Briefing II:

Health, Environmental, Economic and Social-Justice Outcomes of Animal-Sourced Foods

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KEY INSIGHTS

- The strongest evidence of a negative health impact of high meat consumption is the link between red and processed meat and an increased risk of colorectal cancer. Average red meat intake in Europe is 300-600 per cent higher than the EAT-Lancet recommended levels.

- The meat consumption of the average European is four times as high as the amount outlined by various reference diets. For dairy products, consumption is twice as much as is recommended to be healthy and sustainable. Research shows that without a significant reduction in the number of farm animals, European countries will not be able to implement the reductions in greenhouse gases specified in the Paris Agreement on climate change.

- The production of animal-sourced foods (ASFs) is linked to far higher environmental impacts than plant-based alternatives. The average food footprint for European Union citizens is estimated to be 1,070kg of CO2 equivalents annually (roughly the same as driving a petrol car 3,000km). Across Europe, meat and dairy account for more than 75 per cent of the overall food impact.

- Agriculture is the primary driver of global biodiversity loss. Industrial animal agriculture in Europe is linked to a range of damaging environmental impacts, from overgrazing to ecosystem depletion.

- The operations of extractive ASF actors in Europe have been linked to poor working conditions.

- Although animal welfare has been a topic of debate for decades, with some regulations introduced, there has not been a fundamental improvement in living conditions for animals in Europe.

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Health impacts of animal-sourced foods

Although ASFs are a good source of energy and essential nutrients, eating a wide range of other foods can lead to an equally balanced diet. However, in many lower-income countries in the Global South, access to a wider range of foods is limited, meaning that a diet without meat, dairy and other ASFs would be less nutrient dense.[1]

Studying the health outcomes associated with ASFs or any specific food is a complicated task, fraught with confounding factors, underreporting of consumption, and poor-quality study design. However, the strongest evidence to date of a negative impact on health of high meat consumption is the link between red and processed meat and an increased risk for some types of cancer.[2] In 2015, the World Health Organisation's International Agency for Research on Cancer (IARC) classified processed meat as carcinogenic to humans due to an association with colorectal cancer. It also classified red meat as probably carcinogenic, based mainly on evidence of links to the same disease.[3]

According to the IARC's analysis, the average consumption of processed meat in Western Europe is linked to a 9 per cent increase in the risk of colorectal cancer. High intakes of processed meat may also increase the risk of stomach cancer, but there is no strong evidence that it increases the risk of other types of cancer.[4] Papier et al. (2021) analysed data from nearly half a million middle-aged adults recruited into the UK Biobank study between 2006 and 2010, and followed up for an average of eight years. The results found that higher consumption of unprocessed red meat and processed meat combined was associated with higher risks of ischaemic heart disease and other common health conditions.[5] However, higher body mass index accounted for a substantial proportion of these increased risks, suggesting that many or all of the effects were due to, or mediated by, a person being overweight or obese. Higher unprocessed red meat and poultry consumption was associated with lower risk of iron-deficiency anaemia.[6,7] Evidence of a link between poultry consumption and increased risk of cardiovascular disease is very limited.[8] Overall, estimates suggest that high consumption of red and processed meat is linked with nearly 4% of all premature deaths in the European Union.[9]

The 2019 EAT-Lancet report, based on an assessment of healthy diets and sustainable food systems, proposed a reference diet, outlining a recommended intake of types of food per day.[10]

