in petrochemical hub cities. This reflects recent evolutions in the oil industry, with state-controlled oil companies' remarkable expansion and simultaneous integration. The result is that traditional Western multinationals and emerging economy corporations have become increasingly interdependent.[74]

The widespread use of petro-chemicals generates serious and gender-differentiated health harms that are embedded in food systems that prioritize overproduction over care and prevention.[75] The proliferation of synthetic materials, their relative cheapness, and their compatibility with imaginaries of modernity mean that they have become embedded in social relations in entrenched and taken-for-granted ways. Links to the military (through chemical warfare and the use of petrochemicals for explosives) allow the industry to position itself in service of both personal, national, and international security.[76]

Academic research also reveals that industrial intensification of food production was specifically designed to make farmers dependent on expensive inputs provided by agrochemical companies; and market concentration (see section below) means that a small number of companies will unfairly control the price of seeds, which in turn increases the cost of farming, making it harder for farmers to turn a profit. Moreover, the "Big Four" in the seed sector produce most of the agrochemicals correlated with genetically modified seeds. Those agrochemicals reduce biodiversity, which in turn lowers agricultural resilience, making farms more vulnerable to climate change shocks (A/80/213).

[72] Centre for International Environmental Law (CIEL), Curb Petrochemicals to Unlock a Full Fossil Fuel Phaseout (2025), https://www.ciel.org/wp-content/uploads/2026/03/Curb-Petrochemicals-to-Unlock-Fossil-Fuel-Phaseout.pdf, referring to IEA, Oil 2025 Analysis and Forecast to 2030 (2025), 29, https://iea.blob.core.windows.net/assets/c0087308-f434-4284-b5bb-bfaf745c81c3/Oil2025.pdf.
[73] CIEL (n 69), referring to IEA, World Energy Outlook 2025 (IEA, 2025), 152, https://www.iea.org/reports/world-energy-outlook-2025.
[74] https://doi.org/10.1080/00130095.2020.1794809.
[75] Submissions by Brazil. Guatemala, Mexico, Palestine and WECF.
[76] https://www.sciencedirect.com/science/article/pii/S0016718524000423.links.

Academic research has identified as a key obstacle to transitioning away from fossil fuels the multiscalar problem of petrochemical lock-in, related to growing global demand for carbon-intensive plastics consumption, the use of petrochemicals in green technologies, and regional and local economic dependencies, with significant risks of the co-option and rollback of decarbonisation agendas. To navigate this landscape, researchers consider it essential to understand the gap between dominant and alternative narratives, and between highly unequal social and ecological consequences of industrial transformations.[77]

In the context of bringing about renewable energy transitions (see A/80/188), a key question is whether the chemical industry can undergo a transformation to source new forms of feedstocks to defossilize. To that end, researchers also point to the need for governments and industry to move beyond 'plug and play' approaches to energy transitions, which focus on substitutability and shifts in technology and energy sources but not in ownership, control, modes of provision, or power relations.[78]

Fertilizers

Agriculture is the largest emitter of anthropogenic nitrous oxide emissions.[79] Nitrous oxide emissions from agricultural soils are driven predominantly by nitrogen inputs from synthetic fertilizers[80] and manure.[81] Nitrogen losses through runoff and leaching can also generate indirect emissions. In parts of Africa, South America, and South and Southeast Asia, nitrogen fertilizer use has grown markedly, reinforcing this trend.[82]

Nitrogen fertilizers are made of ammonia, which is nearly twice as emissions-intensive as steel production and four times that of cement. 70 to 90% of production costs for fertilizers are fossil gas costs, remainder on coal. Excessive nitrogen application contributes substantially to nitrous oxide emissions, freshwater contamination, and fossil energy demand associated with fertilizer production. Enhanced nutrient stewardship, through precision application, biological nitrogen fixation, and integrated soil fertility management, offers a rare policy convergence, enabling emissions mitigation, environmental protection, and yield stability simultaneously.[83]

Excess fertiliser use can cause nitrogen pollution of drinking water, which has been associated with methemoglobinemia, colorectal cancer, thyroid disease and birth defects.[84] Industrial agricultural practices are the leading cause of water pollution and the largest threat to the drinking water supply of hundreds of millions of people due to the extensive use of industrial pesticides and fertilizers and to slurry from intensive livestock farming (A/80/213). The groundwater threshold for nitrogen pollution is exceeded in 38% of global agricultural lands, particularly affecting the health of rural populations dependent on groundwater.[85] Using far

[77] https://www.rivisteweb.it/doi/10.1425/101444.
[78] https://doi.org/10.1080/09692290.2025.2467394.
[79] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1649.
[80] FAO Update 2025 (n 1).
[81] https://www.unccd.int/resources/global-land-outlook/overview.
[82] FAO Update 2025 (n 1), at 21.
[83] FAO (n 59).
[84] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1633.
[85] Ibid.

less to no chemical fertilizer can result in farms causing fewer GHG emissions and less toxic pollution while also making them more productive and resilient to climate change (A/HRC/52/40).

From a food security perspective, reliance on technologically sophisticated fertilizer pathways may also deepen dependency on global supply chains, financial markets, and proprietary technologies, increasing vulnerability to price volatility and geopolitical shocks. Rather than strengthening food sovereignty, such transitions may lock farmers, especially in the Global South, into new forms of technological dependence that undermine local autonomy and adaptive capacity.[86] Agrochemicals used in industrial food production systems offer generally short-term fixes rather than long-term solutions to food insecurity and pollute the environment, lowering agricultural resilience and making farms more vulnerable to climate change shocks (A/HRC/55/37).

From the perspective of the human right to health, nitrogen pollution from fertilisers is associated with roughly 4 million new cases of paediatric asthma per year, and is largely responsible for agriculture, globally, accounting for 650,000 deaths (20% of mortality) related to poor air quality.[87]

The war in Ukraine has disrupted the global chemical fertilizer supply chain (A/HRC/52/40), while the aggression of Iran led to disruptions of fossil fuel and fertilizer supply chains and increases in costs.[88]

Pesticides

Pesticides and chemical fertilisers, along with other components of the pre- and post-production stages (feed production, processing, storage, refrigeration, retail, waste disposal, food service, transport), account for an estimated 5-10% of GHG emissions.[89]

These estimates of GHG emissions by pesticides, however, only factor in the energy used to produce the active ingredients. A more comprehensive estimate should also include the energy needed to formulate the pesticide products and manufacture the inert ingredients, which can make up the majority of a product. For instance, inert ingredients make up as much as 50–75% of glyphosate products. More than 500 of these so-called inert ingredients have been or are currently used as active ingredients, yet due to proprietary protections, the identification and volume of these ingredients are kept secret from the public, making it impossible to calculate energy requirements for the manufacture of pesticide products in their entirety.[90] Additional emissions result from the release of the pesticide into the environment and the pesticide's

[86] https://doi.org/10.1016/j.erss.2022.1024947; Dunlap et Jakobsen (2020). The Violent Technologies of Extraction. In Technologies of Insecurity: The Surveillance of Everyday Life.
[87] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1633.
[88] https://www.iea.org/data-and-statistics/data-tools/2026-energy-crisis-policy-response-tracker.
[89] https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 476 and 478-479; A/HRC/53/47, para. 15.
[90] IPEN (2023), Pesticides and Climate Change: A Vicious Cycle, https://www.panna.org/wp-content/uploads/2025/05/202308ClimateChangeEng-Aug23-.pdf.

subsequent interactions with organisms in the soil and with the atmosphere, both in the short- and long-term.[91]

Furthermore, some pesticides are themselves greenhouse gases. The fumigant sulfuryl fluoride (used to fumigate commodities during transport and storage), is a powerful greenhouse gas. Emitting just one ton (0.91 tonnes) of sulfuryl fluoride is the equivalent of emitting 4,780 tons (4,336 tonnes) of CO_2. 47 Meanwhile, other pesticides interact with the environment to produce greenhouse gases in a variety of ways. Since often less than 0.1% of applied pesticides reach their target, with the rest ending up on plant leaves, in the soil, in water, or in the air, the implications for GHG emissions of these pesticides' fate (their off-target movement) in the environment is significant.[92]

85–90% of global pesticide application occurs in agriculture. Individual pesticide concentrations exceed safety levels across both terrestrial and aquatic systems.[93] While most pesticides degrade over time, remaining residues can accumulate in organisms and mix with the environment. Legacy contamination can remain in soil, surface water and groundwater for extended periods of time.[94] Chronic exposure to pesticides, including through the consumption of contaminated foods, is associated with increased risks of Parkinson's disease, diabetes, cancer, cardiovascular disease and possibly with infertility.[95]

Moreover, studies show that the emission of pesticides, often derived from fossil fuels, and toxic metals intended to inhibit bacterial growth, can actually lead to anti-microbial resistance. In 2020 alone, global pesticide use in agriculture amounted to 2.7 million tons of active ingredients.[96]

Long-term pesticide use has serious impacts on soil health. Pesticides have a detrimental effect on soil microorganisms crucial for soil health and productivity, and which play a critical role in the carbon and nitrogen cycles that control emissions of carbon dioxide, methane, and nitrous oxide from soils. Pesticide applications emit volatile organic compounds which react with nitrogen oxides and UV rays to produce ground-level ozone. Some commonly used pesticides have also been shown to dramatically increase emissions of nitrous oxide from soils.[97] For instance, the use of chloropicrin—a commonly used fumigant approved for use in the US but never approved in the UK—could increase nitrous oxide production seven to eight-fold.[98]

Globally, 44% of farmers are poisoned by pesticides every year.[99] Neonicotinoids, a type of insecticide, have received public attention due to their significant harm to pollinators, like honey bees. Honey bees play essential roles in pollinating agricultural crops. The service they

[91] Ibid.
[92] Ibid.
[93] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1646.
[94] Ibid.
[95] Ibid, at 1633.
[96] Submission by GCHA.
[97] https://www.pan-uk.org/site/wp-content/uploads/Cultivating-Coherent-Climate-Action.pdf.
[98] Spokas and Wang (2003), 'Stimulation of nitrous oxide production resulted from soil fumigation with chloropicrin' 37 Atmospheric Environment 3501.
[99] IPEN (2024), Pesticides and the Climate Crisis: https://www.pan-uk.org/pesticides-and-the-climate-crisis/.

provide to pollinating crops has been estimated to be worth approximately £691 million per year for the UK.[100]

Increased temperatures are anticipated to result in more pesticide volatilisation (when pesticides transform into a gas) —meaning more pesticides will end up in our air, rather than on their application target. Volatilisation is a key source of pesticide drift, which can cause pesticide poisoning for anyone exposed to the toxic vapor. An increase in severe rain events is expected to increase pesticide loss to waterways. Climate change effects will cause faster pesticide degradation, meaning pesticides will break down faster and become less effective over time.[101]

Manufacturing one kilogram of pesticide active ingredient requires, on average, about 10 times more energy than one kilogram of nitrogen fertiliser.[102] One should also consider emissions from pesticide waste, such as obsolete stockpiles (stockpiles of pesticides that have expired, been made illegal to use or are otherwise unwanted) and their disposal through burning and other methods. Further, pesticides are coated in microplastics, which are derived from fossil fuels, to ensure more controlled release of the product.[103]

The production of herbicides creates between 18.22 and 26.63 kilograms of CO_2eq per kilogram produced on average. The production of insecticides creates between 14.79 and 18.91 kilograms CO_2e per kilogram and the production of fungicides creates between 11.94 and 29.19 kilograms CO_2e per kilogram on average. The GHG emissions of glyphosate, the world's most popular herbicide, produces 31.29 kilograms of CO_2e per kilogram while other pesticides produce greater than 40 kilograms CO_2e per kilogram. To put this in perspective, the energy used to produce the amount of glyphosate used globally in 2014 equals the energy needed to fuel about 6.25 million cars for one year.[104]

Certain practices labelled climate-smart, such as no-till, often rely heavily on synthetic herbicides to control weeds on conventional farms and can lead to increased weed resistance to herbicides.[105] In addition, 'precision agriculture', which promises to reduce the use of petroleum-derived pesticides and fertilisers by using computer-aided technologies to more accurately determine need (pest presence) and then more accurately apply pesticides to intended targets, is expensive, only available to a very limited number of farmers or areas, and maintain a system dependent upon chemical and energy-intensive technologies and materials, while diverting attention from and investment in more effective climate- friendly strategies in agriculture that have additional social and public health co-benefits, such as agroecology. Precision agriculture also increases the power and control of agrochemical companies, many of which own the precision agriculture platforms and the data inputted by farmers.[106]

[100] https://www.pan-uk.org/pesticides-and-the-climate-crisis/.
[101] IPEN (n 95).
[102] Audsley et al (2009). Estimation of the greenhouse gas emissions from agricultural pesticide manufacture and use. Cranfield University, https://dspace.lib.cranfield.ac.uk/server/api/core/bitstreams/78cd42ff-e564-4112-ab50-e5e7fc4da80a/content; Ahlgren et al (2008), 'Ammonium nitrate fertiliser production based on biomass–environmental effects from a life cycle perspective' 99 Bioresource Technology 8034.
[103] IPEN (n 86).
[104] Ibid.
[105] Ibid.
[106] Sarku & Ayamga (2025), 'Is the right going wrong? Analysing digital platformization, data extractivism and surveillance practices in smallholder farming in Ghana' Information Technology for Development, 1–27.

Plastics

The International Energy Agency (IEA) reports that petrochemicals—of which plastics are the primary output—are already the main driver of oil demand growth and could account for 50% of global oil demand by 2050.[107] In particular, plastic production and waste are projected to triple by 2060 under existing policies, driving the non-energy uses of fossil fuels.[108]

The existing data indicate that the plastics lifecycle is responsible for roughly 4% of total global GHG emissions at present, though the data gaps mean it is almost certainly higher (i.e., the plastics sector may be consuming more of the remaining carbon budget than currently assumed). In addition, the various forms of plastic pollution (including macroplastics, microfibers, other microplastics, nanoplastics, and the chemicals in plastics) affect a range of organisms and ecosystems that are vital to the planet's carbon cycle, altering the way that carbon is absorbed from the atmosphere and stored in plants, soils, the ocean, and other carbon sinks – worsens climate change. Existing data indicate that plastics are adversely impacting the oceans' ability to remove carbon from surface waters and store it in the deep ocean, are harming the health of microscopic marine plants that use carbon dioxide for photosynthesis (and thus act as carbon sinks), and are increasing the release of carbon dioxide from soils. Third, plastic particles may physically affect the Earth's radiation budget, changing how the planet reflects, absorbs, traps, and moves energy in the atmosphere and on the surface of the Earth. The indications are that plastic particles on the surface may increase reflectivity, which would have a cooling effect, and that plastic particles in the atmosphere may directly affect energy exchange between the surface and the atmosphere in ways that would also produce a cooling effect.[109]

Plastics are widely used throughout agrifood value chains, including crop and livestock production, fisheries and aquaculture, forestry, food processing and food packaging.[110] While plastics can improve productivity, resource efficiency and food loss reduction, their increasing accumulation in terrestrial and aquatic environments poses risks to soil health, biodiversity, food safety and human health. Agricultural soils are among the main recipients of plastic pollution and may contain higher concentrations of microplastics than marine environments.[111]

The degradation of plastic products used in agriculture can result in persistent micro- and nanoplastics in soils and water, which may enter food chains and raise concerns for food safety and human health, although their precise impacts on soil and water quality and long-term agricultural productivity remain key gaps in current scientific knowledge requiring further

https://doi.org/10.1080/02681102.2024.2447596; Gorain et al. (2024). Ethical Harvest: Ensuring Fairness and Privacy, https://link.springer.com/chapter/10.1007/978-3-032-05603-0_8.

[107] International Energy Agency, "Oil 2023: Analysis and Forecast to 2028" (IEA, 2023).

[108] Hanieh, 'Petrochemical Empire' New Left Review 130 (2021), doi.org/10.64590/kbq.

[109] Kaufman et al, *Plastics: Exposing Their Climate Impacts* (2025).

[110] FAO. 2021. Assessment of agricultural plastics and their sustainability: A call for action, https://openknowledge.fao.org/handle/20.500.14283/cb7856en, 10, 27.

[111] FAO. 2023. Plastic pollution and agrifood systems: Why One Health matters now more than ever. https://www.fao.org/one-health/highlights/plastic-pollution-and-agrifood-systems/en.

research. There are indications, however, that degradation disproportionately affects smallholder farmers, fishers and rural communities whose livelihoods depend directly on natural resources.[112]

Migration of chemicals from food packaging into food and beverages is considered the largest least controlled source of human exposure to chemicals associated with plastic.[113] A majority of these chemicals of concern are petro-additives or come from fossil-based materials.

