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**Why ending factory farming  
must be at the heart of urgent  
climate action**

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# Why ending factory farming must be at the heart of urgent climate action

## Summary

The window to halt catastrophic climate change is rapidly closing: global greenhouse gas emissions should top in the coming three years and after that steadily decrease. Halting climate change, biodiversity loss, and nutrition insecurity to secure the future of people and the planet are some of the biggest challenges our generation faces. The overconsumption of animal products and factory farming are amongst the key drivers of these problems. While scientific and public awareness about the untenable situation grows, global political leaders fail to sufficiently and effectively address these. Political commitments on reduction of deforestation, cutting methane emissions, and improving global food systems fail to tackle the root causes of overconsumption of animal-based products and the industrialised food system, but rather continue on the dead-end street of intensification of production of farm animals. Eighty billion land animals lead a horrible life in factory farms<sup>a</sup> and are slaughtered on an annual basis, and this is set to increase.

The good news is that the solutions are available. Less and better animal-based products is key to keeping global heating within agreed safe boundaries. Drastically cutting the emissions of the harmful greenhouse gas methane – of which production of meat and dairy is one of the major sources – in the coming five years enables a swift reduction of greenhouse gas concentration in the atmosphere. Moving away from diets that are heavily based on animal-sourced products towards more plant-based diets in combination with a transition of food systems towards diverse, ecological farming comes with many benefits: thriving biodiversity, freeing land for nature to restore and sequester carbon, clean and healthy environments and healthy food. These food systems ensure high standards of animal welfare.

Governments should put food and farming at the heart of urgent climate mitigation action and implement policies to enable this transition to sustainable, healthy and diverse food systems in which animals thrive.

**FOUR PAWS urges governments to align their food and farming policies with their climate, development and other international commitments. Furthermore, governments should support the transition to more sustainable food systems and more plant-based diets in order to stay within 1.5 °C of warming. Governments, especially in the Global North, must bring livestock numbers down to within the planetary boundaries.**

<sup>a</sup> Factory farming is an industrial method of raising farm animals. On factory farms, animals are raised under conditions intended to maximize production at minimal cost. The animals in these systems regularly suffer from most cruel practices and their basic needs are not met. They are confined in small spaces and kept indoors and/or in cages for their entire life.



## Problem: How factory farming fuels the climate crisis

'The cumulative scientific evidence is unequivocal: Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all.' (IPCC, 2022)

### Human actions have led to the planet overheating and governments are not doing enough to prevent a climate disaster

The climate is changing, human activities are driving this change, and the impacts are more severe than previously assumed. The conclusions of climate scientists are shocking: while the effects of climate change are present all around us, political leaders and industries are not doing enough to halt global heating. Instead, the emissions of greenhouse gases (GHG) are rising. The Intergovernmental Panel on Climate Change (IPCC) – the world's leading climate scientists – concludes that to limit global warming to 1.5 °C, the emissions of GHG must peak between 2020 and 2025 and, after that, steadily decrease. This ambition has been agreed by the world's political leaders in the Paris climate agreement of 2015, but climate policies implemented by these governments by the end of 2020 will further increase emissions and cause global heating of up to 3.5 °C by 2100<sup>1</sup>.

Although these changes in the earth's temperature might seem small, they have a disastrous impact on ecosystems and human support systems. Since 1900, global temperatures have on average already risen by 1.1 °C, and this has resulted in the changes in climate that are currently observed. Weather extremes such as torrential rainfall, tornados, droughts, melting of icecaps and glaciers, a rise in sea levels, and crop failures that result in food insecurity are just some of the outcomes already witnessed<sup>2</sup>. Undermining and damaging life support systems makes climate change an existential threat.

The science is clear about what needs to happen to halt this unfolding disaster – major transitions in all economic sectors and consumption patterns need to happen to reduce emissions. The good news is that these solutions are available, affordable, and have many positive side effects<sup>3</sup>. Implementation, however, is dependent on political leadership.