EAT-Lancet Planetary Health Plate

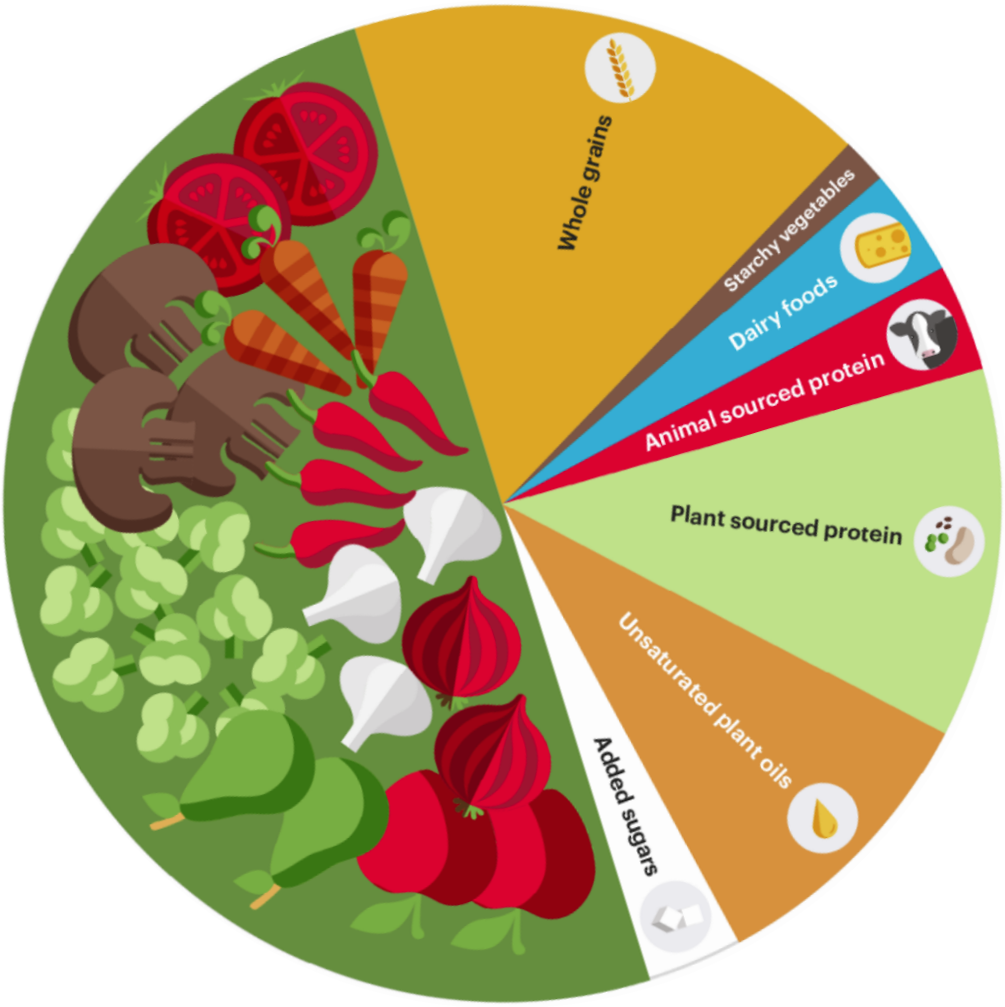


Figure 1. Source: EAT-Lancet Report

The report recommends that weekly consumption limits should be 98 grams (g) of red meat, 203g of poultry and 196g of fish. However, average red meat intake in Europe and North America is 300-600 per cent higher than the EAT-Lancet recommended levels. Poultry and egg consumption also exceeds the recommendations, whereas intake of fruits, vegetables and plant proteins is only half the recommended levels.[11] Figure 2 compares current European Union (EU) consumption of meat, dairy and seafood with the EAT-Lancet recommendations. To align with these, the "average European" would need to reduce beef consumption by 68 per cent, pork by 91 per cent and poultry by 43 per cent. The consumption of dairy and fish would need to decrease by 53 and 43 per cent respectively. This is particularly important, as animal protein sources are interchangeable, and reduction of meat consumption should not be replaced with dairy or fish, which also have problematic consequences for human health and the environment.[12]

Comparison EU consumption and EAT-Lancet reference diet (kg/year)

Figure 2. Data sources: FAOStat and EAT-Lancet reference diet: Willet et al, 2019[13]

Note: These consumption levels reflect an EU average. FAOstat data is in kg carcass weight and the EAT-Lancet reference diet is in grams per day. To enable a comparison, the FAO data has been calculated to consumable meat and the reference diet to kilograms per year. For calculating carcass weight to consumable weight, different "dressing percentages" of different types of meat apply: pork (pig meat): 65-80 per cent, beef (cattle meat): 50-60 per cent, chicken (fowl meat): 80-82 per cent, chevon (goat meat): 48-50 per cent, mutton (sheep meat): 45-55 per cent. (Source: Veterinary science hub). EAT and Eurostat have a slightly different classification of types of meat and fish. The "food supply quantity" is a calculation of the available food for consumption (production + import - export - waste - other uses, divided by the number of inhabitants of a country). The supply refers to the parts of the animals after slaughter that are technically edible, also known as "dressed carcass weight" or just "carcass weight". The supply figures include waste (such as bones) before reaching retail, as well as food that goes unsold or uneaten.

Beyond consumption, animal agriculture has been found to have negative human health impacts through emissions and pollution. Ammonia emissions, approximately three-quarters of which are attributable to animal farming, may contribute to up to 40 per cent of the disease burden from air pollution in Europe. Animal farming plays a major role in the emergence and spread of infectious diseases, with up to 75 per cent of new infectious diseases being of zoonotic origin. Many diseases have emerged only in recent decades with the advent of intensive livestock production, such as the avian influenza H1N1, SARS, West Nile virus and bovine spongiform encephalopathy (BSE).

Agriculture-related drivers, such as biodiversity loss, have been associated with over 50 per cent of zoonotic infectious diseases in humans since the middle of the 20th century.[14] Overuse of antibiotics in animal farming also contributes to antimicrobial resistance. An increasing number of infections in Europe are becoming harder to treat because of such resistance, with at least 33,000 deaths recorded per year.[15]

The environment

Europe's livestock production and the Paris climate agreement

The Paris Agreement, adopted in 2015, legally commits countries to reduce climate change to two degrees Celsius, and preferably 1.5. This means effectively that emissions of greenhouse gases should be reduced to net zero by 2050.[16] The EU agreed to a reduction target of 40 per cent by 2030 compared to 1990 levels and is currently discussing proposals to increase this target to 55 per cent, as part of the European Green Deal. Reduction targets for 2040 and 2050 are 60 per cent and 80 per cent, respectively.[17]

The total contribution to greenhouse gas emissions by the European agricultural sector is estimated to be 10 per cent. However, this figure excludes some important emissions, such as those linked to fertiliser production (attributed to industrial emissions) and the production of feed in countries outside the EU. Research that includes the emissions which agriculture generates in other sectors, such as energy or industry, estimates that the sector's emissions could be twice as high.[18] Eighty-one per cent of the EU's agricultural emissions are from livestock, mostly comprising methane and nitrous oxide.[19]

Since 1990, there has been only a slight decrease in the livestock sector's emissions, mostly explained by a reduction in the number of cattle in Eastern European countries. **To reach an 80 per cent reduction in emissions by 2050, emissions from the livestock sector would need to shrink by 3.5 per cent each year.**[20] Multiple analyses are clear: international climate goals will not be achieved by more efficient production alone or by technological measures to reduce emissions in parts of the supply chain, such as feed, enteric fermentation

(the ruminant digestive process) or manure management. The research concludes that meeting international climate targets will require a combination of efficiency gains and reduction in livestock numbers – meaning less livestock consumption. As the RISE Foundation outlines, **"[t]he alternative is that agricultural emissions will occupy a steadily larger share of remaining emissions". Coinciding research indicates that the size of the livestock herd in Europe should shrink significantly, although the desired size is hard to pinpoint.**[21]

A scenario analysis outlining the consequences of meeting international climate targets in the Netherlands shows that even in a situation where the country's current livestock population is maintained and all known effective technological measures to reduce emissions across the sector are adopted, the livestock industry **"would be responsible for the full amount of the Netherlands' permitted annual greenhouse gas emissions".** To tackle the climate crisis, a decrease in the size of livestock numbers is therefore inevitable.[22] Given the EU's outsized historical and current contribution to the climate emergency, the continent's responsibility to reduce emissions and transform its food system needs to be even more ambitious.

