

Environmental impact of 57,000 multi-ingredient processed foods revealed

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A study estimating the environmental impact of 57,000 food products in the U.K. and Ireland has been published this week in the journal *PNAS* by an Oxford-led research team.

The paper compares the environmental impacts of meat and meat alternative products, such as plant-based sausages or burgers, and finds many meat alternatives had a fifth to less than a tenth of the [environmental impact](#) of meat-based equivalents. This is the first time a transparent and reproducible method has been developed to assess the environmental impacts of multi-ingredient products. It provides a first step towards enabling consumers, retailers, and policymakers to make informed decisions on the environmental impacts of food and drink products.

Lead author, Dr. Michael Clark says, "By estimating the environmental impact of food and drink products in a standardized way, we have taken a significant first step towards providing information that could enable informed decision-making. We still need to find how best to communicate this information effectively, in order to shift behavior towards more sustainable outcomes, but assessing the impact of products is an important step forward."

A study by the U.K.'s Food Standards Agency shows more than half of U.K. consumers want to make more sustainable decisions on the environmental impacts of foods and, at the same time, food corporations are setting ambitious net zero greenhouse gas targets. But there is a lack of detailed environmental impact information on food and drink products—which would allow consumers and corporations to make more sustainable choices.

Today's study, led by researchers in the Livestock, Environment and People (LEAP) program and Oxford Population Health at the University of Oxford, used publicly available information to derive estimates of the environmental impact of 57,000 [food products](#), which make up the majority of foods and drinks for sale in U.K. supermarkets.

They looked at greenhouse gas emissions, [land use](#), water stress, and

eutrophication potential—when bodies of water become enriched with nutrients, often causing harmful algal blooms and ultimately killing other life. For the purposes of analysis, visualization and communication, the team combined these four scores into a single estimated composite environmental impact score per 100 g of product.

Professor Peter Scarborough, Oxford Professor of Population Health, says, "This work is very exciting. For the first time, we have a transparent and comparable method for assessing the environmental footprint of multi-ingredient processed foods. These types of foods make up most of the supermarket shopping we do, but until now there was no way of directly comparing their impact on the environment.

"This work could support tools that help consumers make more environmentally sustainable food purchasing decisions. More importantly, it could prompt retailers and food manufacturers to reduce the environmental impact of the food supply thereby making it easier for all of us to have healthier, more sustainable diets."

The researchers quantify the differences in environmental impact between multi-ingredient products and find those made of fruits, vegetables, sugar, and flour, such as soups, salads, bread and many breakfast cereals, have low impact scores, and those made of meat, fish and cheese, are at the high end of the scale. Jerky, biltong, and other dried beef products, which typically have more than 100 g of fresh meat per 100 g of final product, often have the highest environmental impact.

When looking at specific types of food products, such as meat and their alternatives, lasagna, cookies and biscuits, and pesto sauces, the researchers found large variation within these types of foods. For these food types, lower-impact products often had one half to one tenth the environmental impact of higher-impact products. This type of information, if communicated to consumers and retailers, may help shift

behaviors towards more sustainable foods without requiring large changes in dietary behavior, such as swapping beef for beans.

When comparing the environmental impact score to their [nutritional value](#), as defined by the Nutri-score method, products that were more sustainable tended to be more nutritious, including meat and meat alternatives. There are exceptions to this trend, such as sugary beverages, which have a low environmental impact but also score poorly for nutritional quality.

Jennie Macdiarmid, Professor of Sustainable Nutrition and Health at the the Rowett Institute, University of Aberdeen, says, "An important aspect of the study was linking the environmental impacts of composite foods with the nutritional quality, showing some of the synergies and trade-offs between different parameters. Using this new method manufacturers can reduce the environmental impact, while ensuring a high nutritional quality of products."

The amount of every ingredient in a multi-ingredient food or drink product is usually known only to the manufacturer, but in the U.K. they are legally obliged to provide percentage values for certain ingredients, and ingredients are listed on packaging in order of size. Dr. Clark and colleagues used known percentages and order of ingredients to infer unknown values, cross-referencing products and ingredients through use of a large dataset of products. Individual ingredients were mapped to environmental databases, and the percentages of all ingredients within each product were used to estimate the impact of each whole product.

The analysis makes use of foodDB—a Big Data research platform at the University of Oxford that collects and processes data daily on all food and drink products available in 12 online supermarkets in the U.K. and Ireland, and a comprehensive review of 570 studies of the environmental impact of food production, which includes data from 38,000 farms in

119 countries.

A limitation of the analysis is that information on ingredient sourcing, such as country of origin or agricultural production method, is lacking from ingredient lists and this would help increase accuracy of the environmental impact estimates. Additionally, as portion sizes vary for different products, there remain uncertainties in the total environmental impacts of products.

Dr. Richie Harrington, head of foodDB, says, "Our method fills an information gap on the environmental impacts of multi-ingredient foods. The algorithms we developed can estimate the percentage contribution of each individual ingredient within a product and match those ingredients to existing environmental impact databases. Applying this methodology to generate impact scores for large numbers of products, we illustrated how this can be used to derive quantifiable insight on the sustainability of those products, and their relationship to their nutritional quality."

More information: Estimating the environmental impacts of 57,000 food products, *Proceedings of the National Academy of Sciences* (2022). DOI: [10.1073/pnas.2120584119](https://doi.org/10.1073/pnas.2120584119).

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