Over 16,000 chemicals are used in plastics, of which at least 4,200 are classified as persistent, bioaccumulative, mobile, and/or toxic, yet only 6% are subject to global regulation.[114] Plastic chemicals include known endocrine disruptors, carcinogens, and mutagens, which have been identified in human blood, amniotic fluid and urine,[115] with evidence of detrimental health effects even at very low levels.[116] Health concerns include reproductive and developmental disorders, including infertility; obesity, and noncommunicable diseases including diabetes, cardiovascular disease, and many cancers.[117]

Plastic production involves the emission of toxic substances, including volatile organic compounds like Benzene, Toluene, PAHs, etc., all of which have carcinogenic and/or endocrine-disrupting properties.[118] There is strong scientific consensus that transboundary exposure to plastic chemicals, plastic accumulation, plastics-associated air pollutants and GHG emissions is harming human health globally, with micro- and nanoplastics posing a significant cause for concern.[119] Micro- and nanoplastics are now ubiquitous in the environment and have been found in human brains,[120] lungs,[121] gastrointestinal tracts,[122] and even the placenta.[123] Once inside the body, microplastic particles can cross biological boundaries. Polyethylene particles from artificial joint replacements were found to have translocated to the lymph nodes, liver, and

[112] FAO. 2024. FAO's work on the use and management of plastics in agriculture and the Voluntary Code of Conduct on the Sustainable Use and Management of Plastics in Agriculture. Committee on Agriculture, 10, Guidelines 2.5 and 2.6.
[113] https://www.tandfonline.com/doi/abs/10.1080/10408390500295490.
[114] Wagner et al (n 103).
[115] Symeonides et al (2024), "An Umbrella Review of Meta-Analyses Evaluating Associations between Human Health and Exposure to Major Classes of Plastic-Associated Chemicals," 90 *Annals of Global Health* 52.
[116] EFSA Panel on Food Contact Materials, Enzymes and Processing Aids et al. (2023), "Re-Evaluation of the Risks to Public Health Related to the Presence of Bisphenol A (BPA) in Foodstuffs," 21 *EFSA Journal*, e06857; Maffini et al., "Role of Epidemiology in Risk Assessment: A Case Study of Five Ortho-Phthalates," 20 *Environmental Health*, 114.
[117] Landrigan et al. (2023), "The Minderoo-Monaco Commission on Plastics and Human Health," 89 *Annals of Global Health*, 23.
[118] Azoulay et al (CIEL, 2019), Plastic & Health: The Hidden Costs of a Plastic Planet: https://www.ciel.org/wp-content/uploads/2019/02/Plastic-and-Health-The-Hidden-Costs-of-a-Plastic-Planet-February-2019.pdf.
[119] O'Meara 2023), "Human Rights and the Global Plastics Treaty to Protect Health, Ocean Ecosystems and Our Climate," 38 The International Journal of Marine and Coastal Law 480; Varvastian (2023), "The Role of Courts in Plastic Pollution Governance," 72 *International & Comparative Law Quarterly* 635.
[120] Nihart et al. (2025), "Bioaccumulation of Microplastics in Decedent Human Brains," *Nature Medicine*, 1.
[121] Jenner et al. (2022), "Detection of Microplastics in Human Lung Tissue Using μFTIR Spectroscopy," 831 *The Science of the Total Environment*: 154907.
[122] Turroni et al. (2021), "Microplastics Shape the Ecology of the Human Gastrointestinal Intestinal Tract," 28 *Current Opinion in Toxicology* 32.
[123] Ragusa et al. (2021), "Plasticenta: First Evidence of Microplastics in Human Placenta," 146 *Environment International*: 106274.

spleen.[124] Studies in the emerging field of pulmonary nanodrug delivery show that nanoparticles of 4 nm, 8 nm, 12 nm, and 16 nm can penetrate lung tissue pulmonary surfactant membranes.[125]

In addition, plastics contain 'novel entities' that could have large-scale impacts that threaten the integrity of Earth system processes, exceeding societies' ability to conduct safety related assessments and monitoring. Novel entities are "chemicals and other new types of engineered materials or organisms not previously known to the Earth system as well as naturally occurring elements (for example, heavy metals) mobilized by anthropogenic activities"[126] that can have widespread distribution and accumulation in organisms and the environment, with inevitable global release since production is fed into highly complex, and poorly known global supply chains. [127] Novel entities could have large-scale impacts that threaten the integrity of Earth system processes: increasing rate of production and releases of larger volumes and higher numbers of novel entities with diverse risk potentials exceed societies' ability to conduct safety related assessments and monitoring. These substances have lock-in effect, so a restriction in production and use of one set of chemicals leads to a shift in production of closely related chemicals (e.g., dielectric fluids shifting from PCBs to chlorinated paraffins, polycarbonate production shifting from bisphenol A to other bisphenols), and not to a reduction in total chemical production. Chemical production is fed into highly complex, and poorly known global supply chains.[128]

Migration of chemicals from food packaging into food and beverages is considered the largest least controlled source of human exposure to chemicals associated with plastic.[129] This is particularly the case in ultraprocessed products, which rely on cheap, easily exchangeable ingredients, have a long shelf life, cause addiction and overeating, pose a great risk of obesity and noncommunicable diseases, and can be sold at a much higher price than their production cost. The result is that corporations are driving the homogenization of diets, while marketing ultraprocessed products and countering efforts to restrict their consumption. While these products provide an illusion of diversity, they rely on a handful of crops, the derivatives of which are used to assemble the products. The demand for these crops is a critical driver of biodiversity loss (A/80/213).

The plastic that is most hazardous based on carcinogenic monomer release includes: polyurethanes (flexible foam in furniture, bedding, and carpet backing), polyvinyl chloride (pipes, packaging, wire, and cable coatings, the monomer being vinyl chloride), epoxy resins (coatings, adhesives, and composites, such as carbon fiber and fiberglass), and polystyrene

[124] Urban et al. (2000), "Dissemination of Wear Particles to the Liver, Spleen, and Abdominal Lymph Nodes of Patients with Hip or Knee Replacement," 82 *The Journal of Bone and Joint Surgery* 457.
[125] Xu et al. (2017), "Transport of Nanoparticles across Pulmonary Surfactant Monolayer: A Molecular Dynamics Study," 19 *Physical Chemistry Chemical Physics: PCCP*, 17568.
[126] https://www.researchgate.net/publication/270898819_'Planetary_Boundaries_Guiding_Human_Development_on_a_Changing_Planet.
[127] https://www.nature.com/articles/s41586-025-09184-8.
[128] Monclús et al (2025), Mapping the chemical complexity of plastics, 643 *Nature*, 349.
[129] Grob et al (2006), "Food Contamination with Organic Materials in Perspective: Packaging Materials as the Largest and Least Controlled Source? A View Focusing on the European Situation," 46 *Critical Reviews in Food Science and Nutrition*, 529.

(food packaging, CD cases, hard plastic in consumer products, the monomer being styrene).[130] A majority of these chemicals of concern are petro-additives or come from fossil-based materials.

Due to the complexity of altering chemical processes after construction, production facilities remain largely dependent on fossil fuels for both energy and feedstocks, as their designs are not easily adaptable to alternative sources once built.[131] More than 1,400 fossil fuel-dependent petrochemical facilities could begin operations before 2027, most of them dedicated to producing primary plastics and their building blocks.[132] If left unchecked, plastic production will grow from 460 million tons per year in 2019 to approximately 1 billion tons per year by 2050, driving fossil fuel demand.[133]

Over the past decade, companies have overbuilt plastics production capacity in particular, leading to low-capacity utilization rates, slim margins, and plant closures. The plastic production industry is, thus, experiencing global overcapacity, with more production facilities than actual demand, and demand growth failing to keep pace with the rate of new facility construction.[134] This has resulted in weak financial performance,[135] profit losses,[136] and an increasing reliance on subsidies to sustain the financial stability of companies.[137] For example, in the case of polyethylene—one of the most widely used plastics—more than 23 million tons of capacity will need to be shut down by 2030 to ensure facilities operate at financially sustainable levels.[138] This financial strain provides a strategic entry point for managed decline pathways.[139]

The FAO *Provisional Voluntary Code of Conduct on the Sustainable Use and Management of Plastics in Agriculture* preventive approaches, reduction of unnecessary and problematic plastic products,[140] the need to protect agricultural workers, waste handlers and rural communities from health and environmental risks associated with plastics, including exposure to hazardous additives and poorly managed waste.[141] FAO has further highlighted that the

[130] Lithner et al (2011), "Environmental and Health Hazard Ranking and Assessment of Plastic Polymers Based on Chemical Composition," 409 *The Science of the Total Environment* 3309.
[131] Bauer et al. (2022), "Plastics and Climate Change Breaking Carbon Lock-Ins through Three Mitigation Pathways," 4 *One Earth* 361.
[132] Global Data (2023), "Petrochemicals New Build and Expansion Projects Analysis by Type, Development Stage, Key Countries, Region and Forecasts, 2023–2027" https://www.globaldata.com/store/report/petrochemicals-new-build-and-expansion-projects-market-analysis/.
[133] Karali, Khanna, and Shah, "Climate Impact of Primary Plastic Production."
[134] Speed and Mnyanda, "Petrochemical Glut Makes New Plastic Cheaper than Recycled," *Financial Times*, January 15, 2024; Independent Commodity Intelligence Services, "Chemical Market Overcapacity and Weakening Demand: A Perfect Storm," ICIS Explore, 2024.
[135] S&P Global, "Braskem S.A. Outlook Revised To Negative On Slower Spreads Recovery; Ratings Affirmed," 2024.
[136] Richardson, "China PP Sales Turnover Collapses by $4.6bn after the End of the Supercycle," *Asian Chemical Connections* (blog), October 1, 2024.
[137] Chowdhury et al., "Plastic Money: Turning Off the Subsidies Tap – Phase 2 Report" (Eunomia, QUNO, November 2024).
[138] Richardson, "Global PE Capacity May Have to Be 23m Tonnes/Year Lower in 2023-2030 to End the Downturn," *Asian Chemical Connections* (blog), 2023.
[139] Submission by CIEL.
[140] Article 5 Sections 5.1.2 and 5.2.2.
[141] FAO. 2025. Provisional Voluntary Code of Conduct on the Sustainable Use and Management of Plastics in Agriculture. https://openknowledge.fao.org/handle/20.500.14283; 1 and 17.

impacts of agricultural plastic pollution are global and transboundary, with differing management capacities and socio-economic implications across regions.[142] Indeed, regional data presented in the FAO assessment indicate significant disparities in waste management capacity, with collection rates substantially lower in regions that include many Least Developed Countries and Small Island Developing States.[143] FAO emphasizes the importance of international cooperation, capacity development and technical assistance to support context appropriate and equitable solutions.[144]

The production of plastics and resultant microplastic accumulation also directly contribute to increasing anti-microbial resistance.[145]

1.7 Further human rights impacts

Across all regions there is a pattern of human rights violations and disputes arising where rapid agribusiness expansion happens without effective environmental and social due diligence, community consultation and protection of labour and land rights.[146] Land tenure disputes, involuntary resettlement and loss of livelihoods result also from environmental degradation such as deforestation, water depletion, agrochemical exposure, and air pollution from industrial food production activities. Shifts away from subsistence farming toward cash crop cultivation may enhance food availability and income streams in the short-term, but are connected to dietary transitions, reshape cultural behaviours around food, reorder traditional household responsibilities, and reduce the production of traditional foods over time.[147]

Labour rights concerns, including wages, occupational health and safety, unionization, and housing conditions for worker often intersect with broader community impacts, illustrating how labour conditions, environmental harm, and social conflict are intertwined in large-scale agribusiness investments. On top of that, climate change is increasing worker vulnerability in the sector, by affecting both crop production and labour conditions. Rising temperatures and more intense heatwaves make harvesting physically dangerous. Droughts and erratic rainfall reduce yields and make work more unstable. This pressure can increase labour exploitation, as workers must work harder for the same income. Climate variability is also affecting labour patterns: crop failures or climate stress in poorer regions push workers to migrate for seasonal

[142] FAO (n 106) at 73, 95, 99.
[143] Ibid, at 26, 95.
[144] FAO (n 110).
[145] Submission by GCHA; Kaur, et al. (2022), Microplastic-associated pathogens and antimicrobial resistance in environment 291 Chemosphere, 133005; Marathe and Bank (2022), The microplastic antibiotic resistance connection. In: Microplastic in the Environment: Pattern and Process. Springer International Publishing, Cham, 311–322; Pham et al (2021), Microplastics as hubs enriching antibiotic-resistant bacteria and pathogens in municipal activated sludge. J. Hasard. Mater. Lett. 2, 100014; Tuvo, et al., 2023. Microplastics and antibiotic resistance: the magnitude of the problem and the emerging role of hospital wastewater. Int. J. Environ. Res. Publ. Health 20, 5868.
[146] https://www.cao-ombudsman.org/cases?sector[152]=152 (searched in database for complaints related to agribusiness and forestry).
[147] See, for example, 'Visit to Botswana – Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment' (2023) A/HRC/55/43/Add.2; 'Concluding observations of the Committee on Economic, Social and Cultural Rights – Paraguay' (2008) E/C.12/PRY/CO/3.

harvesting, exposing them to higher risk of exploitation Workers in food supply chains are disproportionately affected by heat exposure, estimated to be far more likely to experience heat-related mortality and substantial labour productivity losses during heatwaves—while global crop and livestock systems also face stress under rising temperatures. [148] Systematic evidence demonstrates that agricultural workers experience a range of heat-related health impacts, including dehydration, heat-related illnesses, kidney strain, and other physiological stressors, particularly in tropical and low-resource settings, and may be further affected by socioeconomic vulnerabilities such as piece-rate pay or inadequate access to shade and water.[149]

Dominant agricultural models generate severe mental health impacts that are disproportionately borne by small-scale farmers. In contexts such as France, the United States or India, high suicide rates among farmers reflect class-based economic precarity, debt, market volatility, and increasing exposure to climate-related environmental shocks. These pressures are intensified by the absence of effective just and green transition policies that include small-scale producers, instead shifting the burden of adaptation onto those with the least capacity to absorb risk. Climate-induced crop failure or yield instability can trigger immediate financial crisis for small-scale farmers, given the widespread lack of labour and social protections such as social protection floors, parental leave, or sickness benefits. These structural vulnerabilities intersect with gendered norms that rely on self-reliance and productivity, compounding psychosocial distress and undermining the right to health. Failure to address these conditions in food system transitions risks entrenching classed and gendered inequalities across the food–climate–health nexus.[150]

Indigenous Peoples' and peasants' human rights are undermined by increasing legislations restricting, prohibiting and criminalising the use, saving, exchanging and selling of seeds, undermining rural women's livelihoods and their production capacity to adapt to climate change.[151]

The agricultural sector accounts for the largest share of child labor. Worldwide, more than half of all child laborers work in agriculture, including in cattle farming and meat processing activities.[152] Human rights abuses in animal farming extend beyond land to aquaculture and industrial fishing, where forced labor and child trafficking are common due to weak and rarely enforced laws governing international waters. The ILO estimated that at least 128,000 people

[148] FAO and World Meteorological Organization, Highlights from the Extreme Heat and Agriculture report: https://openknowledge.fao.org/server/api/core/bitstreams/f6506a63-fb04-4f34-bea6-cb92f665e94f/content?
[149] El Khayat et al (2022). Impacts of climate change and heat stress on farmworkers' health: A scoping review. Frontiers in Public Health, 10, Article 782811: https://pubmed.ncbi.nlm.nih.gov/35211437/ and
Tran et al (2026), 'Heat exposure and agricultural workers' health: A global systematic review with implications for Peri-urban and semi-urban Southeast Asia' 65 Urban Climate: https://www.sciencedirect.com/science/article/pii/S2212095526000428?
[150] Submission by Women Engage for a Common Future.
[151] Submission by Rural Women's Assembly.
[152] https://www.ilo.org/sites/default/files/2025-06/2024%20Global%20Estimates%20of%20Child%20Labour%20Report.pdf.

were trapped in forced labor in the fishing industry in 2021, often enduring long hours, low pay, dangerous working conditions, frequent illnesses, injuries, abuse, and fatalities.[153]

The human right to information is undermined by climate-related food labels, particularly "climate-neutral" and offset-based claims, that mislead consumers. Even when explanatory information is provided, these claims tend to inflate sustainability perceptions. [154] Negative impacts on freedom of association and freedom of speech are a notorious issue in the agricultural sector.[155]

2. MEAT AND DAIRY PRODUCTION

A significant amount of agricultural emissions come from the production of animal-sourced foods,[156] driven by methane emissions from cows, land-use changes, and feed production.[157] In 2023, livestock emissions were the largest single component, followed by deforestation, and by packaging, transport and retail.[158] The production of animal protein accounts for approximately 12 percent of total anthropogenic emissions, and about 40 percent of agrifood system emissions.[159] Between 2018 and 2020 meat production was responsible for approximately 54% of agricultural GHG emissions.[160] Cattle are estimated to contribute to 65-77% of global livestock emissions,[161] with pigs, chickens, buffaloes and small ruminants contributing the remainder. In commodity terms, meat accounts for about 67 percent of livestock emissions, followed by milk at 30 percent and eggs at 3 percent.