Global ecological impacts of the food system

The global food system is a significant driver of climate change, biodiversity loss, depletion of freshwater resources, and pollution of aquatic ecosystems through nitrogen and phosphorus run-off.[23] The food system produces greenhouse gas emissions through deforestation, production and use of fertilisers, enteric fermentation and the use of fossil fuels throughout the production cycle.[24] Global food production is responsible for around a third of planet-heating gases emitted through human activity. Around three-fifths of these come from animal production.[25]

The contribution of the global food system to climate change is so significant that research suggests that even **if all non-food system greenhouse gas emissions immediately stopped from 2020, emissions from the food system alone would likely cause global warming that exceeds the 1.5°C climate change goal.**[26]

There are stark differences in the environmental impacts of different foods, but several themes can be drawn from the data (Figure 3). **The production of meat is linked to more emissions per unit of energy compared with plant-based foods. Meat from ruminants (cattle, sheep and goats) requires over 20 times more land and generates 20 times more greenhouse gas emissions than pulses, per gram of protein. Globally, three-quarters of all agricultural land is dedicated to raising animals or growing animal feed.**

Poultry requires more land and is linked to higher greenhouse gas emissions per calorie than pork, but when measured per gram of protein consumed, their impacts are roughly equal. Dairy has a slightly higher impact on the environment than poultry. Pulses, fruits, vegetables and vegetable oils have a much lower impact than ASFs, but are higher-impact than sugar and staple crops on a per-calorie basis.[27] With appropriate and equitable food systems and land use, agriculture could help positively address the climate and nature emergency.

Figure 3: Differences in land use and Greenhouse gas emissions of foods (per calorie)[28]