### Factory farming of livestock and climate change

Land use, land use change and agriculture, specifically the intensive rearing of livestock, are major drivers of climate change. Globally, more than a third of all greenhouse gas emissions caused by human activity can be attributed to our food systems. According to the UN Food and Agriculture Organisation (FAO), livestock production is responsible for 14.5% of total GHG emissions. This figure is not recent and it is very likely that emissions from livestock have increased to at least 16.5%<sup>4</sup>. If policies concerning food and farming remain as they are, direct agricultural GHG emissions are projected to grow by 4% until 2030. Livestock will account for

more than 80% of this global increase. The main driver of these increased livestock emissions is the growing number of animals in more intensified industrial farming systems<sup>5</sup>.

The FAO estimates that almost half (45%) of livestock-related emissions are caused by the production and processing of animal feed such as grass and feed crops like soya and grains. These emissions are related to the use of synthetic fertilizers and manure and consist mostly of nitrous oxide (N<sub>2</sub>O), a highly potent greenhouse gas.

Deforestation and other land use change, caused by a growing demand for arable land to grow feed, creates emissions of carbon dioxide (CO<sub>2</sub>) and represents roughly a quarter of feed-related GHG emissions (10% of total livestock emissions). Enteric fermentation, a digestive process involving bacteria in the gut of cows and other ruminants that produces methane (CH<sub>4</sub>), accounts for the second largest source of livestock emissions (40%). Manure management causes 10% of emissions, mostly in the form of methane. The smallest share of emissions is represented by energy use<sup>6</sup>.

Factory farming increases the emissions of methane: slatted stable floors and collection of liquid slurry cause higher methane emissions than systems that use storage of dry manure and where farm animals are free to live outdoors. Indoor keeping of animals increases the use of energy due to heating, filter systems and other farm facilities.

The production of meat and dairy is responsible for 32% of emissions of the very potent but short-lived greenhouse gas methane, food systems as a whole are responsible for 40% of methane emissions<sup>7</sup>. Although the share of total emissions is relatively low, the IPCC estimates methane to account for almost a third of the warming observed to date<sup>8</sup>.

### Meat and dairy production are driving deforestation

Farm animals have been bred for high yield that, on the one hand, has led to severe animal welfare issues and, on the other hand, has dramatically increased the amount of protein feedstuff<sup>9</sup>, because high-performance animals have an extremely high demand for energy and protein<sup>9</sup>. This has resulted in an unsustainable food chain reliant on feed imports originating from deforested lands<sup>9</sup>.

The emissions that are indirectly caused by the enormous demand for land for meat and dairy production are often not part of the picture. 77% of global agricultural land is in use for grazing livestock or production of feed<sup>10</sup>. The use of agricultural land to feed livestock in Europe is similar: 72%<sup>11</sup>. An increase in demand for meat and dairy increases the demand for arable land or pasture, often (directly or indirectly) driving deforestation. Agriculture is responsible for 80% of deforestation, causing habitat loss and fragmentation, biodiversity loss at unprecedented rates and converting the earth's carbon sinks into carbon sources<sup>12</sup>.



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<sup>b</sup> See e.g. Profundo. Mapping the European soy supply chain. Profundo research report commissioned by WWF, 2022



WWF's recent Living Planet Report concludes that since 1970, 69% of wildlife populations declined because of human behavior, mainly due to land use change and climate change<sup>13</sup>. Estimating the exact GHG emissions caused by deforestation and land use change for farming is very complex: it causes emissions, releases carbon from carbon sinks, and harms soils' and ecosystems' capacities to store carbon. On top of that, there are major differences between time periods, soils types, and geographic regions.