Animal-sourced foods such as meat and dairy also have large land footprints because animals typically consume more food macronutrients than they produce,[162] thereby negatively impacting on carbon sinks. Industrial livestock production drives deforestation for feed crop production. Cattle ranching has replaced more forest than any other commodity. Pastureland used for grazing cattle occupies around 45.1 million hectares of deforested land, while soy

153 https://www.ilo.org/sites/default/files/wcmsp5/groups/public/@ed_norm/@ipec/documents/publication/wcms_854733.pdf.
154 https://www.sciencedirect.com/science/article/pii/S0950329324001964.
155 Arabadjieva (2017), 'Another Disappointment in Strasbourg: Unite the Union v United Kingdom' 46 Industrial Law Journal 289; Klassen et al (2023), 'Pathways for Advancing Good Work in Food Systems: Reflecting on the good work for good food international forum' 12 Journal of Agriculture, Food Systems, and Community Development 1, at 10. Submission by Tonia Novitz.
156 https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1641.
157 https://www.ejiltalk.org/the-other-transitioning-away-imperative-meat-as-the-next-frontier-in-global-climate-change-policy/.
158 https://openknowledge.fao.org/handle/20.500.14283/cd7300en.
159 https://openknowledge.fao.org/items/ed331aea-c65e-4770-a096-d449cc50fcdf, at 141.
160 https://www.unep.org/resources/emissions-gap-report-2022, at 56-57; https://docs.un.org/en/A/HRC/53/47, para. 14.
161 https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 479.
162 Hayek et al (2020), 'The Carbon Opportunity Cost of Animal-Sourced Food Production on Land' 4 Nature Sustainability 21; FAO (n 1), at 20.

production, mainly intended for animal feed, ranks third with 8.2 million hectares of forest loss.[163]

Within livestock systems, direct emissions —primarily methane from enteric fermentation in ruminants and methane and nitrous oxide from manure management—account for about 60 per cent of total emissions, with indirect emissions—stemming from feed production, fertilizer use, land clearing and deforestation, and transport—making up the balance. Emission sources and their relative importance vary by species and system. In ruminant (cattle, buffaloes, goats and sheep) systems, enteric methane dominates, whereas in monogastric systems (pigs and chickens), feed production, manure handling and land conversion are the leading contributors.[164] Methane from ruminant livestock constitutes the largest and most potent share of agricultural GHG emissions, while carbon dioxide and nitrous oxide constitute the remaining share.[165]

Industrial animal agriculture causes 32% of global anthropogenic methane emissions, more than natural gas, oil or coal production.[166] Methane emissions may be underestimated by as much as 39% to 90% in areas with highly intensified confined feeding operations, which further undermines these models as a sustainable development solution.[167] Methane is a short-lived gas with more than 80 times the global warming potential of CO2 over a 20-year period, making it essential to reduce industrial livestock to reach the targets of Paris Agreement.[168] Just 15 dairy and meat companies produce a staggering quantity of emissions, amounting to approximately 734 million tons of CO_2 equivalent. This is roughly the same as the total GHG emissions of Germany, the world's fourth -largest economy.[169] In addition to methane, the industrial animal agriculture sector is also a significant source of nitrous oxide emissions through both the production of animal feed and the management of manure.

By economic grouping, the largest share of livestock emissions occurs in upper-middle-income economies, followed by lower-middle, high-income, and low-income economies.[170] Analyses of trends in the livestock sector suggest that, as incomes increase and societies urbanize, per

[163] https://files.wri.org/d8/s3fs-public/estimating-role-seven-commodities-agriculture-linked-deforestation.pdf quoted in submission by Brighter Green.
[164] https://www.unccd.int/resources/global-land-outlook/overview; Pathways towards lower emissions, at 6.
[165] https://www.unccd.int/resources/global-land-outlook/overview; Pathways towards lower emissions.
[166] United Nations Environment Programme and Climate and Clean Air Coalition. 2021. Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions, ccacoalition.org/sites/default/files/resources//2021_Global-Methane_Assessment_full_0.pdf referred to in submission by Brighter Green.
[167] Hayek & Miller (2021), 'Underestimates of methane from intensively raised animals could undermine goals of sustainable development' 16 Environmental Research Letters 063006, quoted in submission by Brighter Green.
[168] Forster et al. (2021), 'The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity' In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, doi:10.1017/9781009157896.009 at Table 7.15 quoted in submission by Brighter Green.
[169] GRAIN and the Institute for Agriculture and Trade Policy (2018), Emissions impossible: How big meat and dairy are heating up the planet: https://www.iatp.org/emissions-impossible quoted in submission by Brighter Green.
[170] Pathways towards lower emissions, 6. See also FAO (n 1), at10.

capita consumption of livestock products rises.[171] This, together with population growth, means that total demand for livestock products would grow substantially. Without structural changes, rising global demand for meat and dairy is expected to increase sectoral emissions.[172] Academic researchers suggested that global livestock emissions would need to be reduced by 61% by 2036, with faster and deeper reductions in higher-income countries, with dietary shifts to less livestock-derived foods, particularly in high- and middle-income countries.[173]

2.1 Biodiversity loss

Industrial livestock production and feed production, in particular soy, are major drivers of deforestation and land concentration. Pasture expansion is a leading cause of deforestation in South America, and industrial agriculture accounts for approximately 70 percent of deforestation in Latin America.[174]

Cattle ranching is one of the single largest drivers of deforestation. In the Brazilian Amazon cattle grazing has accounted for roughly 80 percent of forest loss in the region. Investigations have documented how illegal cattle ranching in Pará state has expanded into protected forests and Indigenous territories, accompanied by land grabbing, intimidation, and in some cases violence against forest defenders. Forest clearance for pasture contributes significantly to greenhouse gas emissions, undermining global climate goals, while also violating Indigenous peoples' land rights, cultural rights and the right to food and livelihoods.[175]

Much of soy production used for animal feed in global meat supply chains, has driven large-scale forest, savannah and grassland conversion, particularly in the Amazon. Soy expansion is also increasingly encroaching African Savannahs and Central-Asian natural grasslands. Deforestation associated with soy cultivation increases carbon emissions and disrupts regional rainfall patterns, affecting long-term food security.[176]

2.2 Further human rights impacts

Documented human rights impacts associated with meat production at industrial scale occur across the areas of labour, land, environmental governance, public health, gender equality and climate policy. The impacts documented are interconnected. Industrial livestock production requires large volumes of land, feed, water, labour, energy, and capital. These inputs

[171] Delgado et al. (2024), 'Decarbonization of Nitrogen Fertilizers, from Production to Runoff: A Policy Memo' The Journal of Science Policy & Governance, https://doi.org/10.38126/jspg250106.
[172] https://openknowledge.fao.org/items/ed331aea-c65e-4770-a096-d449cc50fcdf; Pathways towards lower emissions, 14.
[173] Harwatt et al (2024), Options for a Paris-compliant livestock sector. Timeframes, targets and trajectories for livestock sector emissions from a survey of climate scientists (Research report, Harvard Law School), https://animal.law.harvard.edu/wp-content/uploads/Paris-compliant-livestock-report.pdf.
[174] FAO, State of the World's Forests 2016, https://openknowledge.fao.org/server/api/core/bitstreams/74b4394d-b389-4450-a4d7-bd37ab751c31/content.
[175] https://www.hrw.org/report/2019/09/17/rainforest-mafias/how-violence-and-impunity-fuel-deforestation-brazils-amazon.
[176] https://wwf.panda.org/discover/our_focus/food_practice/sustainable_production/soy/.

concentrate power in corporate agribusiness and frequently externalise environmental and social costs onto workers, rural communities, Indigenous Peoples as well as low-income and marginalized populations.

Factory farming often displaces smallholder and Indigenous producers, has the risk of exploiting workers, and exacerbates inequality, with often disproportionate impacts on women and marginalized communities. Policies favouring agribusiness contribute to structural land concentration, impacting various rights including the right to land and territory, the rights of Indigenous Peoples and the right to self-determination. Loss of forests also undermines cultural survival, biodiversity stewardship, and climate resilience.[177]

According to a report by Environmental Integrity, many large meat processing plants are situated in rural, low-income communities that lack the resources to contest pollution. Out of 98 facilities studied, about 75 percent violated their wastewater discharge permits, releasing high levels of nitrogen and phosphorus directly into local rivers and streams.[178] Research conducted in India on slaughterhouses and meat processing units, both legal and illegal/unauthorized, show that these slaughterhouses in city outskirts often lack adequate facilities for waste treatment, discharge untreated wastewater and waste into surrounding land and waterways and create public health and environmental hazards for residents who live nearby.[179] In Yucatan, Mexico, industrial mega-farms are being established on Indigenous territories without obtaining free, prior, and informed consent. Swine waste and other pollutants seeping into sacred natural wells that are essential for water access, undermining both daily life and long-standing cultural practices. In Chile's Atacama region a large industrial pig farm led to pollution and odours, undermining residents' health and daily practices. Community action succeeded in closing the facility, and regulators later introduced odour emissions standards. [180]

Industrial meat production is associated with severe and systemic labour rights concerns, particularly in slaughterhouses and processing facilities. Dangerous working conditions[181] have been documented in relation to meatpacking and poultry processing, which remain among the most dangerous industries. Workers face high line speeds, sharp cutting tools, heavy machinery, extreme temperatures, and exposure to chemical disinfectants. In addition, workers

[177] Submission by Stop Financing Factory Farming.
[178] https://environmentalintegrity.org/wp-content/uploads/2018/10/Slaughterhouse_Report_Final.pdf.
[179] https://www.researchgate.net/publication/353259653_Environmental_Impacts_of_Slaughter_Houses_with_Special_Reference_to_India_A_Review.
[180] https://grain.org/en/article/7194-the-cost-of-industrial-meat-displacement-conflict-and-environmental-destruction; Apaza, Las amunas: Tecnología ancestral de recarga artificial de acuíferos en los andes peruanos. p. 3. https://app.ingemmet.gob.pe/biblioteca/pdf/CPG14-266.pdf; submission by Enkh-Amgalan; Colegio de Geógrafos del Perú. (2021). Amunas, práctica ancestral de siembra y cosecha de agua para la seguridad hídrica. Caso: San Pedro de Casta.
[181] Gen V. Animal Agriculture and Human Rights in the US (2024): https://genv.org/animal-agriculture-and-human-rights-in-the-us/ and FAIRR: Working Conditions in Intensive Animal Agriculture: https://www.fairr.org/resources/knowledge-hub/working-conditions.

are exposed to repetitive strain, cuts, and long-term musculoskeletal damage,[182] long working hours, extreme temperatures, and hazardous machinery causing frequent accidents.[183]

Meat industry workers are also often exposed to dangerous chemicals and pollutants, as well as harmful bacteria.[184] The global meat industry relies heavily on migrant and undocumented workers, particularly in sanitation and night-shift cleaning roles. These jobs are often outsourced to labour agencies that employ abusive subcontracting pay lower wages, provide minimal insurance coverage, and conduct limited documentation checks. This creates heightened vulnerability to exploitation and retaliation.[185] Child labour 13-17-year-olds in slaughterhouses operated by huge meat industry corporations is standard operating procedure.[186]

Large-scale, vertically integrated livestock systems often outcompete traditional pastoralists and smallholders by concentrating market power and pushing producers who cannot meet stringent biosecurity and capital-intensive standards out of key value chains, undermining local food economies and traditional grazing systems. Evidence shows that this industrialisation contributes to the displacement of peasant and Indigenous Peoples, loss of land and resource rights, and increased poverty and social inequality as small farmers are coerced into wage labour or exit agriculture entirely. Environmental degradation from feed production, including deforestation, soil and water pollution, further erodes the natural resources that many communities depend on. Also, the consolidation of meat production by a few multinational processors reinforces governance structures that marginalise local producers and limit their participation in decision-making affecting their economic futures.[187]

From a human right to health perspective, industrial livestock operations emit ammonia, hydrogen sulphide, particulate matter, and methane, which are all pollutants linked to asthma, respiratory diseases, cardiovascular illness and premature death. Manure lagoons release toxic gases that degrade air quality. In addition, large volumes of animal waste contaminate groundwater and rivers, contributing to nitrate pollution in drinking water, as well as higher risks of methemoglobinemia ('blue baby syndrome'- a potentially life-threatening blood disorder) and cancer. [188] Finally, high-density confinement of animals increases the risk of zoonotic disease emergence and accelerates antimicrobial resistance, which is recognized by the World Health Organization as a major global health threat.[189]

[182] Human Rights Watch, "When We're Dead and Buried, Our Bones Will Keep Hurting" 2019: https://www.hrw.org/report/2019/09/04/when-were-dead-and-buried-our-bones-will-keep-hurting/workers-rights-under-threat.
[183] SOMO, The Human Cost of the Global Meat Industry. 2024: https://www.somo.nl/the-human-cost-of-the-global-meat-industry/.
[184] https://www.hrw.org/report/2019/09/04/when-were-dead-and-buried-our-bones-will-keep-hurting/workers-rights-under-threat.
[185] https://genv.org/animal-agriculture-and-human-rights-in-the-us/; https://effat.org/in-the-spotlight/effat-meat-sector-report-poor-conditions-to-blame-for-spread-of-covid-19/.
[186] https://www.food-safety.com/articles/8368-pssi-pays-15-million-for-child-labor-violations.
[187] https://grain.org/en/article/7194-the-cost-of-industrial-meat-displacement-conflict-and-environmental-destruction; https://www.worldanimalprotection.org.in/globalassets/pdfs/reports/english/hidden-health-impacts.pdf.
[188] https://www.worldanimalprotection.org.in/globalassets/pdfs/reports/english/hidden-health-impacts.pdf.
[189] Submission by GCHA.

Shifts toward healthier, more plant-based diets and diversified protein sources could generate significant employment gains in fruit, vegetable, and alternative-protein production, while displacing jobs in meat and dairy value chains over the next decade, with impacts varying by region and community. Because food supply chains are already characterised in many contexts by poor working conditions and documented labour rights risks, the transition presents both potential disruptions and opportunities to improve job quality, incomes, and resilience.[190]

Cultural rights are also relevant here. That said, the growing global discourse around reducing meat consumption often assumes a culturally neutral and universally applicable model of dietary change, overlooking the fact that food practices are deeply embedded in social, cultural, territorial, and historical contexts.[191] In many regions, particularly in developing countries with large rural populations, livestock plays a central role not only in nutrition but also in livelihoods, cultural identity, and social organization. In such contexts, reducing emissions may involve supporting small-scale, free-range, and environmentally sustainable animal production rather than eliminating animal products altogether, thus maintaining food security while lowering methane emissions.[192] disproportionate burdens on populations whose diets and economies are already constrained should be avoided. Sustainable dietary transitions are not merely a question of what people should eat, but of who defines food norms, under which conditions, and with what implications for cultural autonomy and social justice.[193]

3. PASTORALISM

Mobile pastoralists serve as custodians of ecosystems and associated services that are relevant for climate change mitigation and adaptation.[194] However, climate assessments often rely on life-cycle assessment data primarily derived from industrial livestock systems in Europe and North America, which are then generalized thereby overlooking important ecological, social, and livelihood dimensions of livestock production, particularly in rangeland areas where crop cultivation is limited. A more nuanced, systems-based approach to evaluating livestock within climate and food system policies, should differentiate between production systems and consider environmental, socio-economic, and nutritional outcomes together.[195]

Nomadic pastoralism has a minimal or no carbon footprint, depends on no external feed inputs, and strengthens long-term ecosystem resilience. Pastoralism can contribute to both adaptation and mitigation, in particular in dryland and rangeland ecosystems where conventional agriculture is often not viable. Through mobility and flexible herd management, pastoralists are able to respond dynamically to climate variability, reducing pressure on fragile ecosystems

[190] https://www.laudesfoundation.org/media/iyrdwuzj/laudes_just-transition-in-food_executive-summary.pdf.
[191] 10.1093/oxfclm/kgae024.
[192] https://doi.org/10.1007/978-1-4614-6723-6_3.
[193] Vincentnathan (2012), 'Food Rights, Food Frugality, and Climate Change' 20 Food and Foodways, 76, DOI: 10.1080/07409710.2012.652028.
[194] World Alliance of Mobile Indigenous Peoples and Pastoralists (2026), Protecting and Promoting Mobile Indigenous People and Pastoralists Rights.
[195] Submission by PASTRES - Pastoralism, Uncertainty and Resilience.

and enhancing resilience to shocks such as drought.[196] However, this ecological logic is being challenged by policy structures that enforce fixed administrative boundaries for land management, immobile service delivery models for health and education, and strict documentation requirements that are incompatible with mobile life.[197]

Well-managed grazing systems linked to Indigenous and local knowledge systems can support soil carbon sequestration, maintain biodiversity, and sustain key ecosystem services, as well as to secure land tenure and access to grazing routes, thereby contributing to climate-resilient food systems.[198]

A report by the UN Permanent Forum on Indigenous Issues (2026) highlights that Indigenous nomadic and semi-nomadic groups such as pastoralists face barriers including insecure land tenure, restricted mobility, exclusion from decision-making, and displacement linked to climate policies, conservation initiatives, extractive industries and infrastructure development. These pressures threaten their livelihoods, cultural continuity and governance systems, even though their territories often sustain resilient ecosystems and contribute to climate mitigation and biodiversity protection. The report recommends that States should strengthen legal and policy frameworks recognizing Indigenous Peoples as distinct rights holders, implement the UN Declaration on the Rights of Indigenous Peoples (UNDROP) and ensure free prior informed consent (FPIC) for projects affecting their lands and resources. The report also calls for protecting traditional mobility and territorial rights, guaranteeing full participation of Indigenous Peoples in climate and biodiversity governance, increasing direct climate finance and support for Indigenous-led initiatives, and recognizing Indigenous knowledge systems as essential to climate adaptation, environmental protection and sustainable development.[199]

Current investments largely support sedentary infrastructure, which accelerates pastoral decline. Proposals have been made in submissions for national frameworks to: acknowledge pastoralism as a professional specialization equal in value to other occupations; include herder representatives in environmental, land-use, education and climate councils; and ensure that public narratives that portray herders as "uneducated" or "backwards" be replaced with recognition of their vital role as climate stewards and food producers and life in general. In addition, it has been recommended that international financial institutions and government budgets should invest in pastoralism directly, as well as in mobile services such as traveling teachers, mobile clinics, veterinary services, and family and clan-managed water points. These measures strengthen resilience without forcing families to abandon mobility. The submission further suggested that international climate finance, including for loss and damage, should

[196] https://www.fao.org/newsroom/detail/in-a-world-searching-for-solutions-to-the-interconnected-climate--biodiversity--and-land-degradation-crises--rangelands-and-pastoralists-are-part-of-the-answer--fao-animal-production-and-health-expert/en.
[197] Submission by Enkh-Amgalan.
[198] https://iucn.org/sites/default/files/2023-05/practice_i.community-grazing_final.pdf; https://iucn.org/crossroads-blog/202206/sustainable-pastoralism-nature-based-solution-proven-over-millennia.
[199] Permanent Forum on Indigenous Issues, Twenty-fifth session (2026): Report of the international expert group meeting on "Recognition of Indigenous Peoples' rights in the context of the climate crisis, biodiversity governance and territorial integrity."

support sustainable herd composition, fodder reserves, and drought-early warning systems developed with pastoralists' input.[200]

4. FISHERIES

The ocean generates 50 percent of the oxygen we need, absorbs 30 percent of all carbon dioxide emissions[201] and captures 90 percent of the excess heat generated by these emissions. Between 2000-2007, 25 percent of carbon dioxide emitted by humans was removed by the ocean.[202] The ocean is also the largest 'carbon sink', a vital buffer against the impacts of climate change.