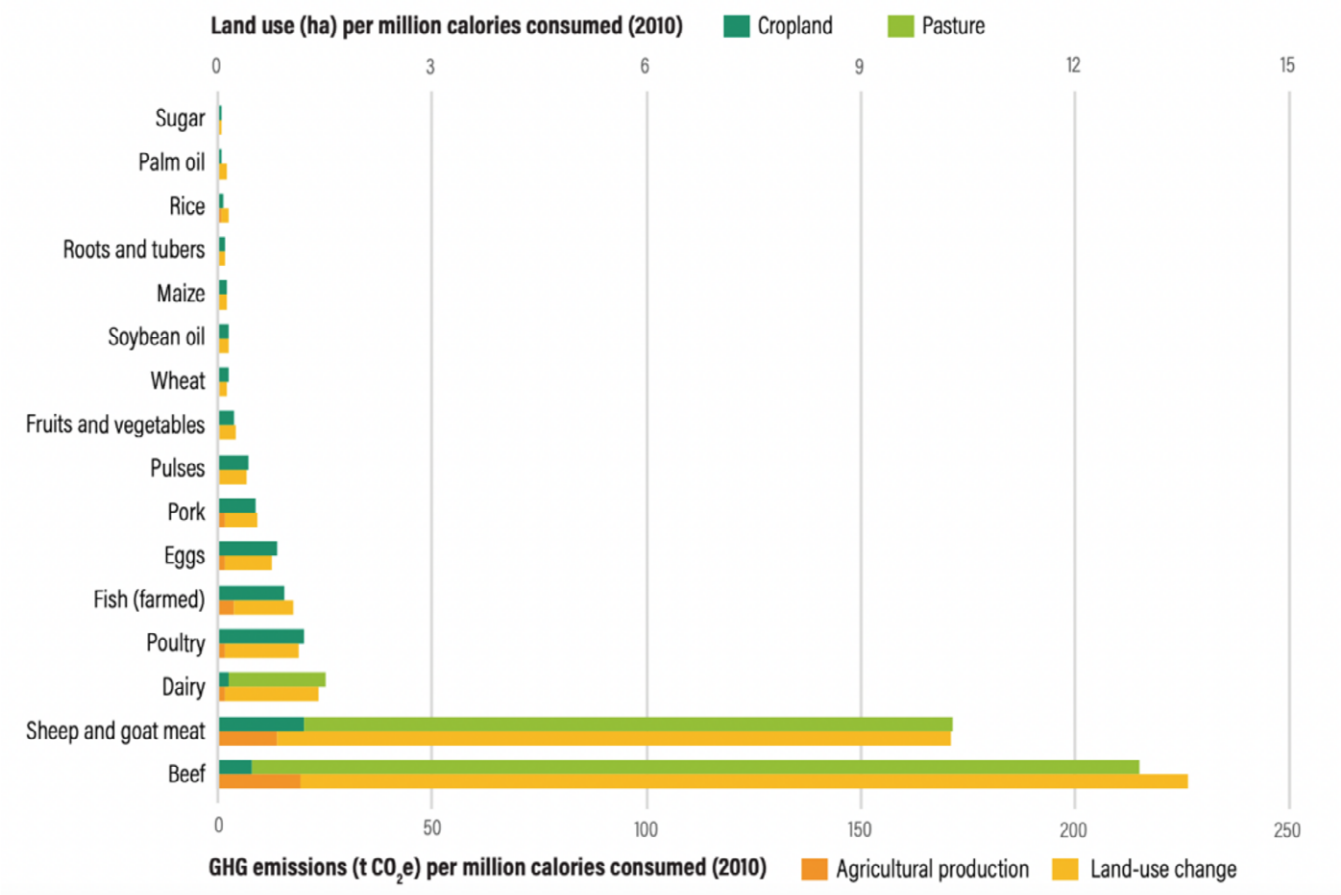


Figure 4: Greenhouse gas emissions across the food supply chain

Land Use Change	Farm	Animal Feed	Processing	Transport	Retail	Packaging
Above ground changes in biomass from deforestation. and belowground changes in soil carbon	Methane emissionsfrom cows. methane from rice, emissions from fertilizers, manure, and farm machinery	On-farm emissions from crop production and its processing into feed for livestock	Emissions from energy use in the process of converting raw agricultural products into final food items	Emissions from energy use in the transport of food items in-country and internationally	Emissions from energy use in refrigeration and other retail processes	Emissions from the production of packaging materials, material transport and end-of-life disposal

BEEF (beef herd) 60

LAMB & MUTTON 24

CHEESE 21

BEEF (dairy herd) 21

Dairy co-products means beef from dairy herds has a lower carbon footprint than dedicated beef herds.

Methane production from cows, and land conversion for grazing and animal feed means beef from dedicated beef herds has a very high carbon footprint.

Transport emissions are very small for most food products

CHOCOLATE 19

PRAWNS (farmed) 12

PALM OIL 8

PIG MEAT (dairy herd) 7

Pigs and poultry are non ruminant livestock so do not produce methane. They have significantly lower emissions than beef and lamb.

POULTRY MEAT 6

FISH (farmed) 5

EGGS 4.5

RICE 4

Pigs and poultry are non ruminant livestock so do not produce methane. They have significantly lower emissions than beef and lamb.

Flooded rice produces methane. which dominates on-farm emissions.

FISH (wild catch) 3

'Farm' emissions for wild fish refers to fuel used by fishing vessels.

MILK 3

Methane production from cows means dairy milk has significantly higher emissions than plant-based milks.

GROUNDNUTS 2.5

WHEAT & RYE 1.4

TOMATOES 1.4

MAIZE (corn) 1

CASSAVA 1

SOY MILK 0.9

PEAS 0.9

BANANAS 0.7

ROOT VEGETABLES 0.4

CITRUS FRUIT 0.3

NUTS 0.3

Nuts have a negative land use change figure because nut trees are currently replacing croplands; carbon is stored in the trees.

CO_2 emissions from most plant-based products are as much as 10-50 times lower than most animal-based products. Factors such as transport distance, retail, packaging, or specific farm methods are often small compared to importance of food type.

Greenhouse gas emissions per kilogram of food product *(kg CO2-equivalents per kg product)*

Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries. Data sot It-re. Poore and Nemecek (7018). Reducing food's environmental impacts through producers and consumers. Science. Images sourced from the Noun Project. OurWorldinData.org Research and data to make progress against the world's largest problems.

Animal Sourced Foods (ASF) environmental impacts in Europe

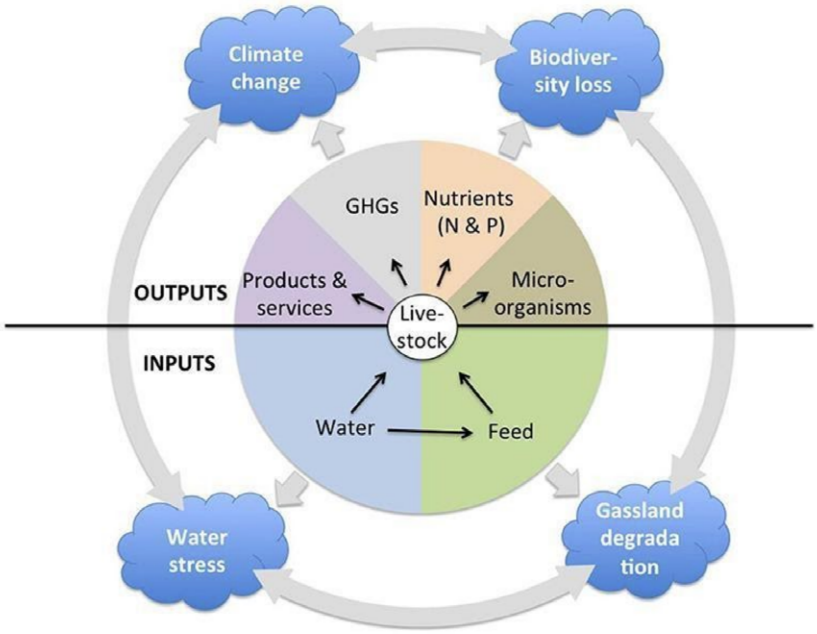
Greenhouse gas emissions

In relation to food, the key greenhouse gases on which researchers have focused are carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Livestock production is responsible for approximately 15 per cent of all anthropogenic emissions.[29] The average EU citizen's food footprint is estimated to be 1,070kg of CO2 equivalents annually (roughly the same as driving a petrol car 3,000km). Portugal scores the highest, at 1,460kg CO2-equivalent, and Bulgaria the lowest, at 610kg CO2-equivalent. **Across all regions, meat and dairy account for more than 75 per cent of the overall food impact.** Within the emissions footprint of animal agriculture in the EU, enteric fermentation and manure management are the largest contributors, each accounting for 22 per cent of total emissions, on average. This is followed by fertiliser use, at 17 per cent. **While many consumers still view "food miles" as an important environmental concern, international food transportation emissions only account for 6 per cent of the total environmental impact.**[30] In recent years, there have been claims that livestock production has the potential to address climate change through a transition to carbon-sequestering pastures. However, research suggests the benefits at a global level would be minimal and likely outweighed by the lifecycle emissions of grazing animals.[31],[32]

Generally, emissions are reported as CO2 equivalents, as a way of expressing the impact of gases on a common scale. However, greenhouse gases differ in the amount of time they persist in the atmosphere. Carbon dioxide can persist in the atmosphere for hundreds of years, whereas methane remains for less than a decade. This means that the key factor for CO2 is cumulative emissions, whereas for methane, it is the rate of emissions that matters.

