

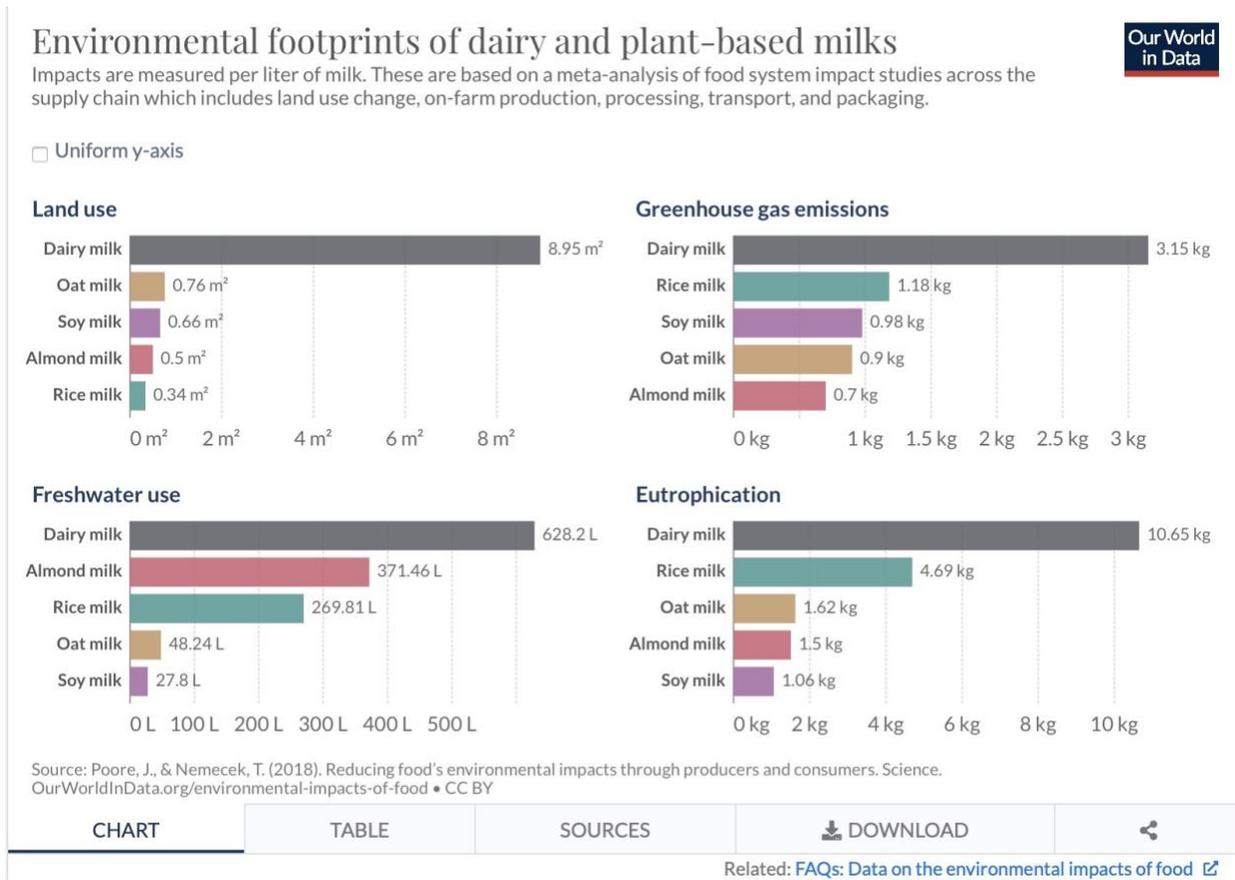
## Dairy vs. plant-based milk: what are the environmental impacts?