Aquatic animal foods account for approximately 20 percent of the per capita animal-protein supply of 3.2 billion people, or more than 40 percent of the world's population.[203] With 80 Mt of aquatic animals produced in 2022, marine capture fisheries remain a significant global source (43 percent) of aquatic animal foods, with the rest coming from inland fisheries, particularly marine- and land-based aquaculture. [204] Blue foods-fish, shellfish, aquatic plants, and algae harvested or cultivated in marine and inland waters-provide essential protein and micronutrients to more than three billion people worldwide.[205] The push to expand blue foods is often justified by appeals to food and nutrition security, but there are viable pathways to healthy diets that do not rely on increased consumption of aquatic animals, including plant-based sources of essential nutrients such as omega-3 fatty acids.[206]

4.1 Climate change impacts on fisheries

The IPCC indicates that global marine animal biomass and fisheries catch potential are expected to decline during the twenty-first century, with the largest reductions projected in tropical regions. Climate change is also driving geographic shifts in fish species toward cooler waters, redistributing fisheries resources and creating new management challenges. These changes are projected to affect the livelihoods and food security of millions of people who depend on fisheries, particularly in coastal regions, Small Island Developing States, and West Africa, where seafood plays a critical role in nutrition and local economies.[207]

In 2018, aquaculture and capture fisheries together accounted for approximately 15 percent of global animal-source production for human consumption.[208] Increasing GHG emissions

[200] Submission by Enkh-Amgalan.
[201] https://essd.copernicus.org/articles/17/965/2025/, 996.
[202] Fisheries and aquaculture in a Changing Climate:
[203] https://link.springer.com/article/10.1007/s12571-021-01246-9; https://openknowledge.fao.org/items/ed331aea-c65e-4770-a096-d449cc50fcdf (FAO, 2024a).
[204] https://openknowledge.fao.org/server/api/core/bitstreams/894b9391-6e75-4d9c-8d59-ee347b62d8ef/content
[205] Footnote 10 FAO, Duke University, and WorldFish. 2023. Illuminating Hidden Harvests - The contributions of small-scale fisheries to sustainable development. Rome: FAO.
[206] Ibid.
[207] https://www.ipcc.ch/srocc/chapter/technical-summary/; https://www.ipcc.ch/srocc/chapter/summary-for-policymakers/; https://www.ipcc.ch/site/assets/uploads/sites/3/2022/03/02_SROCC_TS_FINAL.pdf.
[208] https://link.springer.com/article/10.1007/s12571-021-01246-9.

have affected the health of the ocean, warming and acidifying seawater, causing detrimental changes to life under water and on land, and reducing the ocean's ability to absorb carbon dioxide and safeguard life on the planet. Climate change is causing major impacts on the ocean, including rising sea levels, more frequent and intense marine heatwaves, acidification, and loss of biodiversity, which affect ecosystems, coastal communities, food security, and economies worldwide. These changes threaten marine life and human livelihoods, and they weaken the ocean's ability to continue regulating the climate unless urgent action on mitigation and adaptation is taken.[209]

Ocean acidification is linked to the loss of marine species that rely on calcium carbonate and to changes in marine carbon storage. It also exacerbates other biogeochemical changes, such as ocean warming, and is therefore considered a threat multiplier for marine life.[210]

Coral reef collapse would eliminate reef fisheries supporting 150+ million people in the Coral Triangle region alone, with complete loss of this primary protein source for many small island populations. Mountain glacier collapse exacerbates flooding and water security risks in Asia and Central and South America, in addition to potential detrimental effects on fishing in North America.[211]

4.2 GHG emissions

Emissions from aquaculture and large-scale fisheries represent approximately 10% of total agriculture emissions.[212] Fuel combustion accounts for over 80 per cent of direct emissions from marine capture fisheries: fishing vessels' engines and long trips consume large quantities of diesel which emits CO_2, estimated to be 60 to 90 percent of fishing's GHG emissions, and this is before fish even reach land.[213]

Global fishing-related CO_2 emissions rose by about 28 per cent between 1990 and 2011,[214] with little increase in edible production over the same period.[215] Overfishing disrupts the critical role of marine vertebrates in the ocean carbon cycle, disturbing and damaging the carbon-rich seabed, and contributing to increased GHG emissions through fuel use.[216]

Compared to high-emission land-based animal agriculture, sustainably managed seafood generally has lower GHG emissions, particularly when ecosystem-based and community-led

[209] https://www.un.org/en/climatechange/science/climate-issues/ocean#.
[210] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1647.
[211] https://global-tipping-points.org/download/1418/.
[212] https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 478; https://docs.un.org/en/A/HRC/53/47, para. 16.
[213] https://www.oecd.org/content/dam/oecd/en/topics/policy-sub-issues/fisheries-sustainability/mitigating-the-impact-of-fisheries-on-climate-change-nov-2024.pdf.
[214] https://www.biologicaldiversity.org/programs/population_and_sustainability/pdfs/a-just-transition-blue-foods-brief.pdf; https://www.sciencedirect.com/science/article/pii/S0308597X1730893X
[215] https://oursharedseas.com/wp-content/uploads/2019/11/Parker-et-al.-2018-Fuel-use-and-greenhouse-gas-emissions-of-world-fis.pdf.
[216] https://www.nature.com/articles/s44183-024-00053-x#ref-CR6, at 2.

practices are applied.[217]There is a general lack of data on GHG emissions from aquatic foods post-harvest activities, including processing, distributing, transportation and marketing. [218]

Industrial fishing causes significant climate harm through fossil fuel consumption, millions of tons of annual carbon dioxide emissions, and ecologically devastating practices like bottom trawling, which contributes over one billion tons of aqueous carbon emissions per year due to the disturbance of carbon-storing sediments along the ocean floor.[219] Moreover, the pollution, decimation of benthic ecosystems, and unsustainable exploitation of trillions of fish per year by industrial fishing threaten life below water.[220]

Shifting towards low-impact, small-scale fisheries reduces emissions while strengthening food security and community resilience. In aquaculture, the greatest gains come from expanding low-trophic, low-input systems such as seaweed and bivalves, which require no feed, fertilizers, or antibiotics.[221] Small-scale fisheries are already responsible for almost half of fish capture globally,[222] and they often align with ecosystem-based management approaches that maintain marine biodiversity and ecosystem resilience.[223]

4.3 Dependency on fossil fuels

Larger, fuel-inefficient fishing vessels burn more fuel per kilogram of fish, increasing emissions intensity.[224] In comparison, small-scale fisheries use 11 percent of total fishing fuel while industrial fishing used 89 percent. The 2025 International Maritime Organization (IMO) *Net-Zero Framework*, a legally binding regulatory package designed to cut emissions from international shipping with the aim of reaching net-zero emissions by or around 2050[225] does not yet apply to industrial fishing vessels.

[217] Danish Institute for Human Rights. 2024. Human Rights Obligations and Adaptation to Climate Change: An Analysis of Recommendations to States from International Human Rights Mechanisms. Footnote 12. Govan, Hugh, Watisoni Lalavanua, and Derek J. Steenbergen. 2024. "Coastal Fisheries Governance in the Pacific Islands: The Evolution of Policy and the Progress of Management-at-Scale." In Implementation of the Small-Scale Fisheries Guidelines: A Legal and Policy Scan, edited by José Nakamura, Ratana Chuenpagdee, and Svein Jentoft, 207-40. Cham, Switzerland: Springer Submission by Higa.
[218] Submission by FAO.
[219] Sala et al (2021), 'Protecting the global ocean for biodiversity, food and climate' (592) Nature 397, https://www.nature.com/articles/s41586-021-03371-z.
[220] United Nations Department of Economic and Social Affairs Division for Sustainable Development Goals. (n.d.) *The 17 Goals.* https://sdgs.un.org/goals ootnote 14: Sala et al (2021). Protecting the global ocean for biodiversity, food and climate. *Nature, 592*(7854), 397: https://doi.org/10.1038/s41586-021-03371-z links in submission by Phoenix Zones Initiative.
[221] Submission by Just Food Transition Network.
[222] He et al (2025), 'Post-subsidy Era: Potential for Carbon Pricing in Industrial Fisheries among Global Major Fishing Countries' 59 Environmental Science and Technology, https://pubs.acs.org/doi/10.1021/acs.est.5c02550.
[223] Ocean Wise (2020) The role of small-scale fisheries: https://ocean.org/blog/the-role-of-small-scale-fisheries/. Submission by Masifundise Development Trust and the Legal Resources Centre.
[224] https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/02/oecd-review-of-fisheries-2025_d308ff48/560cd8fc-en.pdf.
[225] https://www.imo.org/en/mediacentre/pressbriefings/pages/imo-approves-netzero-regulations.aspx.

Bottom trawling in particular, as a fishing method, has documented adverse impacts, as trawlers disrupt seafloor sediments, with the risk of releasing stored carbon and reducing the ocean's ability to store carbon dioxide.[226] Bottom trawling also destroys the marine habitat; by dragging large, weighted nets across the sea floor to catch fish, bottom trawlers are also trapping species like sea turtles and damaging seagrass, which has a strong capacity for storing carbon; for example, seagrass takes in carbon 35 times faster than tropical rainforests do. As a result, bottom trawling emits around 40 percent of all annual US transportation emissions.[227] Trawlers are also associated with severe labour abuses globally, with many migrant workers working as crew on such vessels.[228]

In addition, fisheries is dependent on plastics. Plastic products are used in all types of fishing, nets, hooks, in addition to widespread use of single-use plastic packaging and waste that have detrimental impacts on marine ecosystems.[229] Fish Aggregating Devices are often made of plastic and can affect coral reefs and seafloor marine habitants.[230]

Abandoned or lost fishing gear (ghost gear) makes up a significant portion of the 14 million tons of plastic entering the ocean annually, due to inadequate on-board storage, lack of recycling infrastructure and illegal dumping. The waste exacerbates climate change by released GHGs throughout its lifecycle, from production to degradation.[231] In addition, lost gear continues to catch fish, kill or harm marine mammals, and destroy coral reefs and coastal ecosystems, undermining natural protection from flooding and coastal erosion. Coral reefs also provide food and livelihoods to many millions of people.[232]

Antifouling agents are a coating used in fisheries and aquaculture to treat fishing vessels, fishing gear, and aquaculture nets and pens against algae growth. These pollutants have components such as coppers, biocides or other toxic compounds, which can harm marine biodiversity and degrade ecosystems that store carbon or buffer climate impacts. Additional chemical pollution from antifoulants can weaken ecosystem resilience to climate impacts, affecting fish health and ecosystem services that sequester carbon or support adaptation. Antifoulants can also compromise seafood safety and pose risks to workers' health when handling these materials.[233]

[226] https://ocean-climate.org/wp-content/uploads/2024/10/Fishing-aquaculture-in-a-changing-climate_DIFCO2024.pdf.
[227] https://www.clientearth.org/latest/news/mega-scale-fishing-is-accelerating-climate-change-here-s-what-we-can-do-about-it/; https://www.forbes.com/sites/ariannajohnson/2024/01/18/heres-how-much-carbon-emissions-are-caused-by-a-popular-and-controversial-fishing-method-according-to-study/.
[228] https://www.nature.com/articles/s41467-022-28916-2.
[229] Roberts et al (2024), 'Rethinking Sustainability of Marine Fisheries for A Fast-Changing Planet' 3 npj Ocean Sustainability 41. Submission by Ekhator and Moyosore Lalude.
[230] https://www.wwf.org.uk/sites/default/files/publications/Mar17/Tuna%20fisheries%20FADs%20report%20-%20MRAG_WWF.pdf
[231] www.theoceancleanup.com; https://iucn.org/sites/default/files/2022-08/marplasticcs_economic_policy_brief_mozambique_final.pdf.
[232] https://www.wwf.org.uk/coral-reefs-and-climate-change.
[233] https://www.mdpi.com/1422-0067/13/2/1541.

4.4 Food loss and food waste

Food loss and waste in fisheries occur across the value chain, from bycatch and the discarding of unwanted species at sea, to spoilage caused by long fishing trips, inadequate cold storage on board and onshore, poor handling, and processing inefficiencies, as well as market-driven losses linked to oversupply, weak distribution systems and the rejection of substandard fish. Because fish is highly perishable, loss rates are often higher than for land-based crops, with large impacts on food security, nutrition and livelihoods.

Food loss and waste reduce income, particularly for small-scale fishers, and can exacerbate overfishing as fishing fleets may attempt to compensate for lost volumes, while also wasting fuel and energy and increasing greenhouse gas emissions, affecting the climate. Lost volumes can also impact labour rights of crew, requiring workers on vessels to work longer hours, rest less or be away from shore for longer periods. Losses in post-harvest processing and trade can disproportionately affect women, who play a central role in these activities in many regions globally. [234]

4.5 Further human rights impacts

Industrial fishing systems often exacerbate human rights issues, from displacement of Indigenous fishers to labor exploitation.[235] Child labor has also been documented in fish processing facilities by the ILO and FAO. These practices prevent children from attending school and perpetuate the cycle of generational poverty. To protect their profits as wild fish populations collapse, corporations often expand the use of forced labor; rely on illegal, unreported, and unregulated fishing; and intensify large-scale industrial aquaculture operations.

The negative impacts of industrial fishing on small-scale fisheries should be understood as part of cumulative negative impacts arising also from expansion of offshore oil and gas extraction, as well as expansion of marine renewables that negatively impact on marine biodiversity in areas traditionally used for small-scale fisheries due to lack of environmental impact assessments and appropriate safeguards (see A/80/188; A/80/187; and A/HRC/58/59). These and other extractive activities on the coast and offshore deepen socio-environmental conflicts and inequities in coastal territories, with disproportionate impacts on the human rights of small-scale fishers also due to lack of effective participation in decision-making processes affecting them, in addition to climate change impacts on fisheries. These cumulative impacts result in growing food insecurity and uncertainty about sustainable livelihoods for small-scale fisheries, particularly in territories that are highly vulnerable to climate change.[236]

[234] https://www.fao.org/flw-in-fish-value-chains/overview/food-loss-and-waste-in-fish-value-chains/en/.
[235] International Labour Organization. (2024, July). Forced labour in commercial fishing. sites/default/files/2024-08/Forced%20labour%20in%20commercial%20fishing%20Web.pdf.
[236] Contribuciones al informe de la Relatora Especial de Naciones Unidas sobre cambio climático y derechos humanos, Elisa Morguera, sobre sistemas alimentarios, ecosistemas marinos y costeros, combustibles fósiles y energías renovables: *Sistematización de la reunión de consulta con organizaciones de la sociedad civil sobre pesca artesanal marina (12 March 2026).*

5. AQUACULTURE

In 2022, for the first time, aquaculture surpassed capture fisheries in aquatic animal production, accounting for 51 percent of the world total and 57 percent of production for human consumption.[237] However, the rapid growth of aquaculture raises environmental concerns, particularly regarding GHG emissions.[238]

In 2017-2018, aquaculture was estimated to be responsible for 10% of total agriculture emissions,[239] and 0.49 percent of total anthropogenic emissions.[240] Most environmental impacts in aquaculture are driven by feed production.[241] Feed production, especially fishmeal and fish oil from forage fish and terrestrial crops such as soybean, drives land-use change, deforestation, and intensive agriculture, all of which emit CO_2 and other GHGs. It has been recognized that the intensive energy and processing required for feed is a dominant driver of emissions.[242] For example, in the salmon industry, feed is the biggest part of the sector's footprint, around 90 percent of a farm's GHG emissions come from the feed alone.[243] Soybean cultivation for aquaculture feed, which is linked to Amazon deforestation, accelerates carbon release from soils and forests.[244]

Other sources of GHG emissions in aquaculture are juvenile production, pond fertilizer, energy use, on-farm fuel use, land-use change, pond emissions and transportation.[245] Aquaculture operations often rely on diesel fuel and electricity for aeration, pumping, temperature control, and transport. Many large-scale aquaculture producers use high-emitting transport such airfreight to transport salmon across the globe. Aquaculture is further associated with aquatic N_2O emissions (resulting from the nitrification and denitrification of nitrogenous compounds in water), and on-farm energy use (such as for pumping water, lighting, and powering vehicles).[246] Fish farms discharge vast amounts of faeces and uneaten food can release methane and nitrous oxide, which are strong GHGs which can harm marine life.[247] Further, poorly regulated aquaculture sites, high stocking densities and inefficient feeding practices generate nutrient pollution, algal blooms and dead zones, compromising local water quality and public health while undermining the right to a healthy environment.[248]

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[237] FAO (n 1).