Meat production is an important factor in calculations of future global warming, but distinguishing the effects of the different types of greenhouse gasses is critical. The traditional Global Warming Potential 100 (GWP 100) method of reporting emissions views gases as more or less equivalent. This underestimates the warming impact of new methane sources during the first 20 years after the increase and overstates the warming impact of constant methane, because it cycles out of the atmosphere relatively quickly. **Reducing livestock methane emissions could therefore have a greater impact on global warming in the short term than previously believed.**

Figure 5. Pathways for livestock production to impact the environment[33]



Animal-sourced foods and water use

Nearly one third of the fresh water used by agriculture globally is directed to livestock production.[34] The majority of water resources used for livestock come from "green water" – rainfall and other precipitation (87.2 per cent). Growing animal feed accounts for 98 per cent of the total water footprint of livestock production globally.[35] The water footprint associated with ASFs varies widely across types of meat and production systems. Beef production is estimated to be more than three times as water intensive as that of chicken, per kilogram of meat.[36]

Biodiversity and ecosystem loss

The food system also affects ecosystems and their biodiversity through the conversion of nature to agricultural lands. In relation to ASFs, natural habitats are deforested and converted to grassland and pasture, or to arable land in order to produce grain and soy for livestock consumption.[37] A third of the world's arable land is dedicated to feed production.[38]

Livestock production can also cause biodiversity loss through overgrazing[39] and intensive management of meadows[40]. However, in some cases where native herbivores are no longer present, livestock can also help to maintain natural ecosystems.[41]

Several supply-chain analyses have linked ASFs produced and consumed in Europe to widespread ecological destruction outside Europe's borders. One detailed study found that around 20 per cent of soy imports and 17 per cent of beef imports to the European Union from the Amazon and Cerrado in Brazil were linked to illegal deforestation.[42]

Nitrogen pollution

Industrial animal agriculture is linked to widespread nitrogen pollution through excessive animal manure. Animals produce manure, which releases the nitrogen compound ammonia when in contact with urine. Around 94 per cent of ammonia pollution in the EU comes from agriculture, the majority of which stems from animal production.

Due to dense economic activity and the largest concentration of livestock in Europe, the Netherlands is a hotspot of nitrogen emissions and deposition.[43] In a litigation case brought forward by environmental protection groups (see Briefing IV), the court ruled that the country is falling short in conserving Natura2000 protected areas, due to the damaging deposition of nitrogen. This caused a standstill in new agricultural and economic activities.[44] The proposed government action plan intended to solve this has met great criticism from conservationists and environmental groups, since the proposed measures do not sufficiently reduce nitrogen emissions and are therefore legally untenable[45]. It seems inevitable that the only way to solve the "nitrogen crisis" is a significant reduction in the size of the livestock industry. This is clear from many sources, including a recently published set of policy options by the Dutch Environment Agency.[46]

Manure and other waste products from livestock farms – such as slurry, fertiliser runoff or digestate – can spread to water sources and end up damaging water bodies and natural habitats. From intensive pig and poultry farms in Wales causing algal blooms, to "dead zones" in the Baltic Sea generated by run-off from pig farms, the devastating ecological impacts of such eutrophication are felt across Europe.[47] Nitrogen deposition is one of the leading drivers of biodiversity loss in Europe.[48] In Germany, around half the natural and semi-natural terrestrial ecosystems exceed critical loads for eutrophication in place to protect ecosystems.[49]

Environmental impacts of a shift to "less and better" consumption

Several analyses have looked at the potential benefits of transitioning to some form of "less and better" ASF consumption. Tilman and Clark (2014) found that a shift to a plant-based diet could reduce greenhouse gas emissions from food production by 55 per cent by 2050.[50] The adoption of various climate stabilisation strategies could reduce the number of climate-related deaths by 29-71 per cent, depending on how strict the plans were.[51] Reducing consumption of all ASFs would have large benefits, especially within higher-income countries, but switching populations toward vegetarian diets has often meant an increase in dairy and eggs. Ruminants have the greatest impact, so focusing on reducing consumption worldwide by people with the highest intakes would be a promising goal.

Economy, labour and working conditions

In 2017, livestock production accounted for 40 per cent of all EU-28 agricultural activity, totalling €170 billion. Livestock dominates agricultural activity to a greater extent in some European economies, such as Ireland (74.2 per cent), Denmark (66.4 per cent) and the UK (60.2 per cent). The milk sector plays the largest role across the EU (13.9 per cent of total farming activity), followed by pork (8.9 per cent), beef, sheep and goat (8.2 per cent), poultry (5 per cent), and eggs (2.4 per cent).[52] The EU livestock sector employs almost 30 million people,[53] with mixed crop-and-livestock farms accounting for the largest share of jobs (37 per cent). This is followed by dairy farms (25 per cent), while pig and poultry farms are responsible for only 8 per cent.[54]

EU farming employment has been declining for decades. Total employment fell by 30 per cent, from 13.1 million Annual Work Units in 2003 to 9.1 million in 2018. At the same time, the number of small and medium-sized farms has diminished, while the number of large farms (over 100 hectares) has risen as a result of consolidation in the sector. Technological innovation has improved productivity, but also led to lower demands for labour – although a few EU member states, such as Greece, Slovenia and Malta, have seen a recent increase in employment.