## Unhealthy diets and public health

The recent Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) pandemics report highlighted that the rising demand for meat and the globalized food trade drive pandemic risk through land use change (deforestation) and climate change. The increasing expansion of livestock production as well as the increase in the size of farms and number of individual animals at a site have led to an increasing potential for transmission of pathogens to people and some strains of antimicrobial-resistant pathogens<sup>14</sup>. Not only is this a threat to planetary health, but a significant threat to public health. Implementing spillover prevention measures that reduce pandemic risk would bring ancillary climate benefits. Protecting rainforests alone would bring approximately USD 4.3 billion annually in social benefits from reduced greenhouse gas emissions<sup>15</sup>.

There is scientific consensus as to the negative impact of overconsumption of animal sourced products on individuals' health – and specifically red and processed meat. In 2015, the World Health Organisation categorised red meat as carcinogenic to humans. Major health benefits are associated with reducing meat and dairy consumption, including tackling diet-related diseases such as obesity, different types of cancer, risk of coronary heart disease, type 2 diabetes, and reducing mortality from diet-related non-communicable diseases<sup>16</sup>.

The inequalities in terms of food distribution are equally staggering: nearly one billion people experience hunger and one billion people lack important micronutrients in their diets. Overall, there are nearly three billion people with inadequate diets<sup>17</sup>. The shift towards plant-based diets can mitigate these threats as well as help to ensure more resilient food systems.

## Solutions: How diet change and better farming can halt the climate crisis and benefit farm animals and nature

'Where calories and ruminant animal-source food are consumed in excess of health guidelines, reduction of excess meat (and dairy) consumption is amongst the most effective measures to mitigate GHG emissions, with a high potential for environment, health, food security, biodiversity, and animal welfare co-benefits.' (IPCC, 2022)

The need to reduce GHG emissions from livestock farming can have significant benefits for animal welfare. One of the most effective measures to decrease the climate impact of our food system is to produce and consume fewer animal-based products – specifically beef and dairy products. Replacing one type of meat with another is clearly not the solution – plant-based diets are the way forward for sustainable diets. The other benefit for farm animals is that the climate crisis is an opportunity to rethink food and farming and to catalyse a transition to a food system that benefits planet, animals and humans.

## Reducing methane from livestock is an effective pathway to achieving climate goals

A recent study based on a business-as-usual scenario foresees that even if fossil fuel emissions were immediately halted, current trends in global food systems, notably increased meat and dairy consumption, would make it impossible to limit global warming to the 1.5 °C target. The researchers concluded that both demand-side and supply-side strategies are needed, including a shift to more plant-based diets<sup>18</sup>.

Reduction of livestock-related emissions is a very effective climate mitigation, because of its relatively large share of total methane emissions. Cutting methane emissions is crucial in slowing down climate change: Methane is much more potent in terms of global warming than CO<sub>2</sub> and its 'atmospheric lifetime' is estimated to be 12 years. This means that methane reductions could be particularly important in relation to near- and medium-term temperatures<sup>19</sup>. UNEP concludes that cutting human-caused methane by 45% this decade would keep warming beneath a threshold agreed by world leaders, and that healthy diets that are high in plants and lower in meat and dairy could achieve yearly methane reductions in the region of 15–30Mt/year<sup>20</sup>.

## Plant-based diets and less meat and dairy reduces harmful emissions

By far the biggest environmental benefits can be achieved by dietary change – not by improving the impact of production of meat and dairy. It would halve the emissions caused by the food system, drastically reduce land use and deforestation, and have several other environmental benefits (such as reduced water pollution etc.). Even the animal-based products with the lowest environmental impact are way worse than their plant-based alternatives, but beef and lamb meat perform worst from a GHG emission perspective, closely followed by



cheese and other dairy products<sup>21</sup>. In the current food system, the production of animal-based foods causes twice the amount of GHG emissions of plant-based foods<sup>22</sup>. At the same time, the share of protein supplied by meat is only 37% and the calorie supply merely 18%<sup>23</sup>.



The needed reduction of meat and dairy consumption (and production) can be calculated in different ways, leading to slightly different figures. A well-accepted estimation done by a group of leading scientists collaborating in the EAT Lancet commission suggests a 'Planetary Health Diet' based on modelling the 'planetary boundaries'<sup>c</sup> in combination with health recommendations. EAT Lancet recommends a global reduction of 50% of (especially red) meat and a very moderate intake of dairy products<sup>24</sup>. Greenpeace's Science Unit draws similar conclusions, based on a similar approach<sup>25</sup>.