[238] https://www.researchgate.net/publication/394783134_Towards_sustainable_aquaculture_innovative_strategies_for_reducing_environmental_carbon_footprints_across_different_aquaculture_systems.

[239]

[240] FAO (n 1); https://www.nature.com/articles/s41598-020-68231-8.

[241] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1650; https://www.ipcc.ch/srccl/chapter/chapter-5/; https://www.nature.com/articles/s41598-020-68231-8?.

[242] FAO, Climate smart fisheries and aquaculture: https://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b4-fisheries/chapter-b4-4/en/

[243] Hammer et al (2022), 'Reducing carbon emissions in aquaculture: Using Carbon Disclosures to identify unbalanced mitigation strategies' 96 *Environmental Impact Assessment Review*, 106816, https://doi.org/10.1016/j.eiar.2022.106816.

[244] https://grain.org/article/entries/5390-food-sovereignty-can-stop-climate-change-and-feed-us-all.

[245] FAO (n 1); https://www.ipcc.ch/srccl/chapter/chapter-5/.

[246] MacLeod et al (2020), 'Quantifying greenhouse gas emissions from global aquaculture' 10 Sci Rep 11679, https://doi.org/10.1038/s41598-020-68231-8; quoted in Submission by FAO.

[247] https://www.theguardian.com/global-development/2025/dec/02/chile-salmon-farms-fish-industry

[248] https://drive.google.com/file/d/1BzfoL8GcTLBF1H5itlCdvMk7lo5k1Pqj/view.

Among various production systems, aquaculture ponds are the most commonly used facilities for aquatic food production.[249] These shallow systems, if not well managed, can be considered a source of GHGs to the atmosphere, contributing more than 80 percent of all GHGs emitted by the aquaculture sector.[250] In addition, certain practices, such as integrated rice-fish farming, semi-intensive, and extensive production systems are becoming an increasing concern as an significant source of atmospheric CH_4 and N_2O emissions.[251]

Certain forms of aquaculture, particularly farmed catfish and crustaceans, can be as emissions-intensive as beef or even more emissions-intensive than pork. At the same time, farming low-trophic species such as bivalves and seaweed can approach near-zero or even net-negative emissions by sequestering carbon and improving water quality. [252]

The rapid increase in the industry means that the global significance of aquaculture emissions is expected to rise with production intensification.[253] By 2030, aquaculture is projected to generate more than 5 percent of total anthropogenic N_2O emissions,[254] with aquafeed production and use, as well as oxygen availability being major factors in emissions.[255] In addition, due to the wide range of GHG emissions among the vast diverse aquatic species and systems, uncertainties surrounding GHG emissions and removal estimates from aquaculture systems production remain high.[256]

It has been suggested that shifting from carnivorous aquaculture to low-trophic and extractive aquaculture, can significantly contribute to climate change mitigation efforts. For instance, scope-3 emissions in salmon farming can account for over 80 percent of all GHG emissions while feed alone accounts for approximately 40 percent of Scope 3 emissions. Instead, seaweed farming sequesters CO_2 and provides a sustainable source of food.[257] It has also been pointed

[249] FAO (n 1); https://www.researchgate.net/publication/394783134_Towards_sustainable_aquaculture_innovative_strategies_for_reducing_environmental_carbon_footprints_across_different_aquaculture_systems.
[250] FAO (n 1); Yuan et al (2019), 'Rapidgrowth in greenhouse gas emissions from the adoption of industrial-scale aquaculture' 9 Nature Climate Change 318, https://doi.org/10.1038/s41558-019-0425-9; Kosten et al (2020), 'Better assessments of greenhouse gas emissions from global fishponds needed to adequately evaluate aquaculture footprint' 748 Science of the Total Environment: 141247, https://doi.org/10.1016/j.scitotenv.2020.141247.
[251] FAO (n 1); Yuan et al (n 250); Qian et al (2023), 'Greenhouse gas emissions and mitigation in rice agriculture' 4 Nature Reviews Earth and Environment 716, https://doi.org/10.1038/s43017-023-00482-1.
[252] https://www.biologicaldiversity.org/programs/population_and_sustainability/pdfs/a-just-transition-blue-foods-brief.pdf.
[253] FAO (n 1); Yuan et al (n 250).
[254] FAO (n 1); Paudel et al (2015), 'Effects of temperature on nitrous oxide (N2O) emission from intensive aquaculture system' 518 Science of the Total Environment 16, https://doi.org/10.1016/j.scitotenv.2015.02.076; FAO (2025), The State of Food Security and Nutrition in the World 2025, https://openknowledge.fao.org/server/api/core/bitstreams/de95e011-1af9-4b28-9a07-d8ce61f8aa6c/content/state-food-security-and-nutrition-2025/executive-summary.html#gsc.tab=0.
[255] FAO (n 1); Macleod et al (2020), 'Quantifying greenhouse gas emissions from global aquaculture' 10 Scientific Reports, 11679, https://doi.org/10.1038/s41598-020-68231-8; Fang et al (2022), 'Ebullitive CH4 flux and its mitigation potential by aeration in freshwater aquaculture: measurements and global data synthesis' 335 Agriculture, Ecosystems & Environment, 108016, https://doi.org/10.1016/j.agee.2022.108016.
[256] FAO (n 1); Gephart et al (2021), 'Environmental performance of blue foods' 597 Nature, 360, https://doi.org/10.1038/s41586-021-03889-2.
[257] Submission by Eurogroup for Animals and its member organizations.

out that production of bivalve shellfish and seaweeds requires no feed inputs, while fish require 2-8 time less feed than poultry, swine, or cattle.[258]

Aquaculture – one of the fastest-growing food production sectors worldwide, is rapidly intensifying reliance on pesticides, diminishing the nutritional composition of fish.[259] Plastics are widely used throughout aquaculture practices. Aquaculture relies on feed manufactured using fossil fuel-based inputs, and single-use plastic packaging and waste that have detrimental impacts on ecosystems.[260]

5.1 Habitat conversion and loss of carbon sinks

Industrial aquaculture negatively impacts on the climate system through the destruction of carbon-sequestering ecosystems such as mangroves for shrimp farming. The UN Special Rapporteur on the Right to Food and the Working Group on Business and Human Rights focused on shrimp-farming affecting rural farming communities in Ecuador who cultivated rice, built irrigation systems and homes and relied on artisanal fishing in the nearby Babahoyo River for their livelihoods.

In tropical regions, aquaculture development has contributed to an estimated 38 percent of global mangrove loss, a significant carbon sink. Conversion of carbon-rich coastal ecosystems like mangroves for shrimp farms reduces natural carbon storage and releases existing carbon stocks. Mangrove loss has also reduced buffers against extreme weather, exposing coastal communities to storm surges and erosion, impacting housing security and health. Examples of aquaculture industry impacts include:

- In Bangladesh, conversion of rice land to shrimp aquaculture has contributed to groundwater salinization and has forced many farmers into insecure wage labour, undermining traditional livelihoods. Local peoples have reported loss of common land, lack of compensation, and harder access to potable water, forcing long daily walks to fetch drinking water, a right to water and health concern.[261]
- In the Sundarbans in Bangladesh, shrimp farming has caused the destruction of approximately 45 percent of mangrove wetlands, leading to severe biodiversity loss, reduced natural cyclone protection, and increased carbon emissions. It has impacted local communities dependent on mangrove and its ecosystem for their livelihoods. [262]
- In Ecuador, UN experts expressed concerns that aquaculture development may undermine the rights of rural families to land, food, housing and an adequate standard of living because of threats to land tenure of the farming communities, possible displacement or eviction risks, impacts on livelihoods and food sovereignty, intimidation and threats to community members, the use of heavy machinery and security personnel that reportedly damaged cultivated land, and impacts on freedom of movement and access to education.[263]

[258] FAO State of Food Security (n 254).
[259] https://www.mdpi.com/2410-3888/10/5/223.
[260] https://www.nature.com/articles/s44183-024-00078-2.
[261] https://www.fao.org/4/ac279e/AC279E08.htm.
[262] https://www.sciencedirect.com/science/article/pii/S1462901123001818?via%3Dihub.
[263] AL OTH 146/2025.

Aquatic farms also negatively affect ecosystems through acidification, eutrophication and altering disease risks for wild populations.[264] Pollution from aquaculture contributes to eutrophication (low oxygen zones) and harmful algal blooms, which climate change magnifies through warmer water temperatures. The 2016 red tide crisis in Chiloé, Chile, has caused massive death of shellfish and impacted the livelihoods of many thousands of local communities including indigenous peoples relying on small-scale fisheries.[265] Fish farms and their nets, as well as pollution from fish farms directly damage critical habitats for whales, penguins, and other marine species. Pollution from antibiotics and pesticides used in aquaculture also weakens ecosystems, making them less resilient to climate stressors like warming and extreme weather.

With increasing ocean temperatures, there is an increased risk of diseases and parasites, leading to more outbreaks, higher fish mortality and a need for increased chemical use such as pesticides.[266]

5.2 Further human rights impacts

Industrial aquaculture is not adequately regulated in line with climate and human rights obligations. The rapid expansion of salmon farming has been promoted through licensing, export incentives and permissive regulatory frameworks, despite reports of environmental harm and impacts on coastal communities, exacerbated by climate change.[267] In several countries, state support of large-scale shrimp aquaculture has had negative impacts on access to land and water. Regulatory frameworks have often failed to prevent the conversion of rice fields and mangroves into shrimp ponds, despite evidence of salinization, loss of freshwater access, and ecosystem degradation.[268]

Large, industrial-scale extraction of anchoveta for fishmeal, including overfishing of juvenile fish, reduces its availability for local, direct human consumption, threatening food security and the livelihoods of artisanal, small-scale fishers.[269]

Poor welfare in aquaculture – for example, resulting from chronic crowding, inadequate water quality or inappropriate feed – is associated with higher disease levels, greater antibiotic use, elevated mortality and more severe environmental impacts, leading to lower resource efficiency and productivity.[270]

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[264] https://www.thelancet.com/action/showPdf?pii=S0140-6736%2825%2901201-2, at 1650.
[265] https://www.humanrights.dk/files/media/document/ENHANCING%20ACCOUNTABILITY%20FOR%20SMALL-SCALE%20FISHERS.pdf.
[266] FAO (2018), Impacts of Climate Change on Fisheries and Aquaculture, at 22-23: https://openknowledge.fao.org/server/api/core/bitstreams/16725989-5956-4127-8a53-5631b99c77e9/content.
[267] Submission by AIDA; https://aida-americas.org/en/risks-salmon-industrys-expansion-chilean-patagonia
[268] https://ejfoundation.org/resources/downloads/smash_and_grab.pdf?; FAO, Report on a Regional Study and Workshop on the Environmental Assessment and Management of Aquaculture Development: https://www.fao.org/4/AC279E/AC279E04.htm?
[269] Changing Markets, What Lies Beneath: Uncovering the truth about Peru's colossal fishmeal and fish oil industry, November 2020. See: https://changingmarkets.org/report/what-lies-beneath-uncovering-the-truth-about-perus-colossal-fishmeal-and-fish-oil-industry/.
[270] Ibid.

Industrial agricultural practices are the leading cause of water pollution and the largest threat to the drinking water supply for hundreds of millions of people due to the extensive use of industrial pesticides and fertilizers and to slurry from intensive livestock farming (A/79/190).

6 PRE- AND POST-AGRICULTURAL PRODUCTION

Pre- and post-production processes include input manufacturing (fertilizers, pesticides, feed production) and processing, storage, refrigeration, retail, waste disposal, food service, and transport.[271] Their emissions in total have been recorded to account for approximately 5-10% of total food system emissions.[272] These emissions rose by 33 percent from 2001 to 2023, accounting for 32 percent of agrifood systems emissions. In this time period, emissions from manufacturing, transport, packaging, retail, and household consumption grew by about 80 percent.[273]

Data from 2023 also indicates that significant pre- and post-agricultural production emissions were observed in Asia and Europe, reflecting higher energy demand for manufacturing, refrigeration and food distribution in these regions.[274] 88 out of 231 countries and territories had supply chain emissions accounting for half or more of the total agrifood systems emissions. High shares were observed in major agricultural producers such as Japan (71 percent), the Republic of Korea (69 percent), and Italy (58 percent).[275] Advanced industrialization and extensive energy use throughout food systems, including cold chains and retail infrastructure can lead to high emissions, and has been observed in China, the United States of America, the Russian Federation, Turkey, and Japan, where such emissions have ranged from 50 percent to 71 percent in recent years.[276]

Recent globalization of agriculture has also promoted industrial agriculture and encouraged value-added processing and more distant transport of agricultural commodities, leading to increased GHG emissions.[277] In net food-importing countries where consumption of processed food is common, emissions from other parts of the food lifecycle generated in other locations are much higher. High shares were also observed in many food-importing countries such as Lebanon, Kuwait, Oman, Qatar and Saudi Arabia, each with a share of about 80 percent.

The pre- and post-agricultural production sector accounted for more than 95 percent of national agrifood systems emissions in Several Small Island Developing States such as Aruba, the United States Virgin Islands, Turks and Caicos Islands, and Cayman Islands. [278]

[271] https://www.ipcc.ch/srccl/chapter/chapter-5/. *See also* https://edgar.jrc.ec.europa.eu/edgar_food.
[272] Clarke et al (n 10).
[273] FAO (n 3), at 1-4.
[274] FAO (n 3), at 4.
[275] https://openknowledge.fao.org/handle/20.500.14283/cd7300en, 7.
[276] FAO (n 3), at 7.
[277] https://www.ipcc.ch/srccl/chapter/chapter-5/.
[278] FAO (n 3), at 7.

Upstream emissions, such as feed and fertilizer manufacture, and downstream emissions, such as transport, refrigeration, fall significantly for less-intensive and more-localized production systems.[279]

In addition, approximately 13.2 percent of all food meant for human consumption is lost every year between the harvest and retail stages of food production.[280] 17 percent of food is wasted by households or retail and food services.[281] A large share of produced food is lost in developing countries due to poor infrastructure, while a large share of produced food is wasted in developed countries. Similar to food waste, over-consumption (defined as food consumption in excess of nutrient requirements), leads to GHG emissions.[282]

The IPCC finds that climate hazards increasingly affect the entire food system, including infrastructure and supply chains that connect production with markets. Extreme weather events such as floods, storms, and heatwaves can damage transport networks, storage facilities, and processing infrastructure, disrupting the movement of agricultural inputs and food products. Rising temperatures and humidity can also increase post-harvest losses by accelerating spoilage, pest infestations, and food safety risks during storage and handling.[283] FAO assessments similarly emphasize that climate shocks can disrupt food value chains and increase food losses across storage, transport, and processing stages, particularly where infrastructure is limited or climate sensitive. Because a substantial share of global food production is already lost between harvest and retail stages (see section above), climate-related disruptions to supply chains and post-harvest systems can exacerbate food losses, raise prices, and intensify food insecurity, particularly in vulnerable regions.[284]

7. MALNUTRITION

In academic research, climate change and malnutrition are increasingly conceptualized as mutually reinforcing environmental degradation, poverty, and health outcomes.[285] The Secretary General's report to the 2025 UN Food Systems Stocktake highlighted the need for food systems transformation, climate action and malnutrition, to be addressed in an integrated manner, and highlighted opportunities to accelerate progress.[286] For example, shifts to healthy,

[279] https://www.ipcc.ch/srccl/chapter/chapter-5/.
[280] FAO (n 1).
[281] FAO (n 1); UNEP (2021), Food Waste Index Report 2021, https://wedocs.unep.org/bitstream/handle/20.500.11822/35280/FoodWaste.pdf; UNEP (2024). Emissions Gap Report 2024: No more hot air … please! https://wedocs.unep.org/handle/20.500.11822/46404.
[282] https://www.ipcc.ch/srccl/chapter/chapter-5/.
[283] https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter05.pdf.
[284] FAO (2021), The State of Food and Agriculture, https://openknowledge.fao.org/server/api/core/bitstreams/7e6336f8-d90d-4936-805b-f612a218f0c8/content; https://www.ipcc.ch/srccl/chapter/chapter-5/; https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf.
[285] Turkie, A. (2022), 'A human rights-based, regime interaction approach to climate change and malnutrition' 40 Netherlands Quarterly of Human Rights 399, https://doi.org/10.1177/09240519221133642.
[286] United Nations (2025), Accelerating Inclusive, Resilient and Sustainable Food Systems Transitions for People: https://www.unfoodsystemshub.org/media/docs/unfoodsystemslibraries/unfss-4/unfss4_en_sg_report.pdf; submission by Scaling Nutrition.

nutritionally adequate diets, combined with improvements to agricultural productivity and reductions in food loss and waste could reduce food systems' GHG emissions by 20 percent from 2020 levels by 2050, while improving nutrition outcomes.[287] Additionally, nutrition interventions can build the resilience of the most vulnerable individuals, helping them adapt to the increasing challenges of climate change.[288]

Climate change increases the risk of all forms of malnutrition. Climate impacts threaten food production and decrease the nutrient density of crops,[289] thereby exacerbating a growing epidemic of obesity, hunger and undernutrition.[290] By 2050, more than half a million additional deaths from climate-related dietary changes are anticipated globally. 1.4 billion additional women and children will be at risk of iron deficiency. Stunting rates could rise by 23 percent in sub-Saharan Africa and 62 percent in South Asia. Malnutrition interacts with heat exposure in pregnancy, increasing the risk of low birthweight.[291] Nearly half of all deaths in children under 5 years are attributable to undernutrition, which puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and delays recovery (A/HRC/52/40).

