How does our diet affect the climate?

As our purchasing and eating habits have a strong impact on the climate, a climate-friendly diet is therefore particularly important.

Date published online: 12/2023

Explainer videos

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English translation of the German explainer video transcript

Why you should give lentil Bolognese a chance for lunch

How does our diet affect the climate?

Have you ever thought about how your diet affects the climate? About whether greenhouse gas emissions differ between different foods or diets? I once looked at the example of spaghetti Bolognese and compared the carbon dioxide balance of a version with minced meat and one with lentils. But more on that later. Let's start at the beginning.

What greenhouse gases are originating from food production?

Already, our ecosystems are being affected by climate change and the resulting global warming. Warmer temperatures and less rainfall have changed the growing conditions for cereals and less fresh water is available. Many animal and plant species are threatened with extinction. If we manage to limit global warming to below 2°C, these negative impacts could be reduced. To do this, however, we must quickly reduce our greenhouse gas emissions, because these emissions reinforce the natural greenhouse effect. As a result, the Earth is getting warmer and warmer. In this context, it is often said that we should fly less, for example. But many people are not aware that even everyday things like the food we eat contribute essentially to the production of greenhouse gases and thus influence our climate. And precisely here there is still great potential for optimisation: according to the Intergovernmental Panel on Climate Change, the global food system is responsible for about a quarter to a third of all greenhouse gas emissions caused by humans. In addition to carbon dioxide, the two climate gases methane and dinitrogen monoxide, also known

as laughing gas, are produced during the production of food. Carbon dioxide, often abbreviated as CO_2, is produced, for example, by cutting down forests to create pasture or arable land. The felled trees can then no longer bind the gas. Heating greenhouses and, of course, transporting food also release carbon dioxide. Many people know that methane also has a negative impact on the climate. Methane is produced in the stomachs of ruminants such as cattle or sheep and is released through burping or excrement. Worldwide, the demand for meat is increasing. This means that more and more meat is being produced and the amounts of methane in our atmosphere are increasing. However, methane is also emitted in large quantities at another point in agriculture, namely in rice cultivation: rice is predominantly grown in wet cultivation. This means that the rice fields are flooded, primarily to prevent weeds from growing. The heavily watered soil creates an almost oxygen-free habitat in which methane-forming microorganisms feel particularly at home. Dinitrogen monoxide, i.e. laughing gas, is produced by keeping animals on pastureland and by nitrogen fertiliser applied to agricultural land. If too much fertiliser is applied or at times when the plant does not need so much nitrogen, the excess nitrate accumulates in the soil. Certain types of bacteria metabolise the nitrate, causing laughing gas to be released into the atmosphere. If we continue as we are, the Intergovernmental Panel on Climate Change predicts that annual greenhouse gas emissions from agriculture will increase by 30-40 percent by 2050. This is due to the growing world population combined with increasing prosperity. This also changes diets and increases the demand for meat, for example.

What is the individual impact of food?

The greenhouse gas emissions caused by the production of a food product are usually expressed as CO_2 equivalents in order to make the emissions of different gases comparable. In this way, the different greenhouse gases are converted into a uniform unit of measurement. CO_2 equivalents indicate the amount of CO_2 that has the same greenhouse potential as the mixture of greenhouse gases actually emitted. How many greenhouse gas emissions are caused by the production of a food does not only depend on which food it is. How and where the food was produced also has a strong influence. In addition, some factors are not considered by all calculation models, such as the production of fertilisers or the cooling and transport of the food. Thus, the results can vary considerably. For example, estimates for greenhouse gas emissions per kilogram of beef range from 11 to 110 kg CO_2 equivalents. Caution should therefore be exercised when comparing CO_2 equivalents - ideally, one should only compare foods within one calculation method. Nevertheless, general trends can be identified regardless of the method of calculation. In general, meat and other animal products such as milk and eggs have a much worse climate balance than plant-based foods. According to the Food and Agriculture Organization of the United Nations (FAO), animal husbandry contributes a large share of the greenhouse gas emissions caused by humans, almost 15 per cent. Beef is the top greenhouse gas emitter, with an average of 29 kilograms of CO_2 equivalents per kilogram of meat. Chicken and pork, on the other hand, only cause around 5 kilograms of CO_2 equivalents. Processed dairy products are in the middle. Butter, for example, causes 12 kilogrammes of CO_2 equivalents per kilogramme of product. Milk itself is rather in the low range with 1.5 kilogrammes of CO_2 equivalents per litre. This is because a relatively large amount of milk is needed to produce butter - to be precise, 4.5 litres of milk for 1 packet of butter. Added to this is the energy-intensive production and cooling. Compared to animal products, plant-based foods usually have a much better climate balance. The foods with the lowest balance of CO_2 are fruits and vegetables grown outdoors, with an average of half a kilogram of CO_2 equivalents per kilogram of product. Cereals also cause only about half a kilogram of CO_2 equivalents per kilogram of product – with the exception of rice: the large quantities of methane gas produced during the wet cultivation of rice lead to 1 kilogram of rice causing an average of 3 kilograms of CO_2 equivalents. Similar amounts of CO_2 equivalents are produced when fruit and vegetables are grown in heated greenhouses. Rice, fruit and vegetables grown in heated greenhouses thus have the highest value of greenhouse gas emissions among plant-based foods. The example of tomatoes shows the difference between outdoor cultivation and cultivation in heated and non-heated greenhouses very clearly. If tomatoes are grown out of season in a heated greenhouse here in Germany, about 9 kilograms of CO_2 equivalents are produced per kilogram of tomatoes. When grown in an unheated greenhouse, only 2 kilograms of CO_2 equivalents are produced. Open-grown tomatoes from Spain produce half a kilogram of CO_2 equivalents, whereas tomatoes

from regional outdoor cultivation produce less than 0.1 kilograms. So it is not always enough to pay attention to regionality. Seasonal food choices are just as important.

