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EDITED BY
Sophie Attwood,
Behavior Global, United Kingdom

REVIEWED BY
Kenjin B. Chang,
Greener by Default, United States

*CORRESPONDENCE
Chris Macdonald
cm2150@cam.ac.uk

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What are the best sources of protein? Introducing the BPI Score

Chris Macdonald*

University of Cambridge, Cambridge, United Kingdom

The question, "What are the best sources of protein?" is complicated by the significant hidden health and environmental costs associated with many popular options. Existing food rating systems, such as nutritional traffic lights and carbon footprint labels, are valuable but often unidimensional. This narrow focus can conceal critical trade-offs and mislead consumers by failing to present a holistic picture. This perspective paper introduces the BPI Score, a new, multidimensional rating system designed to provide a more comprehensive answer. The goal is not necessarily to create another front-of-package label, but to foster a new literacy that empowers consumers, policymakers, and organizations to make more informed decisions. The initial version (V1) of the BPI Score was used to evaluate 20 high-protein products across two primary categories: people and planet. The Planet Score assesses environmental impact using data on GHG emissions, water pollution, and resource use. The People Score considers health factors like sodium and saturated fat content alongside accessibility metrics such as affordability and availability. A clear disparity emerged between plant-based and animal-based proteins. Tofu emerged as the highest-scoring product, while cheddar cheese ranked last. The top quintile of products consisted solely of plant-based proteins, while the bottom quintile was composed entirely of animal-based proteins. While acknowledging the limitations of this first iteration, the score provides a robust foundation for a more nuanced conversation. Ultimately, beyond the spreadsheets and scores, lies a fundamental reckoning: our protein choice is a referendum on the compassion we are willing to show to the planet and to future generations.

KEYWORDS
carbon footprint (CF), carbon labeling, food, nutrition, plant-based diet, product rating, sustainability, veganism

Introduction

Protein is essential for a healthy diet. However, not all protein sources are created equal. Some of the most popular come with significant hidden costs, from environmental damage to serious health risks. To address this, I founded the Better Protein Institute (BPI), an organization that facilitates and accelerates the transition to better sources of protein.

To achieve this, the BPI conducts critical research from first principles and provides free tools and guidance for policymakers, organizations, and consumers.

The BPI tackles first-principle questions such as, how much protein should be recommended for optimal health outcomes? What are the best sources of protein currently available? How can we increase consumption of the best sources?

My last few papers have shared progress on questions relating to how to increase the consumption (Macdonald, 2023, 2024, 2025a), in this paper, I will share perspectives on the question: "What are the best sources of protein currently available?"

I will focus on my perspectives relating to what is meant by "best," how this is defined and measured, and how it can be improved in the future. I will begin with a summary of how food products are typically rated.

In the UK, a traffic light system provides a useful at-a-glance summary of key nutritional values. Red, amber, and green colors are used to quickly indicate high, medium, and low levels of fat, saturates, sugars, and salt. Similarly, in many EU countries, the nutri-score system uses a five-color scale to visualize nutritional values. Other systems reflect external costs: carbon footprint labels have been widely trialed to visualize the resulting greenhouse gas emissions; fairtrade seals signal that producers receive a fair price; and terms such as free-range signal animal welfare conditions.

While the results of such systems, in their current form, often yield mixed and modest results with regard to change in consumer behavior (Macdonald, 2025a), they may provide upstream value by demanding greater transparency from companies and proving valuable information to better inform and support policies. However, while such unidimensional ratings and certifications may be valuable, a holistic analysis is essential to better understand the broader picture. For example, an environmental score that does not include water pollution is incomplete. Furthermore, a complete environmental score that does not also consider nutritional values is still incomplete. Without multidimensional analysis, we could be missing important trade-offs; a product may be a clear winner in a given category but a clear loser in another. Put simply, certain measurements, presented in isolation, may be misleading. Unidimensional ratings may conceal inconvenient truths.

To address this, I wanted to create a holistic rating system. One that considered multiple factors. The intent was not necessarily to create a new front-of-package label or certification but at least to have a multidimensional measurement for use at the BPI, which could then inform subsequent conversations and better-informed evidence-based interventions.

There are two key psychological barriers which can prevent the creation of a broader rating system. First is analysis paralysis (Kurien et al., 2014), whereby one could become "paralysed" by a myriad of options and combinations to the extent that no action is taken. The second is perfectionistic paralysis/perfectionism (Shafran et al., 2002), whereby one will never be satisfied with an outcome and therefore not publish it. To address these, I adopted a "V1 mindset." I acknowledged that I could not include everything, and I acknowledged that there would be significant compromises, but I knew this was only the first version and that it would be improved by external critique and subsequent iterations.