The industrialization of food systems, together with climate change, are having profound impacts on global nutrition. Climate impacts threaten food production and therefore food security; while heightened levels of atmospheric CO_2 decrease the nutrient density of crops.[292] So one of the major causes of climate change, and climate change impacts are exacerbating a growing epidemic of obesity, along with significant hunger and undernutrition.[293] Roughly the same percentage of people around the world are obese as those who lack access to nutritious and healthy food, approximately 2 billion at each end of the spectrum.[294]

Despite a 300% increase in global food production since the mid-1960s, malnutrition is a leading factor contributing to reduced life expectancy (A/76/237). Nearly half of all deaths in children under 5 years are attributable to undernutrition, which puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and delays recovery (A/HRC/52/40).

By 2050, more than half a million additional deaths from climate-related dietary changes are anticipated globally.[295] Women and girls are disproportionately affected by nutrition-related impacts of climate change, facing malnutrition due to declining food quality, heavier

[287] Rockström et al (2025), 'The EAT–Lancet Commission on healthy, sustainable, and just food systems' 406 *The Lancet* No. 10512; and Planet: Report of the Secretary-General" (2025).
[288] Standing Together for Nutrition, "The Climate Crisis and the Nutrition Crisis Are Intertwined: The need and the opportunity for policy action to address both crises simultaneously" (Washington, D.C., Micronutrient Forum, 2025). Quoted in submission by Scaling Nutrition.
[289] https://pmc.ncbi.nlm.nih.gov/articles/PMC12616468/.
[290] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2818%2932822-8/fulltext.
[291] Submission by Scaling Nutrition.
[292] https://pmc.ncbi.nlm.nih.gov/articles/PMC12616468/.
[293] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2818%2932822-8/fulltext.
[294] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2818%2932822-8/fulltext.
[295] Springmann et al (2016), 'Global and regional health effects of future food production under climate change: a modelling study' 387 *The Lancet* No. 10031, 1937, quoted in submission by Scaling Up Nutrition.

workloads, extreme heat, and shifting disease patterns.[296] 1.4 billion additional women and children will be at risk of iron deficiency,[297] and stunting rates could rise by 23 percent in sub-Saharan Africa and 62 percent in South Asia.[298] Malnutrition interacts with other climate drivers: heat exposure in pregnancy increases the risk of low birthweight by 29 percent in some areas.[299]

The EAT–Lancet Commission on healthy, sustainable, and just food systems report of 2025 provides a series of recommendations for food systems transformation that by 2050 would reduce land use for agriculture by 11-18%, GHG emission by 55-67%, water use by 9%, nitrogen and phosphorus use by 26%, compared to business-as-usual trajectories:

- Planetary Health Diet as a flexible dietary pattern designed to support optimal health across diverse populations and contexts that is rich in plants—whole grains, fruits, vegetables, nuts, and legumes form the foundation— while allowing for modest amounts of animal-sourced foods, including dairy, fish, and meat, depending on cultural preferences. Red and processed meat and added sugar are limited due to strong evidence of health risks. A shift to this pattern could prevent approximately 15 million avoidable deaths each year, about 27% of deaths worldwide;
- more equitable access to land and water resources, strengthening public advisory services, reducing power asymmetries between producers and dominant agribusinesses, and coordinated public and private sector investments that support farmers transition to sustainable, diverse, context-specific practices that store carbon, create and connect habitats, reduce nutrient and fertilizer applications, and prevent water pollution;
- a less resource- and labor-intensive system capable of feeding 9.6 billion people with healthy diets, while keeping food costs largely stable. Fruit, vegetable, and nut production would need to rise by 63%, and fisheries and aquaculture by 46%, while ruminant meat production may need to fall by one-third, with regional differences in how this restructuring occurs;
- well-designed policies that safeguard the livelihoods and preferences of different actors, and ensure benefits and burdens are equitably distributed, anticipating and managing for change with 5–20-year outlooks with a view to: ensuring livable incomes and collective bargaining, regulating market concentration and financial speculation, improving transparency, accountability, representation and access to information;
- protecting the human right to adequate food in conflict zones;
- use taxes and subsidies to make unhealthy food and beverages more expensive and healthier options more affordable; increase purchasing power for households, particularly in the lowest quintile, through social protection, employment creation, food safety nets,

[296] Rivera-Ferre (2021), Achieving gender equality and the empowerment of all women and girls in the context of climate change, environmental and disaster risk reduction policies and programmes (EGM/ENV/EP.19). UN Women. Quoted in submission by Scaling Nutrition.
[297] Smith et al (2017), 'Potential rise in iron deficiency due to future anthropogenic carbon dioxide emissions", 1 *GeoHealth*, 248 quoted in submission by Scaling Nutrition.
[298] Lloyd et al (2011), 'Climate change, crop yields, and undernutrition: development of a model to quantify the impact of climate scenarios on child undernutrition' 119 *Environmental Health Perspectives* 1817, quoted in submission by Scaling Nutrition.
[299] Chersich et al (2020), 'Associations between high temperatures in pregnancy and risk of preterm birth, low birth weight, and stillbirths: systematic review and meta-analysis' 371*The BMJ* art. M3811, quoted in submission by Scaling Nutrition.

and living wage legislation; recognize and include traditional healthy foods and diets in food-based dietary guidelines and public procurement programs;
- Support local markets and value chains to promote consumer demand of underutilized healthy and locally produced crops. [300]

8. TIPPING POINTS

According to IPCC, climate change is already affecting food security, with recent studies in both large-scale and smallholder farming systems documenting declines in crop productivity related to rising temperatures and changes in precipitation.[301] These impacts include: shifts in climate envelopes causing shifts in cropping varieties planted; warming trends extending growing seasons; high temperatures affecting critical growth periods, flooding/droughts; CO_2 concentrations, short-lived climate pollutants, and dust. Water resources for food production will be affected through changing rates of precipitation and evaporation, ground water levels and dissolved oxygen content.[302]

According to the EAT–Lancet Commission on healthy, sustainable, and just food systems, food is the single largest cause of planetary boundary transgressions, driving the transgression of five of the six breached boundaries. Food systems also exert a notable impact on the transgressed climate boundary and on the ocean acidification boundary. Only 1% of the global population live in a country that is in a safe and just space.[303]

The abrupt and severe changes characteristic of tipping events would amplify food security risks to a greater extent than risks from gradual climate change. Crop yield volatility, supply chain disruption and price shocks from tipping points are expected to create disruptions beyond what gradual climate change would produce, particularly in terms of rain fall and temperature. For example, over half of the global population lives in tropical monsoon regions, where disruptions to monsoon systems caused by climate tipping points therefore pose serious threats to agricultural productivity. Tipping points also threaten food security through indirect pathways, including altered pest and disease dynamics as changing temperature and precipitation patterns expand the geographic range and seasonal activity of crop pests and pathogens. Although climate-driven crop failures in one region may be offset by production in another region, simultaneous harvest failures across multiple major crop-producing regions pose a threat to global food security, driven by concurrent weather extremes from strongly meandering jet streams.[304]

The Atlantic Meridian Overturning Circulation (AMOC) collapse is expected to lead to widespread agricultural system collapse in Northern Europe due to regional cooling. Ice sheet collapse and sea-level rise lead to flooding or saltwater intrusion of low-lying, coastal, and

[300] Lancet-EAT Summary for Policy Makers (2025).
[301] https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 454.
[302] https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Full_Report.pdf, at 451-454.
[303] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(25)01201-2/fulltext, at 1661.
[304] https://global-tipping-points.org/download/1418/.

river delta agricultural areas, threatening food production globally, with risks to major farming regions such as the Ganges-Brahmaputra Delta, Mekong Delta, Po Valley, and Nile Delta. [305]

Carbon dioxide increase leading to stronger El Niños and compounding effects of elevated climate variability and mean state warming are likely to lead to catastrophic cascading impacts on land and in the ocean, including reef demise and plankton crisis with significant impacts on food security.[306]

9. CORPORATE POWER

There is significant evidence that agri-food sectors are dominated by a handful of firms with vested interests in promoting and perpetuating fossil fuel and chemical-dependent, industrial food systems: these companies make significant political contributions to protect their interests.[307]

Academic literature has identified a 'fossil fuel historical bloc', which is composed of national and transnational actors across the fossil value chain, whose interests lie in fossil fuel dependence and expansion. To that end, they use diverse strategies to co-opt challengers and reframe oppositional ideas, to create and sustain the impression that alternative economic models are 'complementary to and supportive of' harmful, dominating economic models.[308] These industry actors have relied on issue-specific, industry-led multi-stakeholder partnerships to contain transformational demands and rather focus attention on market-based, soft or voluntary (self-)regulation, diverting attention away from the inter-linked ecological crises and their root causes linked to whole systems of production and consumption. In that context, specific efforts are made to portray the crises are discrete, isolated issues, solvable through incremental technical fixes, with corporations presented as indispensable problem-solvers.[309]

Academic research is also focusing on the 'upstream' social forces underlying the production of fossil fuels, plastics and other petro-chemicals and the co-evolving and mutual entanglements of energy, fossil fuel and plastic industries, which ats as 'a semi-coherent political force'.[310] A 'petrochemical historical bloc' has thus been identified, which encompasses not only industry members but also an array of state institutions, non-governmental organizations (NGOs), private finance, state-capital entities, and consultancy firms, who legitimize, normalize, and expand dependence on plastics while marginalizing or co-opting alternatives.[311]

[305] https://global-tipping-points.org/download/1418/.
[306] https://www.science.org/doi/10.1126/science.ado2030.
[307] Submission by GCHA; https://futureoffood.org/wp-content/uploads/2023/11/ga_food-energy-nexus_report.pdf
[308] Hanieh (2021), 'Petrochemical empire: The geo-politics of fossil fuel production' 2 *New Left Review* 25, https://doi.org/10.64590/kbq.
[309] Taggart et al (2026), 'The battle for plastic hegemony: the petrochemical historical bloc and the UN Global Plastics Treaty' Review of International Political Economy, https://www.tandfonline.com/doi/full/10.1080/09692290.2026.2642934#abstract.
[310] Ibid.
[311] Ibid.

Multistakeholderism has served as a vehicle through which traditional members of the petrochemical bloc seek to expand their engagement and alliances with wielders of financial capital in the Global North. It has served to institutionalize interaction between corporate interests and governments as part of its expanding ecosystem of partnerships actively engaging in plastic treaty negotiations, and to further extend and incorporate private finance and state capital within a financialized market for plastic waste by promising lucrative financial returns.[312] Petrochemical companies have also relied on issue-specific, industry-led multi-stakeholder partnerships to contain transformative demands that would challenge over-production and consumption: with these partnerships, petrochemical companies are framed as indispensable problem-solvers for the energy transition, as opposed to a target of the fossil fuel phaseout.[313] The Special Rapporteur on the right to food underscored that multi-stakeholder coalitions can serve as a vehicle through which industry blocs exercise undue influence on UN processes (A/76/237). Academic research also indicates that industry-led multi-stakeholder partnerships can help obtain financial capital, while assimilating transformative proposals.[314]

According to independent research, "major consumer goods and food and beverage corporations—such as Nestlé, Unilever, Danone, Coca-Cola, and Procter & Gamble—play key roles in the plastics bloc."[315] In addition, "transnational financial institutions—banks, insurers, investors, and development banks—fund new plastic production and refining facilities," with their investments in petrochemical technologies and infrastructure expected to exceed $300 billion by 2030. Much of these investments are within developing countries via direct loans and corporate bonds.[316] The appeal and strategic significance of these investments hinge upon sustained plastic demand growth, which supports large-scale petrochemical projects and fossil fuel exporters who diversify and ensure fossil fuels' continued use as feedstock. For states anticipating declining oil demand, petrochemicals serve as a crucial diversification strategy and thus hedge against losses via electrification.[317]

For the petrochemical historic bloc, this strategic alignment between fossil fuel and petrochemical actors fosters a 'polycentric but global network' that strengthens mutual interests and entrenches commitments to fossil fuel extraction and related state subsidies, helping to keep plastic feedstock prices low.[318] Sovereign Wealth Funds, closely tied to fossil fuels, are also investing heavily in petrochemical production petrochemical corporations, fast-moving consumer goods firms, global food and beverage companies, state-capital entities, consultancies, and financial actors are mutually entangled with fossil capital.[319]

[312] Ibid.
[313] doi.org/10.1016/j.erss.2022.102880, https://doi.org/10.1016/j.ecolecon.2024.108261.
[314] https://www.tandfonline.com/doi/full/10.1080/09692290.2026.2642934#abstract.
[315] Taggart et al (n 308).
[316] Ibid.
[317] Tullo (2019), 'The future of oil is in chemicals, not fuels' *C&EN Global Enterprise*, 97, 26.
[318] IMF (2019), *Global fossil fuel subsidies remain large – an update based on country level estimates* (Working paper), https://www.imf.org/en/Publications/WP/Issues/2019/05/02/Global-Fossil-FuelSubsidies-Remain-Large-An-Update-Based-on-Country-Level-Estimates-46509; Koplow & Steenblik (2024), *Protecting nature by reforming environmentally harmful subsidies: An update*. Earth Track. https://www.earthtrack.net/sites/default/files/documents/ehs_report_september-2024-update_final.pdf.
[319] Taggart et al (n 308).

It should be recalled that financial businesses can be directly linked to adverse human rights impacts through its business relationships (such as through the provision of financing); they can also contribute to human rights harm through their own operations and actions. If a bank identifies, or is made aware of, an ongoing human rights issue that is directly linked to its operations, products or services through a client relationship, yet over time fails to take reasonable steps to seek to prevent or mitigate the impact, it can be viewed as enabling the situation. a financial business can move from being directly linked to an adverse human rights impact to contributing to that impact if it does not take action to prevent or mitigate the business relationship to which it is directly linked, including by undertaking human rights due diligence (AL OTH 89/2023).

At the same time, academic research warns about the links between plastics and the energy transition. Although plastics rely on fossil fuels as feedstock, petrochemicals and synthetic materials are playing a central material role in development of renewable energy (A/80/188). Plastics are embedded in infrastructures, consumption practices, and imaginaries of future growth—including those associated with electrification to incorporate waste pickers and their associations through promises to 'unlock' the value of plastic waste via 'innovative' financing mechanisms.[320]

There are also links between renewable energy and agribusiness initiatives that tend to prioritize scale, efficiency, and export orientation, creating incentives for the conversion of smallholder land into plantations or energy crops and reducing access to land and water for subsistence producers.[321] Even in sectors such as animal agriculture, mitigation policies can produce sharply divergent outcomes depending on their design: they may support small, extensive systems, or instead favour industrialized models that marginalize rural households and intensify structural inequalities.[322] These patterns are not accidental, but embedded in broader power structures that shape contemporary decarbonization pathways: many renewable-agribusiness trajectories reproduce extractive logics rather than dismantling them, because financing mechanisms, corporate strategies, and policy incentives remain oriented toward capital accumulation and large-scale production.[323]

Even supposedly disruptive innovations, such as cellular or high-tech food systems, may reinvest in industrial paradigms by scaling centralized production instead of promoting decentralization, autonomy, or democratic control.[324] territorial control, political autonomy, and agroecological pluralism. It explicitly challenges renewable investments and agribusiness partnerships.[325] There is thus a call to move away from fossil-intensive and scale-centric

[320] Taggart et al (n 308).
[321] Li et al (2022), 'An Equality-Based Approach to Analysing the Global Food System's Fair Share, Overshoot, and Responsibility for Exceeding the Climate Change Planetary Boundary' 11 Foods 3459; Laurent (2018), Report of the Independent Commission for Sustainable Equality, Sciences Po publications.
[322] Feigin et al (2025), 'Solving Climate Change Requires Changing Our Food Systems,' 5 Oxford Open Climate Change, doi: 10.1093/oxfclm/kgae024.
[323] Tribaldos et al (2022), 'Just transition principles and criteria for food systems and beyond' Environmental 43 Innovation and Societal Transitions 244, https://doi.org/10.1016/j.eist.2022.04.005; Delgado et al (n 171).
[324] UNEP (2023), Driving Finance for Sustainable Food Systems: A Roadmap to Implementation for Financial Institutions and Policy Makers, https://wedocs.unep.org/items/901e5623-f60c-4d71-907d-c42eef5f103e.
[325] Laurent (n 320); Burney (2025), 'Eliminating Hunger in a World Serious about Climate Mitigation' Proceedings of the National Academy of Sciences of the United States of America. https://doi.org/10.1073/pnas.2410202122; Gomez and Cordova (2023), 'Theoretical and Legal Perspectives on

models toward systems that prioritize smallholder empowerment, collective rights, and democratic control over resources.[326] This perspective reframes climate mitigation not as a matter of optimizing emissions, but as a process that must actively safeguard dignity, subsistence, and social inclusion.