A fair and just distribution of the needed reduction of animal-based products would require the regions where consumption of these products is high – such as Europe and especially the US – to cut consumption levels more drastically than regions where consumption is lower – such as South East Asia and Sub Sahara Africa. A comparison of the 'Planetary Health Diet' to diets in Europe and the US indicates a needed reduction of meat intake by 70–90% or even more.

Another perspective underlining the need for lower consumption of animal-based products (and reduction of feed that competes with food consumption) is that this can enable extensification of farming, needed to reduce pollution and impacts on biodiversity. A group of scientists concluded that with a decrease of 50% arable feed consumption and reduction of food waste, the whole global food system can shift to organic methods<sup>26</sup>.

The good news is that plant-based solutions are a booming business and that in some countries meat consumption seems to be declining. A 2021 publication by ProVeg International analysing the sales of meat replacement products in European supermarkets concludes that the sales value of these products increased by a staggering 49% in the period between 2018 and 2020<sup>27</sup>. Market analysts come to similar conclusions<sup>28, 29</sup>. Some European countries see a decline in meat consumption. An example is Germany, where in 2021 people ate less meat than ever before in the past 30 years<sup>30</sup>. However, the start of a trend towards plant-based diets is far from enough to achieve the GHG emission reduction needed.

<sup>c</sup> See 'The nine planetary boundaries' by the Stockholm resilience centre. These boundaries define a 'safe operating space', based on the earth's ecological capacity. Many of these are relevant to farming, e.g. climate change, land system change, and biochemical flows.

## The climate crisis should trigger better food systems and animal welfare

The massive impact of factory farming on the climate is only one of the problematic outcomes of the industrialised food system: this exploitative and resource-dependent industry is driving biodiversity loss at unprecedented rates, is responsible for pollution of air, water and soil, and is causing human health problems. It facilitates antimicrobial resistance and the spread of zoonoses. Billions of farm animals lead a miserable life in this industry. That factory farming is a driving factor in all these crises leads to the urgency to rethink the global food system. A transition to a more sustainable, animal welfare conscious and extensive livestock farming system, which is less dependent on processed feed, is urgently needed<sup>31</sup>.

Farming for animal-based products is an inefficient use of land and resources that could otherwise have been left untouched or farmed by small-scale farmers in diversified, higher welfare, agroecological systems, in line with the principles of social justice and food sovereignty. A fundamental transition of the food system to more diverse, ecosystem-based practices, centered around a dietary shift, can put an end to many of the problematic outcomes of industrial farming.

The IPCC recognises that agroecological principles and practices and 'other approaches that work with natural processes support food security, nutrition, health and well-being, livelihoods and biodiversity, sustainability and ecosystem services<sup>32</sup>.' Improving animal health and welfare, which is a key tenant of agroecology, can support environmental and climate protection aims, particularly when farms have lower densities of animals. Keeping fewer animals in species-appropriate conditions, such as with continuous access to well-managed pasture, can also positively affect soil carbon sequestration through silvo-pastoral and agroforestry systems and appropriate feeding systems involving grazing<sup>33</sup>.

In a sustainable agricultural system, ruminants are fed with hay and grass according to their needs<sup>34</sup>. Additionally, agricultural by-/waste-products could be used for poultry or pigs as feedstuff<sup>35</sup>. Such a production system, rooted in lower consumption of animal products, would have far fewer negative externalities for humans, animals and the environment. In an integrated crop-livestock-system, manure from farm animals is then used to fertilize the soil, reducing dependence on synthetic inputs and promoting environmental benefits. Slower growing and locally adapted breeds are privileged over those bred for higher productivity levels that are dependent on high inputs of highly nutritious feed. High productive and fast growing breeds would suffer from hunger and physiological disbalances from an abrupt change to these more sustainable feed sources.