So what do these figures mean in practice? The example dish mentioned at the beginning illustrates this quite well. A portion of spaghetti Bolognese, prepared with minced meat fried in butter, produces 1.3 kilograms of CO_2 equivalents per portion. If you replace the butter with olive oil and the minced meat with lentils, the same dish produces only 0.6 kilograms of CO_2 equivalents – that's less than half.

How can I eat in a climate-friendly way?

Based on the greenhouse gas emissions of food, we can consider a number of recommendations on how to eat a low-emission diet. If we eat less meat and animal products, this leads to significantly lower greenhouse gas emissions. On the one hand, this is due to the high proportion of greenhouse gases that their husbandry causes. On the other hand, it is also due to the energy-intensive further processing and cooling. A regional and seasonal diet is also important. Fruit and vegetables from heated greenhouses cause the highest proportion of emissions in the plant food sector. However, food cannot be grown outdoors all year round, so it is best to eat those that are in season. A seasonal calendar, which can be printed out for free on many websites, is helpful. And the carbon footprint of food is significantly worse if it comes from overseas. It is therefore also worth taking a look at the indication of geographical origin of foodstuffs.

However, food that has not been consumed probably has the worst climate balance. That's why we should avoid food going bad and/or being thrown away as much as possible. Worldwide, 25-30 percent of all food ends up in the waste. In industrialised countries like here in Germany, we in private households are responsible for the largest share of wasted food.

These recommendations show that we can all play a part in emitting fewer greenhouse gases: Less animal products, regional and seasonal foods and a conscious use of these are tips that are actually not that difficult to implement. Next time, simply replace the minced meat with a vegetable alternative such as lentils. You will see that with lentil Bolognese you can make a delicious contribution to climate protection.

Literature

Bundesanstalt für Landwirtschaft und Ernährung. (4. Februar 2021). Wie viel Milch braucht man für ein Päckchen Butter? https://www.landwirtschaft.de/landwirtschaft-verstehen/haetten-sies-gewusst/wie-viel-milch-braucht-man-fuer-ein-paeckchen-butter

Clune, S., Crossin, E. & Verghese, K. (2017). Systematic review of greenhouse gas emissions for different fresh food catego-ries. Journal of Cleaner Production, 140, 766–783. https://doi.org/10.1016/j.jclepro.2016.04.082

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. (2013). Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities. Rom. http://www.fao.org/3/i3437e/i3437e.pdf

Grünberg, J., Nieberg, H. & Schmidt, T. G. (2010). Treibhausgasbilanzierung von Lebensmitteln (Carbon Footprints): Über-blick und kritische Reflektion. vTI Agriculture and Forestry Research, 60(2), 53–72. https://literatur.thuenen.de/digbib_extern/bitv/dn046465.pdf

Intergovernmental Panel on Climate Change. (2019). Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. https://www.ipcc.ch/site/assets/uploads/2019/11/SRCCL-Full-Report-Compiled-191128.pdf

Klimatarier.com. (25. Januar 2021). CO2 Rechner | Klimatarier.com. https://www.klimatarier.com/de/CO2_Rechner

Schmidt, T., Baumgadt, S., Blumenthal, A., Burdick, B., Claupein, E., Dirksmeyer, W., Hafner, G., Klockgether, K., Koch, F., Leverenz, D., Lörchner, M., Ludwig-Ohm, S., Niepagenkemper, L., Owusu-Sekyere, K. & Waskow, F. (2019). Wege zur Reduzierung von Lebensmittelabfällen - Pathways to reduce food waste (REFOWAS): Maßnahmen, Bewertungsrahmen und Analysewerkzeuge sowie zukunftsfähige Ansätze für einen nachhaltigen Umgang mit Lebensmitteln unter Einbin-dung sozio-ökologischer Innovationen (Thünen Report 73). https://www.thuenen.de/media/publikationen/thuenen-report/Thuenen-Report_73_Vol1.pdf

Trydeman Knudsen, M., Halberg, N., Hermansen, J. & Andreasen, L. (2010). Life Cycle Assessment (LCA) of organic food and farming systems: Focusing on greenhouse gas emissions, carbon sequestration potential and methodological challenges and status. RTOACC workshop at FAO, Rome, Italy, November 2010. https://www.organicandclimate.org/fileadmin/documents_organicresearch/rtoacc/events/meetings-events/2010-11-22/4_Knudsen-LCA_of_organic_food_and_farming_systems.pdf

Verbraucherzentrale Bundesverband e.V. & Stiftung Warentest. (2010). Essen – (K)eine Klimasünde? https://www.verbraucherbildung.de/sites/default/files/downloads/201001_essen_klimasuende_ue_stiwa_vzbv.pdf