On the other hand, decentralised renewable energy systems, such as solar dehydrators and solar panels for pumping water (irrigation) or for powering freezers to store goods, can be integrated into the local production system, with the aim to increase and stabilize agricultural production and this food security (for example, because of the option to freeze and store fish). At the same time, this can be financed by community-owned credit mechanism and open up new business opportunities. However, such interventions often aim at establishing access to energy, rather than replacing emissions from the existing energy system. Nonetheless, they are key as they have multiple benefits for the community and allow to leapfrog the intensification of fossil fuels in existing energy systems.[327] Nonetheless, climate finance and technical solutions are frequently channeled through corporate agribusiness, privileging actors with economic power[328] (see section 10 below).

9.1 Land accumulation

1% of farms control 70% of farmland:[329] this represents the culmination of an ongoing rush to grab land, which creates severe inequality in access to and control and ownership of land, leading, in turn, to massive inequality of wealth and to systemic hunger, poverty and violence (A/HRC/61/51).The report of the Special Rapporteur on the right to food on land concentration indicated that the largest 10 transnational landowners together control 404,457 km2 – an area larger than Japan, include Blue Carbon (United Arab Emirates), which is focused on carbon projects in Africa, and Shell, which controls land for ethanol production in Brazil (via a joint venture, Raízen), with growing involvement in carbon offset markets (A/HRC/61/51). In the context of increasing and increasingly widespread climate change and biodiversity loss, the availability of arable land and hunting opportunities, and access to fishing territories, are becoming more limited – making the risks to the right to food from land grabs even more acute (A/HRC/61/51).

Updated estimates indicate that there are more than 608 million family farms around the world, occupying between 70 and 80 percent of the world's farmland and producing around 80 percent of the world's food in value terms. In terms of farm size, around 70 percent of all farms, operating on just 7 percent of all agricultural land, are less than one hectare, while another 14 percent of farms, controlling 4 percent of the land, are between one and two hectares, and

Energy-Smart Agri-Food Systems: Sustainability and the Right to Food' 0 Global Jurist, doi: 10.1515/gj-2022-0072.

[326] Delgado et al (n 171); Burbridge (2022), A Just Agroecological Transition through Food Sovereignty: Exploring Theories of Justice in a Just Transition, the Green New Deal and Extension, https://search.proquest.com/openview/9de48a1fc905881d7064fe82e4aebcc2/1?pq-origsite=gscholar&cbl=18750&diss=y.

[327] Submission by Fastenaktion and Operation Native Amazon.

[328] Delgado et al (n 171); Laurent (n 317).

[329] Submission by FIAN International.

another 10 percent of all farms, with 6 percent of the land, are between two and five hectares. Meanwhile, "the largest one percent of farms in the world - greater than 50 hectares - operate more than 70 percent of the world's farmland, with nearly 40 percent of agricultural land found on farms larger than 1000 hectares."[330]

Civil society assessments have estimated that over 70 percent of the world's population is fed by small-scale producers and workers in 'peasant food webs', despite them accounting for less than 1/3 of agricultural land and resources. In some regions the figure may be higher still, with an FAO study noting that small-scale and family farmers produce 80 percent of the food supply in sub-Saharan Africa and Asia.[331]

The first comprehensive food security assessments since the COVID-19 pandemic revealed that nearly 30 percent of the world is food insecure, and 42 percent of people are unable to afford a healthy diet. Corporate-controlled global food chains deepen risks and vulnerabilities: the exposure of industrial commodity production to climate shocks; the diversion of valuable resources into ultra-processed foods, livestock feed, and fuel; the standardization of diets around wheat, rice, and maize; and the growing reliance on a handful of crops and commodity exporters for global calorie intake; the bottlenecks in fragmented and geographically-dispersed global chains; the vast energy requirements built into high-tech digitalized supply chains.[332]

9.2 Market concentration

Global agricultural markets are increasingly dominated by a small number of large agribusiness corporations. Market power refers to the capacity of firms to influence supply and/or demand elements of a market in ways that enable them to control prices and generate profits that exceed normal return on capital (A/80/213). Recent increases in food prices reflect the high concentration of suppliers' market power. Globally, food inflation rates are at record highs. Food inflation is principally caused by transnational corporations raising prices at rates that exceed increased costs and risks. Corporations have been falsely attributing price hikes to various crises, to hide their profiteering (A/80/213).

According to academic research, most agricultural regimes and trade governance systems were built after World War II according to entrenched 'productionist' approaches (increasing production through industrial methods, monocultures, and efficiency metrics) and 'productivist' approaches (prioritizing maximizing agricultural output as a central goal, often linked to modernization, technological intensification, and economic growth). Accordingly, incentives for the agricultural sector focus on output-linked subsidies, price supports, and liberalized trade that distort markets and diets by under-pricing environmental externalities.[333]

[330] https://www.fao.org/newsroom/detail/Small-family-farmers-produce-a-third-of-the-world-s-food/en; Which farms feed the world and has farmland become more concentrated? - ScienceDirect.
[331] https://ipes-food.org/wp-content/uploads/2024/06/FoodFromSomewhere.pdf.
[332] FAO State of Food Security (n 254).
[333] Williams (2025), 'Transforming the Livestock Sector through Climate Change Mitigation Law' (Verfassungsblog), https://verfassungsblog.de/climate-change-law-and-livestock/.

These norms have become stabilized and locked-in through mechanisms such as economies of scale, sunk investments, and entrenched infrastructure[334]

The report of the Special Rapporteur on the right to food on this topic (A/80/213) pointed to the horizontal strategies such as mergers, acquisitions and joint ventures to reduce competition and expand market share. He also pointed to vertical strategies and use mergers, acquisitions or contractual control over suppliers, distributors, retailers and ancillary industries (e.g. transportation and storage) to dominate the supply chain and gatekeep market access. Corporations also gain control over material conditions such as technology, labour conditions, processing practices and food environments, thereby limiting choices for consumers and workers. Further, corporations are shaping food policy because of their growing political influence, which weakens democratic participation. As the Rapporteur clarified, corporate power in food systems essentially "allows a relatively small group of people to shape food systems in a way that serves the ultimate goal of profit maximization instead of the public good." He prioritized the need to curtail corporate power and hold corporations accountable for human rights violations in food systems, in order to protect the right to food and ensure food markets are fair and stable (A/80/213).

Crucially, the concentration of agri-business and related power asymmetries also entrenches dependency on fossil fuels across different economic actors:

- The chemical industry has been co-evolving with the energy industry, and in particular the fossil fuel industry. Moving from biomass to coal to oil and most recently to fossil gas, the use of chemical feedstock has followed the trajectory of the energy system, using new sources of feedstock as they became available at low cost, reinforcing their extraction and use. In this sense, the two generalized uses of fossil fuels—as feedstock and as fuels—are mutually dependent.[335]

- Agrochemical companies specifically, including fertilisers, pesticides, and plastics (including for packaging), have sustained the fossil fuel industry's plans for continued growth will sustain their profits.[336] For instance, the Special Rapporteur on the right to food (A/80/213) identified five firms controlling 25 per cent of the phosphate fertilizer market: OCP (Morocco), the Mosaic Company (United States of America), ICL (Israel), Nutrien (United States) and Sinofert (China).

- In the animal farming sphere, a handful of corporations control the majority of the industry, benefitting from a variety of exemptions that allow corporations to bypass labor, environmental, and animal welfare laws.[337] Due to revolving doors between industry and government, these corporations have significant influence on laws, policies, and regulations that oversee, or fail to oversee, their own industry.[338]

[334] Submission by Rebecca Williams.
[335] Bennett, 2007
[336] https://www.cnbc.com/2022/01/29/how-the-fossil-fuel-industry-is-pushing-plastics-on-the-world-.html.
[337] Blattner & Amman (2019), 'Agricultural Exceptionalism and Industrial Animal Food Production: Exploring the Human Rights Nexus' 15 Journal of Food Law & Policy, https://doi.org/10.54119/jflp.rmgf4715 quoted in submission by Phoenix Zones Initiative
[338] Sievert et al (2021), 'Understanding the Political Challenge of Red and Processed Meat Reduction for Healthy and Sustainable Food Systems: A Narrative Review of the Literature' 10 International Journal of Health

- The spread of supermarkets often coincides with increased imports and sales of ultra-processed foods. Single-use plastics underpinned the rapid expansion of ultra-processed foods globally,[339] confirming the co-evolution of large-scale food, petro-chemicals and fossil fuels industries.[340] Between 1990 and 2000, supermarkets' share of all retail food sales in Latin America increased from 15 per cent to 60 per cent, with similar transitions occurring in Asia, parts of Europe, Western Asia and urban parts of Africa. The exponential growth of supermarkets and fast-food chains is displacing smaller, informal fresh food markets that sell locally sourced food. This shift in food environments favours larger-scale suppliers, often multinationals, that can meet supermarkets' needs and requirements more easily than smaller-scale suppliers, which in turn reinforces the power imbalances throughout the food system (A/80/213).

- In addition, agrifood corporations are turning towards new digital technologies and large-scale data processing, through the use of digitalization, which creates new human rights challenges in food systems. As the Special Rapporteur on the right to food emphasized (A/80/213), "what is unique today is the expansion of corporate power into all aspects of the food system and the consolidation of corporate power over the past decades." The entry of Big Tech companies into agriculture and food, as well as in partnerships with agribusiness deepens existing forms of marginalization; an increasingly important tool for corporate actors to expand their reach and control over food system. while digital technologies increasingly shape access to services and control over resources and goods. Consequently, the ability to collect, store, process, analyse and use data increasingly determines the profit, prospects and power of companies and other actors (A/80/213).

From a human rights perspective, high levels of corporate concentration and power in food systems undermines people's agency and autonomy, understood as their ability to make choices and meaningfully participate in food systems. Corporate power limits the ability of individuals to gain access to the resources necessary to make food available, such as land, water and agricultural inputs. It also limits their access to adequate food because of corporate-created inflation or the dominance of supermarkets. Corporate power disrupts local and territorial markets, pushing more people to depend on unstable global markets and complex supply chains. Corporate food systems tend to produce food that is not culturally, nutritionally or environmentally adequate. Corporate food systems also exacerbate structural inequalities, disproportionately affecting those who already face systemic barriers to food access (A/80/213).

Growing market concentration limits smallholder farmers' access to essential inputs like seeds, restrict their entry into markets, and undermine their ability to secure fair prices. This can in turn reduce competition and stifle innovation, with critics calling for less reliance on market-based solutions to food insecurity,[341] and more support for a just transition led by smallholder

Policy and Management, 793, https://doi.org/10.34172/ijhpm.2020.238 quoted in submission by Phoenix Zones Initiative.

[339] https://www.tandfonline.com/doi/full/10.1080/09692290.2026.2642934#abstract.

[340] https://doi.org/10.1080/00130095.2020.1794809.

[341] https://doi.org/10.1515/9783111519869-025.

farmers by making localized, agro-ecological alternatives economically advantageous through public policy intervention.[342]

Growing market concentration also undermines climate action, rather than support it, in the context of food security.[343] The persistence of vested interests across food, energy, and financial sectors generate institutional environments in which transformative pathways are difficult to implement. In such contexts, decarbonization strategies tend to remain confined to narrow sectoral interventions, disconnected from broader redistributive or democratic reforms. Rather than overcoming structural barriers, many energy-smart initiatives become absorbed into existing institutional logics, reproducing the same asymmetries of power that characterize conventional agri-food systems.[344]

The Special Rapporteur on the right to food highlighted how the concentration of corporate power aggravates climate impacts, weakens food sovereignty, and limits democratic control over food systems. The rise of corporate power in food systems, in effect, correlates with the increasing trend of the industrialization of food production and related corporate-led increased rates of GHG emission, biodiversity degradation, pollution and systemic human rights violations (see sections 1-2 and 4-5 above). During the coronavirus disease (COVID-19) pandemic, industrialized agriculture and food production sites became breeding grounds for pathogens (A/80/213).

9.3 Disinformation and Climate Obstruction

Many of the strategies for evading social and environmental responsibilities come from a 'playbook' used by fossil fuel and petrochemical industries and are widely applied by industrialized actors in food systems. These strategies include distraction —i.e. keeping discussions focused on consumer behaviour change rather than producer responsibility— and greenwashing through corporate sustainability initiatives, the creation of 'astro-turf' organizations, lobbying and obstructionism at national and international negotiations, and contesting the scientific, technical and economic case for climate action. The industrial agriculture industry is keen to portray itself as the purveyor of 'climate-smart agriculture' through 'sustainable intensification',[345] 'petro-farming'[346] as well as relying on the lobbying efforts of the fossil-based fertilizer industry.[347] Other industry tactics (A/80/213) include marketing practices that spread false health and nutrition claims, appealing directly to children and creating a false perception of environmental and social stewardship.[348]

[342] Submission by Ritu Dhingra.
[343] https://doi.org/10.1073/pnas.2410202122.
[344] https://doi.org/10.1016/j.eist.2022.04.005.
[345] "A Just Agroecological Transition through Food Sovereignty: Exploring Theories of Justice in a Just Transition, the Green New Deal and Extension", [Online]. Available: https://search.proquest.com/openview/9de48a1fc905881d7064fe82e4aebcc2/1?pq-origsite=gscholar&cbl=18750&diss=y.
[346] Moore (2015). *Capitalism in the web of life: Ecology and the accumulation of capital* (Verso Books).
[347] https://doi.org/10.1080/09692290.2025.2467394.
[348] Submissions by GCHA, LDA, Chisoméjé Rural Women Rising.

The Special Rapporteur on the right of health illustrated how corporate production and marketing strategies for unhealthy foods and beverages detrimentally influence dietary decisions, specifically targeting lower-income countries with unhealthy products, while often pushing healthier foodstuffs in wealthier countries. Many food and beverage corporations' market or repackage their products in a way that creates the perception that they are altering their business practices to address social, economic, environmental and health problems, while deceiving consumers into believing that certain products are more sustainable or nutritious than they actually are (A/78/185; A/80/213).

According to academic research, the Petrochemical Historical Bloc has used diverse strategies to divert attention from the need to phase out fossil fuels and limit plastics productions, and rather focus on plastic *pollution* and *waste*, despite the great limitations in recycling, with a view to distracting from the 'upstream' fossil fuel extraction and plastics production industry which are portrayed as implausible and undesirable. In addition, the bloc advances more explicitly financialized approaches that frame circularity as an investment opportunity. [349] Marketing campaigns presented plastics as the literal 'skin of commerce' via food packaging, to symbolize hygiene, freshness, and consumer choice. To promote further expansion, the industry explicitly embraced single-use plastics and disposability, despite industry awareness that neither mechanical nor chemical recycling are technically and economically feasible. [350]

The world's 35 largest meat and dairy companies engage in climate disinformation in relation to their commitments to mitigating climate change and explicit commitments to net-zero emissions by 2050. In general, these commitments emphasize mitigating energy use, with minimal focus on emissions (e.g., methane) from animal and land use, which make the biggest warming contributions in the agricultural sector. [351] Academic research has also unveiled that since at least 1989, the US livestock industry knew of its role in global warming, and a newly uncovered industry document makes clear that the industry planned to obstruct efforts to shift US diets to reduce emissions. [352]

A report 'The New Merchants of Doubt' by Changing Markets investigated how the 22 largest meat and dairy companies across four continents use greenwashing, misleading metrics, political access, advertising, and science distortion to deter meaningful climate action.[353] According to the report, big meat and dairy companies use strategies to:

- distract (advertising to cast meat and dairy as healthy, sustainable or essential, and to attack plant-based alternatives; and downplaying the climate impact of livestock methane emissions by framing them as harmless or by promoting controversial metrics like Global Warming Potential that make emissions look smaller;
- delay (solutions such as methane-suppressing feed additives are pushed but rarely scaled; The industry resists proposals to shift consumption toward plant-based diets, framing its own growth as diversification rather than acknowledging the need to reduce animal production) and

[349] https://www.tandfonline.com/doi/full/10.1080/09692290.2026.2642934#abstract.
[350] Ibid.
[351] https://iopscience.iop.org/article/10.1088/1748-9326/adb6c0.
[352] https://link.springer.com/article/10.1007/s10584-021-03047-7; https://iopscience.iop.org/article/10.1088/1748-9326/adb6c0#erladb6c0bib9.
[353] https://changingmarkets.org/press-releases/groundbreaking-report-reveals-how-meat-and-dairy-industries-have-derailed-climate-action-globally/.

- derail (lobbying, political donations and revolving doors between government and industry to influence policymakers and weaken or block climate policy, with the result that agriculture is often exempt from emissions regulation due to industry pressure that keeps climate obligations voluntary and light).