Many different studies on the benefits of organic livestock production systems show that not only from a climate perspective do these systems perform better (lower direct emissions and higher rates of carbon sequestration in biomass and soils); organic farms contribute to an increase of biodiversity, less pollution, and higher welfare of animals<sup>36</sup>. However, it is important to note that from an animal welfare perspective, there remains room for improvement of the organic production standards.

Various agroecological food systems have shown to be more resilient to the impacts of climate change and many other environmental stresses. They offer stable and sustainable food security, while supporting ecosystems and welfare in rural communities around the world<sup>37</sup>.

## Less livestock creates room for nature to restore – and sequester carbon

The conversion of animal feed into animal protein is accompanied by a huge loss of energy, as the greatest part of the energy is used to simply keep the animal alive. Only 4% to 25% of the protein inputs as feed are converted into an animal product, e.g. milk or meat; 96% to 75% would be lost during conversion. It is also a significant waste of land. It is estimated that if the world adopted plant-based diets, it would free up 75% of agricultural land<sup>38</sup>. If the protein plants that are fed to animals, or the arable land that is used for the cultivation of protein feedstuff, would instead be directly used for human consumption, more people could be fed<sup>39</sup>.

More and more scientists are also pointing out that decreasing consumption of animal products will not only prevent deforestation, it will also give room for reforestation. This is important in the fight against climate change, because of so called 'carbon sequestration' – trees and other biomass that capture carbon from the atmosphere and preserve it in biomass and soils. Sun et al., for example, modelled the 'double climate dividend' of adopting the EAT Lancet diet in 54 rich countries and allowing nature to restore in the freed-up land. They conclude that this would capture as much carbon as caused by the entire global farming system over 14 years<sup>40</sup>.

Another study concludes that the combined impact of swift reduction of meat consumption in combination with increased carbon sequestration on former agricultural land could in itself achieve half of the emission reductions needed to achieve the goals set by the Paris climate agreement – limiting global warming to 2 °C, preferably 1.5 °C<sup>41</sup>.

## Technological fixes are not effective and are often harmful to farm animals

The application of emission-mitigation techniques in livestock farming – often dubbed 'sustainable intensification' by the meat and dairy industry – are very limited in effectiveness. In industrial western farms, reductions potential of technologies such as feed management to reduce emissions from enteric fermentation and breeding for livestock with higher productivity are measured up to 21%, but this does not apply to less industrialised production systems in other regions of the world<sup>42</sup>.

Researchers conclude that further intensification and increased efficiency of livestock production will very likely not be enough to meet the agreed GHG emission reduction goals and that less livestock production and less consumption of livestock products should be part of the solution. Otherwise, problems will aggravate and the meat industry will occupy a large (and growing) share of remaining emissions<sup>43</sup>.

In addition to the limited effectiveness of technological solutions, these do not contribute to a shift to a holistically sustainable food system. It might reduce GHG emissions but does not address the land use issues by feed production, local environmental issues or animal welfare. On the contrary: some of the proposed mitigation technologies are further undermining the welfare of farm animals, which already suffer now of severe behavioural and health problems induced by already exceeding productivity levels. A focus on reducing the 'carbon intensity' of animal sourced products (lower emissions per kg of product) by increased productivity is driving further intensification of an already industrialised system that is inherently detrimental for the well-being of animals. For example: the relatively low climate impact of chicken meat is mainly caused by the fast growth rates of these animals, which in itself leads to a 30-days life full of suffering. Increased intensification by higher stocking rates of farm animals has also shown to be detrimental to animal welfare<sup>44</sup>.

'[...] behavioural change towards diets of lower environmental impact and higher nutritional qualities faces barriers both from agricultural producers and consumers and requires policy packages that combine informative instruments with behavioural, administrative and/or market-based instruments, and are attentive to the needs of, and engage, all food system stakeholders including civil society networks, and change the food environment.' (IPCC, 2022)

## FOUR PAWS key policy recommendations

### Governments must align their food and farming policies with their climate, development and other international commitments.