With that said, here are the measurements of 20 high-protein products using V1 of a newly established holistic rating—the BPI Score. The 20 high-protein foods are nominally categorized into two primary product types: plant-based proteins and animal-based proteins. The complete list can be seen in Figure 1.

The BPI Score

While acknowledging the inherent overlap, V1 of the BPI Score comprises two primary categories: people and planet. I will begin with the latter.

Planet Score

Clark et al. (2022) dataset was used for the planet category. Given my research question is focused on protein sources, "per 100 g of protein" is used as the standard unit for a fair and consistent comparison. For a broader understanding of the planetary impact, both pollution and resource use were measured.

When measuring pollution, GHG emissions and water pollution values were scraped from Michael Clark et al.'s database. As has been noted by many others (Espinosa-Marrón et al., 2022; Agudelo Higuita et al., 2023; Bidoglio et al., 2024), it was apparent that there was a significant difference between some forms of plant-based protein and some forms of animal-based protein—in some cases, by orders of magnitude. For example, chia seeds were cited at 3.07 g of water pollution (PO_4eq) per 100 g of protein, and pork was cited at 46.23 g of water pollution, likewise, tofu was cited at 0.61 kg of GHG emissions (CO_2eq) per 100 g of protein, and beef was cited at 64.19 kg of GHG emissions (two orders of magnitude higher). Water use values correspond to consumptive blue water use (freshwater use) rather than total water use including green water. Blue water was selected because it better reflects pressure on scarce freshwater resources and is therefore considered a more meaningful indicator of environmental impact.

When assessing resource use, both land use and water use values were considered. With regard to land use, a similar order of magnitude trend emerged, whereby tofu (2.16 m^2 of land per 100 g of protein) used significantly less land than beef (211.38 m^2). Water use was less conclusive, as while nuts required the most amount of water (2,239.1 L per 100 g of protein), it was the plant-based options that required the least amount of water overall—e.g., tofu (14.23 L), sunflower seeds (6.68 L), and beans (0.07 L).

Given the range of values, points-based norm-referenced grading was used. A simplified 5-point scale was implemented: 0–4. This was considered an optimal starting point as it provided a neutral middle grade (2), the possibility of zero, and a degree of nuance. Each list (GHG emissions, water pollution, land use, and water use) was first sorted numerically, from lowest to highest. Those in the top 20%, received the maximum of 4 points. The next highest 20% received 3 points, and so on leaving the bottom 20% with 0 points. The scores were combined to create an overall Planet Score (with a maximum of 16 points).

The product winner was tofu (with 16 points). The product loser was beef (with 1 point). The product type winner was plant-based proteins as every product in the top quintile of the combined scores was plant-based—tofu, chia seeds, beans, and quinoa. The product type loser was animal-based proteins as every product in the bottom quintile of the combined scores was animal-based—mozzarella, pork, cheddar, and beef.

People Score

For a broader understanding of the potential impact on people, factors relating to health, as well as factors relating to accessibility were considered. I will begin with the former.

A potential risk with a holistic rating system is that it could include factors that are not relevant to a specific product.

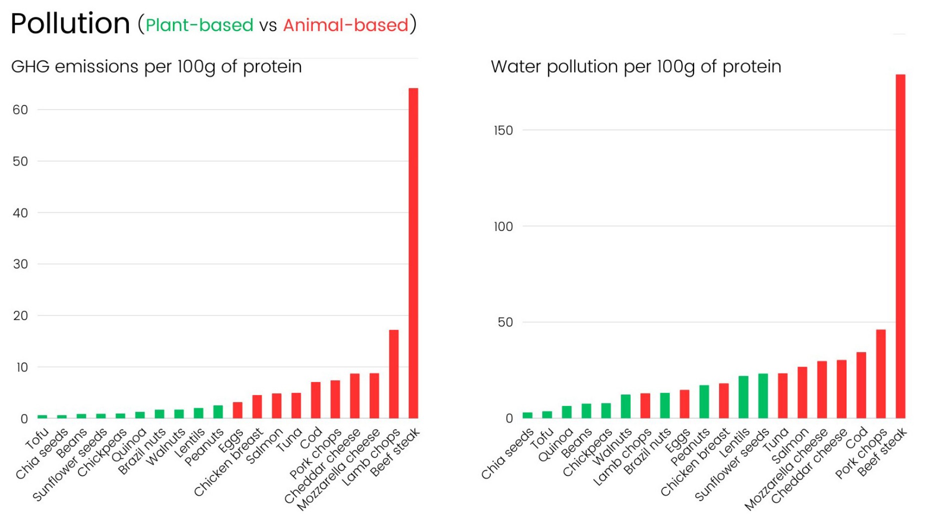

FIGURE 1
Two bar charts comparing greenhouse gas emissions and water pollution produced by plant-based and animal-based protein sources per 100 g of protein.