The UN Special Rapporteur on the right to food also pointed to corporations creating an increase in demand for ultra-processed products through advertising, promotions and other marketing strategies that disproportionately target racial and ethnic minorities and people from socially disadvantaged backgrounds. For example, between 2000 and 2013, the consumption of ultra-processed products in Latin America increased by more than 25 per cent and the consumption of fast food by 40 per cent. Similar trends were seen in parts of Africa as well. Most alarming is the disproportionate targeting of children, thereby increasing the risk of childhood obesity (A/80/213).[354]

There are specific concerns about fossil fuel companies' climate disinformation and obstruction in the context of food systems. The concern with regard to fossil fuel company climate disinformation and obstruction in food systems is further complicated by the way in which these actions lead to distorted understanding of (i) who bears the responsibility for greenhouse gas emissions; (ii) who is most vulnerable to the impacts of climate change; and (iii) what are the solutions to address greenhouse gas emissions associated with food systems.[355]

In addition, fossil fuel companies and agribusiness actors also contribute to fund and disseminate narratives that delegitimize community-based solutions and reinforce power-concentrating models.[356] For instance, agrochemical corporations linked to fossil fuel producers promote narratives that chemical-intensive agriculture is necessary for food security, despite evidence of environmental and health harms.[357]

Civil society have expressed specific concerns about climate disinformation focusing on 'false solutions' in relation to limited technology-based fixes like converting manure methane into biogas and feed additives, or the misuse of metrics to distort and greenwash methane's heating impact, by the meat and dairy industry, while they are planning for a 70% increase in global animal protein consumption by 2050.[358] In particular, with regard to biogas, civil society referred to studies of biogas operations increasing on-farm ammonia emissions by 46%[359] and 47%[360] and indicating that generating electricity from biogas created worse environmental impacts compared to hydro, wind, and geothermal power.[361] Another study concluded that

[354] Submission by GCHA.
[355] Submission by Ekhator and Lalude.
[356] Submissions by Instituto Linha D'Água (LDA) and Mexico City.
[357] Submission by LDA.
[358] https://foodrise.org.uk/wp-content/uploads/2025/10/Roasting-The-Planet-Report-FINAL-16_10_25.pdf included in submission by Brighter Green; see also submission by La Vía Campesina.
[359] Harper et al (2010), 'The effect of biofuel production on swine farm methane and ammonia emissions' 39 Journal of Environmental Quality 1984, https://acsess.onlinelibrary.wiley.com/doi/10.2134/jeq2010.0172.
[360] Weaver et al (2012), 'Effects on carbon and nitrogen emissions due to swine manure removal for biofuel production' 41 Journal of Environmental Quality 1371, https://acsess.onlinelibrary.wiley.com/doi/10.2134/jeq2011.0374.
[361] Fusi et al (2016), 'Life cycle environmental impacts of electricity form biogas produced by anaerobic digestion' 4 Frontiers in Bioengineering and Biotechnology 26, ttps://www.frontiersin.org/journals/bioengineering-and-biotechnology/articles/10.3389/fbioe.2016.00026/full.

biogases are unlikely to deliver GHG-negative or zero-GHG energy at scale because of the inability to capture sufficient methane and the common occurrence of leakage.[362] Another concern regards over-reliance on land conversion to design national net-zero carbon strategies by food-related companies, which would displace food production, threaten biodiversity, and disrupt livelihoods, leading to severe social and ecological trade-offs that far outweigh the potential climate benefits.[363]

In terms of lobbying, 302 industrial agriculture representatives were present at UN Climate COP 30 in November 2025),[364] which represents a 14% rise from COP29. In addition to lobbying directly, petrochemical firms act through seemingly credible intermediaries that promote their specific interpretation of circularity, while integrating private capital and civil society organizations, at plastics negotiations.[365]

Disinformation and undue influence from the food and beverage industry interferes with States' efforts to adopt and enforce laws, regulations and policies with the heightened risk of public institutions being undemocratic and unresponsive to people's demands and rather focused on preserving the status quo, as the Special Rapporteur on the right to food warned (A/80/213).

9.4 Exceptionalism under the international climate change regime

The United Nations Framework Convention on Climate Change (UNFCCC) recognizes the imperative of "ensuring that *food production* is not threatened" in its objective. The Paris Agreement recognizes "the fundamental priority of safeguarding *food security* and ending hunger". However, the integration of food systems into climate negotiations has been slow and uneven, with terrestrial agriculture receiving still limited attention, and even less attention for aquatic and marine food systems.[366] In effect, marine food systems have not been granted a dedicated negotiation track, work programme, or sustained policy platform within the UNFCCC architecture. Empirical analyses of NDCs and related UNFCCC reporting instruments further reveal the marginal position of fisheries and aquaculture in national climate planning. These sectors are mentioned infrequently, and when they do appear, they are typically framed solely in terms of vulnerability and adaptation needs, rather than as domains with mitigation potential or strategic relevance for climate solutions.[367]

Corporate power (section 9.1-9.3 above) can explain why food systems are not more central to climate change mitigation efforts. This is explained in academic research as "agricultural exceptionalism" – the tendency to treat agriculture as a sector shielded from the regulatory expectations applied to other emission-producing activities because of concerns over food security, national sovereignty, political sensitivities, trade, and the complexity of measuring

[362] Submission by Just Food Transition Network.
[363] https://landgap.org/downloads/2025/2025_Land-Gap-Report_Final.pdf.
[364] Submission by Rural Women's Assembly. https://www.desmog.com/2025/11/18/more-than-300-lobbyists-for-industrial-agriculture-are-attending-cop30/ mentioned in submission by Brighter Green.
[365] https://www.tandfonline.com/doi/full/10.1080/09692290.2026.2642934#abstract.
[366] https://doi.org/10.1017/S175173111300089X.
[367] https://doi.org/10.1126/science.abo2364.

and mitigating agricultural emissions.[368] Such exceptionalism has been sustained by highly concentrated large-scale food producers, with strong lobbying capacity, who were granted disproportionate influence over negotiation agendas and technical standards. It was further supported by subsidies, funding and rules that privilege high-output food systems, despite their emissions, energy and resource intensity, and other environmental harm.[369]

Academic analysis points to a 'productionist bias' that reproduces a technocratic vision of climate mitigation that sidesteps deeper structural questions about the organization of food systems and the political economy of agri-food markets. This limitation is particularly evident in relation to aquatic food systems. Fisheries and aquaculture, despite their critical role in global food security, employment, and nutrition, remain strikingly underrepresented in national climate plans.[370] Their marginalization reflects both data limitations and institutional fragmentation, but also reveals a broader pattern in which ocean-based food systems are treated as peripheral to climate governance.[371]

Linked to the narratives drawing on climate disinformation and obstruction strategies discussed above (section 9.3 above), sectoral mitigation is shaped by the interaction between concentrated economic interests, regulatory capacity, and the visibility of costs and benefits to political actors. Sectors with highly concentrated actors, strong lobbying capacity, and deep political embeddedness tend to resist ambitious mitigation policies more effectively. These sectors successfully frame climate regulation as economically disruptive, socially harmful, or politically infeasible, thereby securing exemptions, delays, or softer regulatory treatment. This dynamic explains why energy-intensive industries, transport, and agriculture often receive differentiated treatment in climate regimes, despite their significant emission profiles.[372]

Academic research also illustrates how the Koronivia Joint Work on Agriculture tends to privilege technocratic, productivity-oriented frameworks while marginalizing relational, territorial, and Indigenous knowledge systems central to agroecological paradigms. In other words, the Koronivia Joint Work on Agriculture reproduces power asymmetries over which forms of knowledge, farming models, and development trajectories are rendered legitimate within the UNFCCC system, even if structured negotiations on soils, water and nutrient management, livestock systems, and socio-economic dimensions under this Joint Work could open up a formal space in which agroecological principles could be prioritized as climate solutions.[373]

Commonly reported measures in Nationally Determined Contributions (NDCs) include technical improvements in crop and livestock management, the expansion of agroforestry systems, soil carbon sequestration practices, and efforts to reduce deforestation linked to

[368] https://doi.org/10.1017/s2047102522000437.
[369] Submission by Rebecca Williams.
[370] Zurek et al (n 368).
[371] https://doi.org/10.1126/science.abo2364.
[372] Newell, Phillips & Pueyo (2014), The political economy of low carbon energy transitions: Evidence from Sub-Saharan Africa. Institute of Development Studies Working Paper No. 445. Institute of Development Studies, University of Sussex.
[373] Loboguerrero et al (2019), 'Food and Earth Systems: Priorities for Climate Change Adaptation and Mitigation for Agriculture and Food Systems' 11 Sustainability 1372, https://www.mdpi.com/2071-1050/11/5/1372.

agricultural expansion At the same time, the integration of agriculture into national reporting frameworks remains characterized by significant methodological and institutional inconsistencies on agricultural emissions, resulting in fragmented data sets and limited comparability across national inventories.[374] Most NDCs prioritize production-side interventions, focusing on on-farm efficiency and land management, while largely neglecting consumption patterns, supply chain emissions, dietary transitions, and food loss and waste.[375]

A majority of countries (69 %) prioritize adaptation in agrifood systems, particularly for forests, crops, and fisheries. Only 8% of pledged emission reductions among the top 15 agrifood emitters are supported by concrete mitigation measures with clear implementation pathways. The NDCs collectively estimate only one-sixth of the finance needed to transform agrifood systems in line with the Paris Agreement, and only five out of thirty-five countries provide updated finance estimates for agrifood action.[376]

At UN Climate COP30 in November 2026, the Sharm Joint Work on the Implementation of Climate Action on Agriculture and Food Security did not find consensus on a substantive outcome. While some parties recognized the value of systemic and holistic approaches, others rejected the content outright, leading to the postponement of substantive decisions to 2026.[377]

10. FINANCE

Industrial food actors receive the lion's share of international climate and other funding, while remaining largely shielded from responsibility.[378] Governments pay more than $670 billion annually in direct agriculture and fishery subsidies that support fossil fuel use and harmful practices.[379] The additional downstream costs from pollution, GHG emissions, and biodiversity loss as a result of these direct subsidies bring the total, direct plus indirect, subsidies of harmful food system practices to several trillion US dollars per year.[380]

Agriculture as a sector receives among the highest subsidies in comparison to the fossil fuel, forestry, infrastructure, mineral mining, fisheries and aquaculture sectors. The current system channels nearly a trillion dollars annually into supporting industrial agriculture practices. However, current subsidies disproportionately benefit large-scale agribusinesses, allowing them to externalize environmental and social costs of production and distort the market with artificially cheap products –particularly meat and dairy– that harm public health, the

[374] https://doi.org/10.1080/14693062.2018.1559793.
[375] Zurek et al (2022). 'Climate change and the urgency to transform food systems' 376 Science 1416, https://doi.org/10.1126/science.abo2364.
[376] FAO (2025), NDC3 Rapid Analysis for COP30: From Farms to COP30: Can the World's Climate Plans Deliver on Food? https://www.fao.org/climate-change/what-we-do/policy-support/nationally-determined-contributions-and-long-term-strategies/ndc3-rapid-analysis-for-cop30/en.
[377] https://enb.iisd.org/sites/default/files/2025-11/enb12888e.pdf.
[378] Submission by FIAN Belgium. https://viacampesina.org/en/2024/01/peasants-at-the-frontline-of-the-climate-struggle-share-testimonies/.
[379] https://www.worldbank.org/en/news/press-release/2023/06/15/trillions-wasted-on-subsidies-could-helpaddress-climate-change.
[380] Submission by GCHA.

environment, and small- and mid-size producers (see sections 1-2 above). They widen income disparities between industrial and smallholder, or traditional farmers.[381] Opportunities for marginalised rural populations are limited by the present subsidy system. People's access to resources is restricted while more inclusive and locally appropriate food systems are undermined.[382]

Many states continue to provide fuel subsidies and other forms of financial support to large-scale industrial fishing fleets, despite clear evidence that these fleets are disproportionately responsible for GHG emissions, overfishing and habitat destruction (see section 4 above). Such subsidies incentivize longer fishing trips, distant water operations and fuel-intensive gear such as bottom trawling, directly undermining climate mitigation goals as well as labour rights abuses. On the contrary small-scale fisheries receive minimal support, exacerbating inequalities within the marine food systems. [383]

In terms of climate finance, agrifood systems require 54% of adaptation finance overall, they receive only 20% of adaptation funds. Of the $540 billion that are currently given as agricultural subsidies, 87 per cent is either distorting prices or harmful for biodiversity, climate and human health.[384] The majority of global agricultural subsidies has been given to commodities such as beef, milk and rice, which are responsible for high GHG emissions.[385]

On the whole, agrifood systems remain severely underfunded, with livestock, fisheries, forestry, and crop production receiving only 4% of total climate-related development finance in 2023. 45 percent of agrifood-related climate finance supports adaptation, compared with 34 percent for mitigation and 21 percent for cross-cutting objectives. According to FAO's analysis, the costs of adaptation for fisheries and aquaculture for all developing countries are estimated to be USD 4.8 billion per year by 2030. Least Developed Countries received only USD 7.7 billion, or five percent, of agrifood-related climate finance in 2023.[386] The public international adaptation finance flows to the aquatic food sector have averaged only USD 0.22 billion per year (2017–2021), underscoring a significant adaptation finance gap.[387] Meanwhile, smallholder farmers, who produce one-third of the world's food and face the harshest climate impacts, are often unable to access climate finance due to systems that are overly complex, fragmented, and disconnected from their needs.[388]

[381] Moreddu (2011), Distribution of Support and Income in Agriculture 46, https://doi.org/10.1787/5KGCH21WKMBX-EN.
[382] Submission by Just Food Transition Network. Damania et al (2023), 'Detox Development: Repurposing Environmentally Harmful Subsidies': https://doi.org/10.1596/978-1-4648-1916-2.
[383] https://oneoceanhub.org/wp-content/uploads/2023/10/Policy-Brief-WTO-Fisheries-Subsidies_26.10.23.pdf and Danish Institute for Human Rights. The human rights impacts of fisheries subsidies: https://www.humanrights.dk/files/media/document/The%20Human%20Rights%20Impacts%20Of%20Fisheries%20Subsidies%20%28Working%20Draft%29.pdf.
[384] FAO, United Nations Development Programme and UNEP, *A Multi-Billion-Dollar Opportunity: Repurposing Agricultural Support to Transform Food Systems* (Rome, 2021).
[385] Ibid.
[386] FAO (2024), The fisheries and aquaculture adaptation finance gap: https://openknowledge.fao.org/handle/20.500.14283/cd1588en.
[387] Submission by FAO.
[388] Submission by PROFOREST.

Attention should also be turned to economic lock-in: subsidy regimes and trade rules channel funds into maintaining high-output systems. These supports create structural advantages for industrial-scale producers, reinforcing their market power and lobbying capacity (see section 9 above). Smaller, diversified producers rarely access equivalent resources, deepening asymmetries.[389] High debt forces governments to favour rapid extractive agribusiness models rather than sustainable transformation.[390] In addition, financial institutions frequently rely on corporate assurances or limited environmental and social management plans, rather than requiring comprehensive assessments of climate alignment, biodiversity impacts, and community-level harms. As a result, agri-business practices that are incompatible with climate stability and human rights protection continue to be normalized and financed.[391] For instance, between 2010-2020, the International Finance Corporation provided more than USD 1.8 billion to industrial livestock and factory farming companies worldwide through loans, equity stakes, and other financial instruments. According to NGO reports, of 38 loans made between 2020-2025 to meat, dairy and feed corporations, none met the climate requirements set out by the Corporation.[392]

Academic research underscored that the dominant narrative of financial scarcity obscures the reality that substantial public and private resources already exist but are systematically allocated toward industrial, carbon-intensive food systems. The challenge is therefore not the absence of capital, but its political economy: who controls financial flows, for what purposes, and under which accountability mechanisms.[393] Redirecting subsidies, restructuring taxation, and prioritizing participatory financing models are essential steps to shift investment toward agroecological, territorially embedded, and socially inclusive food systems. Within this financial landscape, unequal access to credit and investment emerges as a central justice issue. Women and smallholder farmers remain structurally disadvantaged in financial markets, limiting their capacity to adopt sustainable practices and to benefit from transition policies. Addressing these disparities requires targeted financial instruments, public guarantees, and regulatory frameworks that explicitly link climate finance to social equity objectives.[394]

Other suggestions made in submissions were the following:

- Conditioning international cooperation on debt relief on the implementation of eco-centric food system policies;[395]
- Scaling up concessional finance and grants specifically for sustainable food systems;
- Reforming global financial institutions to unlock long-term investment that supports smallholder and inclusive rights-based climate solutions;
- Closing the climate finance gap by aligning NDCs with clear investment plans in transforming food systems, ensuring transparency and equitable participation of civil society and vulnerable communities in decision-making.[396]

[389] Submission by Rebecca Williams.
[390] Submission by Rural Women's Assembly.
[391] Submission by Stop Financing factory Farming.
[392] https://stopfinancingfactoryfarming.com/news/ifc-fails-to-address-ghg-emissions-in-agricultural-loans/ ; https://www.farmlandgrab.org/post/29736.
[393] https://doi.org/10.1525/elementa.2025.00026.
[394] https://doi.org/10.59117/20.500.11822/42230.
[395] Submission by Ritu Dhingra.
[396] Submission by Just Food Transition Network; https://futureoffood.org/wp-content/uploads/2025/05/ga_climatefinancereport_2024.pdf.