#### They should:

- ▶ Extend and expand the Koronivia Joint Work on Agriculture beyond COP27 and beyond agriculture production to incorporate a holistic food systems approach, including the consumption of healthy and plant-rich foods as an essential topic.
- ▶ Revise their Nationally Determined Contributions (NDCs) to include ambitious pathways and targets for sustainable production and sustainable consumption of animal-based products.
- ▶ Commit to a 45% reduction of methane emissions by 2030 under the Methane Pledge, and to address not only the energy sector, but also explicitly address livestock numbers.

## Governments should support the transition to more sustainable food systems. They should prioritise policies that:

- ➔ Re-orientate public policies, subsidies and investments to help farmers transition from harmful agricultural practices towards agroecological and regenerative farming systems.
- ➔ Set clear targets across the food chain to reduce meat and dairy consumption and production in line with WHO dietary guidelines and planetary boundaries, i.e., EAT-Lancet Planetary Health Diet.
- ➔ Limit and strictly regulate the production and importation of animal feed; bring forward due diligence legislation to ensure deforestation-free supply chains.
- ➔ Support and invest in the development of plant-based food products and innovation.
- ➔ Ensure public procurement policies, based on minimum standards that respect high animal welfare criteria, specify a certain portion of plant-based protein/meals per week.

## Governments, especially in the Global North, must bring livestock numbers down to within planetary boundaries. They should implement regulations that:

- ➔ Reduce animal stocking densities to levels coherent with animal welfare and air, water and soil environmental quality parameters.
- ➔ Allocate a percentage of current land used for rearing livestock or feed for restoration or preservation of ecosystems, landscapes and biodiversity, whilst compensating participating farmers with payments for environmental services (PES).
- ➔ Enact a moratorium on the expansion or construction of new intensive livestock farms.
- ➔ Internalise the cost of livestock production, by applying true price accounting to animal-sourced products.
- ➔ Apply the Precautionary Principle to technological abatement strategies to ensure that they do not harm animal welfare as well as safeguarding against maladaptive responses that could lead to further intensification.
- ➔ Regulate meat and dairy companies to ensure they report and reduce their scope 3 emissions – and ensure this does not lead to further intensification and deterioration of animal welfare, but rather less and better animal-based products.
- ➔ Halt financing the promotion of consumption of meat and dairy products, diverting funds to increase the uptake of grains, legumes, nuts, fruit and vegetables.