Socioeconomic status of the workforce

There is an age and education bias in agricultural employment, as younger people and those with higher education are more likely to be employed in other sectors. Women are also far less likely to work in EU farming operations.[55] The impact of the Common Agricultural Policy (CAP) on agricultural jobs is mixed. The CAP's direct payments and rural development measures have produced differing outcomes for the farming labour force, depending on the type and size of the investments, farm managers' use of the payments, and the farming systems in place locally.

Subcontracting, and workers 'and migrants' rights

The use of temporary agricultural workers obtained through recruitment agencies is becoming much more widespread, which can undermine workers' protection.[56] The subcontracting system originated in Germany and is blamed for the loss of thousands of jobs in other EU countries, with Denmark, France, the Netherlands and Belgium particularly affected. In Germany, the meat sector employs approximately 110,000 people, of whom about 30,000 are employed through subcontractors. These workers are generally migrants from Central and Eastern European countries. In some of the largest EU meat companies, as many as 80-90 per cent of workers are subcontracted.[57] These arrangements facilitate exploitative and precarious working conditions, and have met significant criticism from human rights organisations. Subcontracted workers across Europe's meat sector earn on average between 40 and 50 per cent less than contracted workers.[58]

Subcontracting workers in the meat industry is now widespread across Europe. Given Poland's central geographic position and relatively low labour costs, the country has quickly become a significant importer of live pigs and fresh or frozen meat. It is a leading player in the EU's pig slaughtering and processing sector. However, Poland's growth in this area has diminished in recent years due partly to slow technological progress and strong competition, including from imports.[59] Following Brexit, the UK meat industry is dealing with a shortage of traditional EU workers. The Department of Education did not include any food-related training in its skills support initiative, which industry has claimed is making it harder to recruit UK workers.

Working and living conditions

As in other regions, meat processing jobs in Europe require physically hard and repetitive work in a fast-paced environment, often with a high risk of injury. Some plants are starting to adopt automation technology which can eliminate some of the repetitive physical work, but this process is slow – probably in part due to the availability of cheap labour. Meat processing jobs now no longer go to skilled butchers, but have been deskilled and adapted to production lines, making employment accessible to a broad range of workers.

Industrial factory farms and meat processing facilities across Europe have been linked to horrific working and living conditions, particularly in key countries such as Germany.[60]

Around the world, there were numerous Covid-19 outbreaks in slaughterhouses and meat processing facilities, including many in Europe. Poor working and housing conditions are blamed as key reasons why the virus took hold in the meat sector. The industrialised model of animal production has focused on production and cost efficiency, but critics claim that this has been at the expense of worker safety and biosecurity, making the sector vulnerable to shocks such as Covid-19.[61]

Overall, working conditions for agricultural workers in the EU, from organic farms in France to strawberry fields in eastern Spain, remain precarious, underregulated and, in many cases, deplorable.[62] Labour exploitation and recurrent violations of workers' rights are not just restricted to industries producing ASFs, but occur across the agricultural sector. Building a better food system means ensuring that dignified agrarian jobs and livelihoods are core priorities.

Animal welfare

In the EU, discussions around animal welfare began in the 1980s and led to member states adopting several directives to protect farm animals. These address matters such as space, balanced diets, the environment and limiting harmful procedures. **Animals are now recognised as sentient beings at member-state and EU levels.** After Brexit, this law was not retained in the UK and in 2021 a House of Commons Committee discussed a bill to reinstate it. European animal welfare standards are now among the best in the world. However, regulations are different across member states, with northern countries being generally stricter. The rules have also been criticised for being too vague. The transport of livestock is subject to regulation, but live animals are still moved over long distances, which activists believe causes them needless and excessive stress. In 2019, over 1.6 billion live farm animals were transported across the EU and to non-EU countries.[63]

Major gaps exist in the regulations. For example, no legislation currently covers housing or transportation conditions for fish, despite significant growth in aquaculture across Europe. Similarly, many campaigners have criticised current animal welfare legislation for being outdated and not reflective of contemporary scientific research.[64]

There is strong public support across the EU for stronger regulations to protect animal welfare, with 82 per cent of EU citizens indicating more should be done.[65]

Endnotes

1 Jackson, J., Williams, R., McEvoy, M., MacDonald-Wicks, L., & Patterson, A. (2016). Is higher consumption of animal flesh foods associated with better iron status among adults in developed countries? A systematic review. Nutrients, 8(2), 89.

2 Ekmekcioglu, C., Wallner, P., Kundi, M., Weisz, U., Haas, W., & Hutter, H. P. (2018). Red meat, diseases, and healthy alternatives: A critical review. Critical reviews in food science and nutrition, 58(2), 247-261.

3 Bouvard, V., Loomis, D., Guyton, K. Z., Grosse, Y., El Ghissassi, F., Benbrahim-Tallaa, L., ... & Corpet, D. (2015). Carcinogenicity of consumption of red and processed meat. The Lancet Oncology, 16(16), 1599-1600.

4 World Cancer Research Fund/American Institute for Cancer Research (2018). Continuous UPdate Project Expert Report 2018. Meat, fish and dairy products and the risk of cancer. Available at dietandcancerreport.org

5 Hazard ratio per 70 g/day higher intake 1.15, 95 per cent confidence intervals (CIs), 1.07–1.23

6 Hazard ration per 50 g/day higher intake 0.80, 95 per cent CIs 0.72–0.90

7 Papier K., Fensom G. K., Knuppel A., Appleby P. N., Tong T. Y., Schmidt J. A., ... and Perez-Cornago A. (2021). "Meat consumption and risk of 25 common conditions: outcome-wide analyses in 475,000 men and women in the UK Biobank study". BMC Medicine, 19(1), 1-14.