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*A growing number of people are interested in switching to plant-based alternatives to dairy. But are they better for the environment, and which is best?*

Milk is a dietary staple across many countries in the world. But dairy can contribute a lot to the greenhouse gas emissions of our food. In typical EU diets, it accounts for just over one-quarter of the carbon footprint, sometimes as much as one-third.<sup>1</sup>



Growing awareness of this means many are looking to plant-based alternatives. In the UK, [surveys suggest](#) one-quarter of adults now drink some non-dairy milks (although not always exclusively). It's even more popular in younger demographics with one-third of 16 to 23-year-olds opting for them.<sup>2</sup>

There is now a range of 'plant-based' milk alternatives available, including soy, oat, almond, rice, and coconut. This raises two common questions: are plant-based milks really better for the environment, and which is best?

In the chart here we compare milks across a number of environmental metrics: land use, greenhouse gas emissions, water use, and eutrophication – the pollution of ecosystems with excess nutrients. These are

compared per liter of milk.<sup>3</sup> At the end of this article I address some of the differences in the nutritional quality of these milks, which is important to consider in certain populations.

Cow's milk has significantly higher impacts than the plant-based alternatives across all metrics. It causes around three times as much greenhouse gas emissions; uses around ten times as much land; two to twenty times as much freshwater; and creates much higher levels of eutrophication.

If you want to reduce the environmental footprint of your diet, switching to plant-based alternatives is a good option.

Which of the vegan milks is best? It really depends on the impact we care most about. Almond milk has lower greenhouse gas emissions and uses less land than soy, for example, but requires more water and results in higher eutrophication.

All of the alternatives have a lower impact than dairy, but there is no clear winner on all metrics.

Land use 0 m<sup>2</sup> 2 m<sup>2</sup> 4 m<sup>2</sup> 6 m<sup>2</sup> 8 m<sup>2</sup> Dairy milk 8.95 m<sup>2</sup> Oat milk 0.76 m<sup>2</sup> Soy milk 0.66 m<sup>2</sup> Almond milk 0.5 m<sup>2</sup> Rice milk 0.34 m<sup>2</sup> Greenhouse gas emissions 0 kg 1 kg 1.5 kg 2 kg 2.5 kg 3 kg Dairy milk 3.15 kg Rice milk 1.18 kg Soy milk 0.98 kg Oat milk 0.9 kg Almond milk 0.7 kg Freshwater use 0 L 100 L 200 L 300 L 400 L 500 L Dairy milk 628.2 L Almond milk 371.46 L Rice milk 269.81 L Oat milk 48.24 L Soy milk 27.8 L Eutrophication 0 kg 2 kg 4 kg 6 kg 8 kg 10 kg Dairy milk 10.65 kg Rice milk 4.69 kg Oat milk 1.62 kg Almond milk 1.5 kg Soy milk 1.06 kg

*Common FAQs on this topic:*

### **How does the nutritional profile of dairy compare with plant-based milks?**

In the figures above we look at the comparison of milks *per liter*. A liter of dairy milk is not comparable to a liter of plant-based milk in terms of its nutritional profile.

Dairy milk tends to be higher in calories, and importantly, contains more protein. 100ml of cow's milk [will contain](#) around 3.4 grams of protein, versus 0.5 grams [in almond milk](#). The protein in dairy is also a more 'complete' protein source, which means it has the full profile of essential amino acids.<sup>4</sup> Most plant-based milks have a similar calcium content to cow's milk – almond and cow's milk both have around 120 milligrams per 100ml, for example.

One of the benefits of plant-based milks is that they are often fortified with vitamins and minerals. Vitamin D, for example, is often added. Cow's milk naturally contains very little vitamin D, although it is possible to buy fortified varieties. Vitamin B<sub>12</sub> is one micronutrient that only occurs in animal products; vegans are therefore at risk of deficiency without supplementation. However, most plant-based milks are now fortified with vitamin B<sub>12</sub>.

From a nutritional perspective, the replacement of dairy with plant-based milks is unlikely to be a concern for those with a diverse diet, and for those who do not rely on milk as an important source of protein. It is possible to meet these requirements from other foods – such as a combination of legumes, meat substitutes, and grains. However, for certain demographics – especially young children, and those on lower incomes with poor dietary diversity – this might be an inappropriate switch.