## References

- 1 IPCC. Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, UK and New York, NY, USA., 2022. doi: 10.1017/9781009157926.001.
- 2 IPCC. Summary for Policymakers. 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 Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 2021. pp. 3–32, doi:10.1017/9781009157896.001
- 3 IPCC. Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, UK and New York, NY, USA. , 2022. doi: 10.1017/9781009157926.001.
- 4 See for example: Eisen M & Brown P. Rapid global phaseout of animal agriculture has the potential to stabilize greenhouse gas levels for 30 years and offset 68 percent of CO<sub>2</sub> emissions this century. PLoS Climate. 2022. 1(2), e0000010. Gerber P, Steinfeld H, Henderson B, Mottet A, Opio C, Dijkman J, Faluccci A & Tempio G. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome. 2013.
- 5 OECD & FAO. OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris. 2021. <https://doi.org/10.1787/19428846-en>.
- 6 Gerber P, Steinfeld H, Henderson B, Mottet A, Opio C, Dijkman J, Faluccci A & Tempio G. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome. 2013.
- 7 United Nations Environment Programme and Climate and Clean Air Coalition. Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions. Nairobi: United Nations Environment Programme. 2021. ISBN: 978-92-807-3854-4 Job No: DTI/2352/PA
- 8 IPCC The IPCC Sixth Assessment Report WGIII climate assessment of mitigation pathways: from emissions to global temperatures. EGUsphere [preprint]. 2022. <https://doi.org/10.5194/egusphere-2022-471>, 2022.
- 9 Llonch P, Haskell M, Dewhurst R, & Turner S. Current available strategies to mitigate greenhouse gas emissions in livestock systems: an animal welfare perspective. Animal. 2017. 11, no. 2: 274-284.
- 10 Richie H & Roser M. Land use. Published online at OurWorldInData.org. 2019. Retrieved online October 2022 from: <https://ourworldindata.org/land-use>
- 11 Lesschen J, Martin van den Berg H, Westhoek H, Witzke & Oenema O. Greenhouse gas emission profiles of European livestock sectors. Animal Feed Science and Technology. 2011. 166 (2011): 16-28.
- 12 IPBES. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. IPBES secretariat, Bonn, Germany. 2019. 1148 pages. <https://doi.org/10.5281/zenodo.3831673>
- 13 WWF. Living Planet Report 2022 – Building a nature positive society. WWF, Gland, Switzerland. 2022.
- 14 IPBES. Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services. IPBES secretariat, Bonn, Germany. 2020. DOI:10.5281/zenodo.4147317.
- 15 Alimi Y, Bernstein A, Epstein J, Espinal M, Kakkar M, Kochevar D & Werneck G. Report of the scientific task force on preventing pandemics. Cambridge, MA: Harvard Global Health Institute, Center for Climate, Health, and the Global Environment at Harvard T.H. Chan School of Public Health. 2021.



- 16 Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, Garnett T et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*. 2019. 393, no. 10170 447–492.
- 17 FAO, IFAD, UNICEF, WFP and WHO. *The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all*. Rome, FAO. 2021. <https://doi.org/10.4060/cb4474en>
- 18 Clark M, Domingo N, Colgan K, Thakrar S, Tilman D, Lynch J, Azevedo I & Hill J. Global food system emissions could preclude achieving the 1.5 and 2 C climate change targets. *Science*. 2020. 370, no. 6517: 705–708.
- 19 IPCC The IPCC Sixth Assessment Report WGIII climate assessment of mitigation pathways: from emissions to global temperatures. *EGUsphere* [preprint]. 2022. <https://doi.org/10.5194/egusphere-2022-471>, 2022.
- 20 United Nations Environment Programme and Climate and Clean Air Coalition. *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions*. Nairobi: United Nations Environment Programme. 2021. ISBN: 978-92-807-3854-4 Job No: DTI/2352/PA
- 21 Poore J, & Nemecek T. Reducing food's environmental impacts through producers and consumers. *Science*. 2018. 360, no. 6392: 987–992.
- 22 Xu X, Sharma P, Shu S, Lin T, Ciaia P, Tubiello F, Smith P, Campbell N, & Jain K. Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nature Food*. 2021. 2, no. 9: 724–732.
- 23 Ritchie H & Roser M. Land use. Published online at OurWorldInData.org. 2019. Retrieved online October 2022 from: <https://ourworldindata.org/land-use>
- 24 Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, Garnett T et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*. 2019. 393, no. 10170 447–492.
- 25 Tirado R, Thompson K, Miller K. & Johnston P. Less is more: Reducing meat and dairy for a healthier life and planet. Greenpeace Research Laboratories. 2018. Technical Report (Review) 03-2018. ISBN: 978-1-9999978-1-6. 86 pp.
- 26 Muller A, Schader C, Scialabba N, Brüggemann J, Isensee A, Erb K, Smith P et al. Strategies for feeding the world more sustainably with organic agriculture. *Nature communications*. 2017. 8, no. 1: 1–13.
- 27 ProVeg International. Plant-based foods in Europe – How big is the market? 2021. Available at: <https://smartproteinproject.eu/wp-content/uploads/Smart-Protein-Plant-based-Food-Sector-Report.pdf>
- 28 BCG and Blue Horizon. Food for thought – The protein transformation. Available at: <https://cutt.ly/fTzWfKc> 57. 2021.
- 29 ING Research. Growth of meat and dairy alternatives is stirring up the European food industry. Available at: <https://cutt.ly/KTzWJKu>. 2020.
- 30 Albert Schweitzer Foundation. Web article: Meat Consumption in Germany at Record Low. Published on May 14. 2022. Available online: <https://albertschweitzerfoundation.org/news/german-meat-consumption-at-record-low>
- 31 IPES Food. From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems. International Panel of Experts on Sustainable Food systems. 2016.
- 32 IPCC. Climate Change 2022. Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. 2022. p.21. doi:10.1017/9781009325844
- 33 Forabosco F, Canu F, & Mantovani R. Greenhouse gas emissions of livestock raised in a harsh environment. *Int. J. Glob. Warm.* 2018. 15, 431–446. <https://doi.org/10.1504/IJGW.2018.10015007>