8 Mohammadi, H., Jayedi, A., Ghaedi, E., Golbidi, D., & Shab-Bidar, S. (2018). Dietary poultry intake and the risk of stroke: A dose–response meta-analysis of prospective cohort studies. Clinical nutrition ESPEN, 23, 25-33.

9 Pushkarev, N (2021). 'Meat Production & Consumption (in Europe) and Public Health: An exploration'..

10 Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Murray, C. J. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet, 393(10170), 447-492.

11 Burlea-Schiopoiu, A., Ogarca, R. F., Barbu, C. M., Craciun, L., Baloi, I. C., & Mihai, L. S. (2021). The impact of COVID-19 pandemic on food waste behaviour of young people. Journal of Cleaner Production, 294, 126333.

12 Westhoek, H., Rood, T., van den Berg, M., Janse, J., Nijdam, D., Reudink, M., ... & Woltjer, G. B. (2011). The protein puzzle: the consumption and production of meat, dairy and fish in the European Union (No. 500166001). Netherlands Environmental Assessment Agency.

13 Food and Agriculture Organisation of the United Nations (FAO). FAOstat Food Balance Sheets. Available at: http://www.fao.org/faostat/en/#data/FBS; Willett W., Rockström J., Loken B., Springmann M., Lang T., Vermeulen S., ... and Murray C. J. (2019). "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems". The Lancet, 393(10170), 447-492.

14 Espinosa, R., Tago, D., & Treich, N. (2020). Infectious diseases and meat production. Environmental and Resource Economics, 76(4), 1019-1044.

15 Kakoullis L., Papachristodoulou E., Chra P. and Panos G. (2021). "Mechanisms of antibiotic resistance in important gram-positive and gram-negative pathogens and novel antibiotic solutions". Antibiotics, 10(4), 415.

16 See: UNFCCC (2015). Adoption of the Paris Agreement. Report No. FCCC/CP/2015/L.9/Rev.1, http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

17 See: European Comission (2020). 2030 climate & energy framework. Available at: https://cutt.ly/iTxgPxi

18 Leip, A., Billen, G., Garnier, J., Grizzetti, B., Lassaletta, L., Reis, S., ... & Westhoek, H. (2015). Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity. Environmental Research Letters, 10(11), 115004.

19 Ibid.

20 Dooley, E.; Frelih-Larsen, A. Agriculture and Climate Change in the EU: An Overview (2015). Climate Policy Info Hub. 2015.

21 Buckwell A. and Nadeu E., 2018. "What is the Safe Operating Space for EU Livestock?" RISE Foundation, Brussels. Available at: https://cutt.ly/zTxgKd9

22 Council for the Environment and Infrastructure (RLI), (2018). "Sustainable and healthy – Working together towards a sustainable food system". Available at: https://cutt.ly/0RFa2XO

23 Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., ... & Willett, W. (2018). Options for keeping the food system within environmental limits. Nature, 562(7728), 519-525.

24 Clark, M. A., Domingo, N. G., Colgan, K., Thakrar, S. K., Tilman, D., Lynch, J., ... & Hill, J. D. (2020). Global food system emissions could preclude achieving the 1.5 and 2 C climate change targets. Science, 370(6517), 705-708.

25 Xu X, Sharma P., Shu S., Lin T.S., Ciais P., Tubiello F.N., Smith P., Campbell N. and Jain A.K. "Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods". Nature Food. September 2021; 2(9): 724-32.

26 Ibid.

27 Searchinger T., Waite R., Hanson C., Ranganathan J., Dumas P., Matthews E. and Klirs C., 2019. Creating a sustainable food future: A menu of solutions to feed nearly 10 billion people by 2050". Final report. WRI.

28 Source: Searchinger T., Waite R., Hanson C., Ranganathan J., Dumas P., Matthews E., and Klirs C. 2019. "Creating a sustainable food future: A menu of solutions to feed nearly 10 billion people by 2050". Final report. WRI. Figure 6-6a.

29 Gerber P. J., Steinfeld H., Henderson B., Mottet A., Opio C., Dijkman J., Falcucci A. and Tempio G. 2013. "Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities". Food and Agriculture Organisation.

30 Sandström V., Valin H., Krisztin T., Havlík P., Herrero M., and Kastner T. 2018. The role of trade in the greenhouse gas footprints of EU diets". Global Food Security, 19, 48-55.

31 Henderson, B. B., Gerber, P. J., Hilinski, T. E., Falcucci, A., Ojima, D. S., Salvatore, M., & Conant, R. T. (2015). Greenhouse gas mitigation potential of the world's grazing lands: Modeling soil carbon and nitrogen fluxes of mitigation practices. Agriculture, Ecosystems & Environment, 207, 91-100.

32 Conant, R. T., Cerri, C. E., Osborne, B. B., & Paustian, K. (2017). Grassland management impacts on soil carbon stocks: a new synthesis. Ecological Applications, 27(2), 662-668.

33 Source: Otte J., Pica-Ciamarra U., and Morzaria S. 2019. "A comparative overview of the livestock-environment interactions in Asia and Sub-Saharan Africa". Frontiers in Veterinary Science, 6.

34 Hoekstra, A. Y., & Mekonnen, M. M. (2012). The water footprint of humanity. Proceedings of the national academy of sciences, 109(9), 3232-3237.

35 Mekonnen, M. M., & Hoekstra, A. Y. (2012). A global assessment of the water footprint of farm animal products. Ecosystems, 15(3), 401-415.

36 Eshel, G., Shepon, A., Makov, T., & Milo, R. (2014). Land, irrigation water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and dairy production in the United States. Proceedings of the National Academy of Sciences, 111(33), 11996-12001.