The average person in many lower-income countries gets most of their calories from cheap, energy-dense crops like cereals and tubers (like cassava). This can be [more than three-quarters](#) of an individual's calorie

intake. These diets do not provide the diversity of nutrients needed for good health – they are likely to be deficient in a number of [micronutrients](#), and protein (once we adjust for quality). Without access to foods that are fortified with vitamins and minerals, often small amounts of animal protein – such as milk – provide one of the few sources of complete protein and micronutrients in their diet.

In such cases, removing dairy from a person’s diet without sufficient replacements could have a negative impact on health and nutrition. For most people in middle-to–high income countries, however, this is unlikely to be an issue.

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### **I’ve heard that soy is linked to deforestation in the Amazon. Is this a concern for soy milk?**

One of the largest concerns about alternatives such as soy milk is that they drive deforestation in the Amazon region. It’s true that the [growing demand for soy](#) has been [one of the drivers](#) of Brazilian land-use change. Although, by far, the largest driver has been pasture for beef production.

But, it’s important to note what this soy is used for. 95% of Brazilian soy is used for animal feed.<sup>5</sup> Globally, [more than three-quarters](#) of soy, by mass, is used for animal feed. The other main co-product is soybean oil. This means that very little of Amazonian land-use pressures from soy have been driven by crops for direct human consumption; most is for animal feed.

Another factor to consider here, especially for European consumers, is that [most of Brazil’s soy](#) crop is genetically modified (some estimates put this figure at 94%). There are strict regulations on the use of GM soy for direct human food in the European Union. Most of the soy consumed in Europe is produced in Europe.

[Soy yields](#) are similar in the EU as they are in Brazil and the rest of South America – 3 tonnes per hectare in France versus 2.9 tonnes in Brazil. In fact, some EU countries have higher yields, such as Spain (3.3 tonnes) and Italy (4 tonnes). So the environmental impact of EU soy will be lower than in South America.

### **Endnotes**

1. Sandström, V., Valin, H., Krisztin, T., Havlík, P., Herrero, M., & Kastner, T. (2018). [The role of trade in the greenhouse gas footprints of EU diets](#). *Global Food Security*, 19, 48-55.
2. Despite a large share of the population saying they now drink plant-based alternatives, dairy milk still dominates the UK market in terms of sales volume (with 96% for white milk). Market surveys suggest people favor cow’s milk versus vegan milks for particular uses e.g. hot versus cold drinks.
3. This data comes from the largest meta-analysis of food impacts to date, published by Joseph Poore and Thomas Nemecek (2018) in *Science*. In this study, the authors looked at data across more than 38,000 commercial farms in 119 countries and quantified their environmental impacts taking into account the entire production chain – from land-use change through to retail and packaging.  
  
Poore, J., & Nemecek, T. (2018). [Reducing food’s environmental impacts through producers and consumers](#). *Science*, 360(6392), 987-992.
4. One way of comparing the quality of different protein sources is using their Protein Digestibility-Corrected Amino Acid Score (PDCAAS). This score looks not only at the total protein they provide but also digestibility, and whether there are particular deficiencies of specific amino acids. Most animal proteins tend to score very highly on PDCAAS. Plant-based foods such as soy

also score very highly. But achieving a complete amino acid profile on a vegan diet requires a mix of grains, legumes and meat-free substitute proteins.

Schaafsma, G. (2000). [The protein digestibility–corrected amino acid score](#). *The Journal of Nutrition*, 130(7), 1865S-1867S.

Young, V. R., & Pellett, P. L. (1994). [Plant proteins in relation to human protein and amino acid nutrition](#). *The American Journal of Clinical Nutrition*, 59(5), 1203S-1212S.

5. Poore, J., & Nemecek, T. (2018). [Reducing food’s environmental impacts through producers and consumers](#). *Science*, 360(6392), 987-992.

FAOstat: UN Food and Agriculture Organization (FAO) Statistics. Available at:  
<http://www.fao.org/faostat/en/#data>.

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