- 34 Brodt S, Six J, Feenstra G, Ingels C & Campbell D. Sustainable Agriculture. *Nature Education Knowledge* 2011. 3,10,1. Retrieved from: Sustainable Agriculture | Learn Science at Scitable (nature.com).
- 35 Ajila C, Brar S, Verma M, Tyagi R, Godbout S & Valéro J. Bio-processing of agro-byproducts to animal feed. *Critical Reviews in Biotechnology*. 2012. 32, 382–400
- 36 Humane Society US. An HSUS Report: The Impact of Animal Agriculture on Global Warming and Climate Change. 2011
- 37 IPES Food. From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems. International Panel of Experts on Sustainable Food systems. 2016.
- 38 Ritchie H & Roser M.. If the world adopted a plant-based diet we would reduce global agricultural land use from 4 to 1 billion hectares. *Our World in Data*. 2021. Accessed online 9 May, 2021. <https://ourworldindata.org/land-use-diets>
- 39 Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M, Rosales M, & De Haan C. *Livestock's long shadow: environmental issues and options*. FAO. 2006.
- 40 Sun Z, Scherer L, Tukker A, Spawn-Lee S, Bruckner M, Gibbs H, & Behrens P. Dietary change in high-income nations alone can lead to substantial double climate dividend. *Nature Food*. 2022. 3, no. 1 : 29–37.
- 41 Eisen M & Brown P. Rapid global phaseout of animal agriculture has the potential to stabilize greenhouse gas levels for 30 years and offset 68 percent of CO<sub>2</sub> emissions this century. *PLoS Climate*. 2022. 1, no. 2: e0000010.
- 42 Höglund-Isaksson L, Gómez-Sanabria A, Klimont Z, Rafaj P, & Schöpp W. Technical potentials and costs for reducing global anthropogenic methane emissions in the 2050 timeframe—results from the GAINS model. *Environmental Research Communications*. 2020. 2, no. 2: 025004.
- 43 Buckwell A, & Nadeu E. What is the Safe Operating Space for EU livestock. The RISE Foundation. 2018 Brussels.
- 44 Llonch P, Haskell M, Dewhurst R & Turner S. Current available strategies to mitigate greenhouse gas emissions in livestock systems: an animal welfare perspective. *Animal*. 2017. 11, no. 2: 274–284.



## About FOUR PAWS

FOUR PAWS is the global animal welfare organisation for animals under direct human influence, which reveals suffering, rescues animals in need and protects them. Founded in 1988 in Vienna by Heli Dungler and friends, the organisation advocates for a world where humans treat animals with respect, empathy and understanding. The sustainable campaigns and projects of FOUR PAWS focus on companion animals including stray dogs and cats, farm animals and wild animals – such as bears, big cats and orangutans – kept in inappropriate conditions as well as in disaster and conflict zones. With offices in Australia, Austria, Belgium, Bulgaria, France, Germany, Kosovo, the Netherlands, Switzerland, South Africa, Thailand, Ukraine, the UK, the USA and Vietnam as well as sanctuaries for rescued animals in eleven countries, FOUR PAWS provides rapid help and long-term solutions.



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