37 De Sy, V., Herold, M., Achard, F., Beuchle, R., Clevers, J. G. P. W., Lindquist, E., & Verchot, L. (2015). Land use patterns and related carbon losses following deforestation in South America. Environmental Research Letters, 10(12), 124004.

38 See: Heinrich-Böll-Stiftung, Friends of the Earth Europe & BUND (2021). Meat Atlas 2021.

39 Davies, J., Poulsen, L., Schulte-Herbrüggen, B., Mackinnon, K., Crawhall, N., Henwood, W. D., ... & Gudka, M. (2012). Conserving Dryland Biodiversity. IUCN (International Union for the Conservation of Nature).

40 Kok, A., Oostvogels, V. J., de Olde, E. M., & Ripoll-Bosch, R. (2020). Balancing biodiversity and agriculture: Conservation scenarios for the Dutch dairy sector. Agriculture, Ecosystems & Environment, 302, 107103.

41 Fuhlendorf, S. D., & Engle, D. M. (2001). Restoring heterogeneity on rangelands: ecosystem management based on evolutionary grazing patterns: we propose a paradigm that enhances heterogeneity instead of homogeneity to promote biological diversity and wildlife habitat on rangelands grazed by livestock. BioScience, 51(8), 625-632.

42 Rajão, R., Soares-Filho, B., Nunes, F., Börner, J., Machado, L., Assis, D., ... & Figueira, D. (2020). The rotten apples of Brazil's agribusiness. Science, 369(6501), 246-248.

43 European Environment Agency (2020). "The European environment – state and outlook 2020". 2020. Available at: https://cutt.ly/ATxnlOR

44 See: "The Netherlands struggles with nitrogen headache". (2 Oct 2019). Politico. Available at: https://cutt.ly/GTxncBQ

45 See: Greenpeace NL (2020). "Reactie op consultatie Wet stikstofreductie en natuurverbetering". Available at: https://cutt.ly/ZTxnYYH

46 See: "Netherlands proposes radical plans to cut livestock numbers by almost a third". (9 Sep 2021). The Guardian, https://cutt.ly/qTzV5MZ

47 See: "River pollution leads to Welsh demand for halt to intensive chicken farms". (5 Oct 2020). The Guardian, https://cutt.ly/PTzBikY; "Poland | Drowning in Algae: Dead Zones in the Baltic Sea". (18 Nov 2020). Arc 2020, https://cutt.ly/4TxnFif

48 WallisDeVries, M., & Bobbink, R. (2017). Nitrogen deposition impacts and biodiversity in terrestrial ecosystems: mechanisms and perspectives. Biological Conservation, 387-496.

49 SRU (2015). Nitrogen: Strategies for resolving an urgent environment problem. Available at: https://cutt.ly/aTzlXZ0

50 Tilman, D., and Clark, M. (2014). "Global diets link environmental sustainability and human health". Nature, 515(7528), 518-522.

51 Springmann M., Mason-D'Croz D., Robinson S., Garnett T., Godfray H.C.J., Gollin D., ... and Scarborough P. 2016. "Global and regional health effects of future food production under climate change: a modelling study". The Lancet, 387(10031), 1937-1946.

52 European Commission (2018). "Agricultural and farm income". European Commission, Brussels, DG Agriculture and Rural Development.

53 Animal Task Force (2013). Research & innovation for a sustainable livestock sector in Europe. An Animal Task Force white paper, April.

54 ESCO, INRA (2016). Role, impact and services provided by European Livestock Production. Short summary of the collective scientific assessment report at the request of the French ministries responsible for Agriculture and the Environment, in cooperation with the French Environment and Energy Management Agency (ADEME).

55 Maucorps, A., Münch, A., Brkanovic, S., Schuh, B., Dwyer, J. C., Vigani, M., ... and Keringer, F. (2019). "The EU farming employment: current challenges and future prospects".

56 Hansen, M.E. (2018). "Meat processing workers: Occupational report". European Foundation for the Improvement of Living and Working Conditions (Eurofound). Available at: https://cutt.ly/yTxnMbZ

57 EFFAT (2020). "Covid-19 outbreaks in slaughterhouses and meat processing plants: State of affairs and proposals for policy action at EU level". European Federation of Food, Agriculture and Tourism Trade Unions. Available at: https://cutt.ly/TRDKnkq

58 Ibid.

59 "Poland's pig sector: Once thriving, now fragmented". 6 February 2019. Pig Progress. Available from https://cutt.ly/LRDKYWM

60 "Warum die Arbeitsbedingungen in Schlachtbetrieben so prekär sind". 22 June 2020. Deutschlandfunk. Accessed 27 October 2021, https://cutt.ly/jRDKKMg

61 FAIRR Initiative (2020). "An industry infected: Animal agriculture in a post-COVID world". Available at: https://cutt.ly/ATzVZ0Y

62 "Invisible workers: Underpaid, exploited and put at risk on Europe's farms". 22 July 2020. Euronews. Accessed 27 October 2021, https://cutt.ly/1RDK9Gk; Reigada, A. (2016). Family farms, migrant labourers and regional imbalance in global agri-food systems: On the social (un) sustainability of intensive strawberry production in Huelva (Spain). In Migration and Agriculture (pp. 119-134). Routledge.

63 See: Euro Group for Animals (2021). "What We Do: Areas of Concern". Available at: https://cutt.ly/QRDZHhx

64 "EU's farmed animal welfare rules need 'serious and extensive review". Euronews. 28 April 2021. Accessed 27 October 2021, https://cutt.ly/HRDZXK6

65 Heinrich-Böll-Stiftung, Friends of the Earth Europe & BUND (2021). Meat Atlas 2021. pp.54.