For example, lowering the overall score for beef because it is low in vitamin C is misleading. It should be factored in that, at a macro-level, beef provides high quantities of a vital macronutrient (protein), and that peripheral fruit and vegetables can provide micronutrients such as vitamin C (Fenech et al., 2019; Feszterová et al., 2023; Budiarto et al., 2024). Accordingly, when looking at health impacts, I focused on the potentially harmful components that might come from the protein package rather than what beneficial secondary nutrients may or may not be absent.

Accordingly, factors linked to obesity and cardiovascular disease (the most common cause of death) were scraped from the Nutritionix database: sodium, saturated fat, and cholesterol. As was the case for the Planet Score, "per 100 g of protein" was used as the standard unit.

When looking at sodium values, the plant-animal split re-emerged—e.g., beans (11.11 mg of sodium per 100 g of protein) vs. mozzarella (2549.55 mg). Beans, walnuts, Brazil nuts, and lentils contained the lowest levels of sodium, whereas eggs, tuna, cheddar, and mozzarella contained the highest amounts.

Saturated fat values revealed an interesting mix, with animal-based proteins the best and worst performing: cod (0.47 g of saturated fat per 100 g of protein) vs. cheddar (84.74 g). Both the top and bottom 20% also contained plant-based proteins—beans (1.11 g) in the top quintile and Brazil nuts (78.32 g) in the bottom quintile.

Cholesterol presented a unique challenge as all plant-based options provided a value of zero (mg of cholesterol per 100 g of protein). As a result, a binary scoring system was considered for cholesterol—e.g., 0 points if present, 4 if not. However, this would be unfair as some animal products such as tuna had a relatively low amount (152.94 mg) compared to an animal product such as eggs (2,960.32 mg). Accordingly, an adapted scoring system was implemented to reflect the diverse spread across animal-based products. As a result, points in the range of 0–3 were distributed across the animal-based proteins.

One other value was considered for the health subsection of the People Score: whether a given protein source is considered a complete protein source.

Proteins are made up of smaller units called amino acids. There are 20 different amino acids that the human body uses. Out of these 20, nine are often considered essential because the human body cannot synthesize them on its own. This means they must be obtained through one's diet. Accordingly, a food that contains all nine essential amino acids is often referred to as a complete protein source.

To factor this in, a yes-no question was applied to every food item: "Is it a complete source of protein?" A binary scoring system was implemented: 4 points for "Yes," and 0 points for "No." This measurement could be considered controversial as one could logically argue that should a consumer eat varied incomplete protein sources, then they can gain adequate amounts of all 9 essential amino acids. However, despite this, as the research question relates to optimal sources of protein, the scoring was applied. It was noted that while some plant-based sources such as tofu were considered complete, most plant-based sources were not. By contrast, all animal-based protein sources were flagged as complete sources.

The final two measurements for the People Score relate to accessibility. The first is affordability. To assess this, data was scraped from the website of a UK supermarket: Aldi. Aldi has consistently been named the UK's cheapest supermarket and therefore its prices reflect more affordable options for consumers.

When adjusting the prices to "per 100 g of protein," a mixed spread was revealed. Both the top and bottom quintiles contained plant-based and animal-based proteins. While a plant-based product (lentils) was revealed as the cheapest option, a plant-based product (quinoa) was also revealed as the most expensive option.

The other accessibility consideration was related to product availability. For this, a yes-no question was applied to every food item: "Is this product available at a UK supermarket?" A binary scoring system was applied: 4 points for "Yes," and 0 points for "No." This consideration was somewhat redundant as the answer was "Yes" to every item, however, this was included as it will be an important factor to consider in the future as more protein options are gradually introduced to the consumer as products transition from proof of concept to commercialization, to rollout, and then scale-up—e.g., protein-rich products made via precision fermentation or lab-grown meat (Macdonald, 2026a).

The scores relating to health and accessibility were combined to create an overall People Score with a maximum of 24 points.

The product winner was tofu (with 20 points). The product loser was lamb (with 10 points). The product type winner was plant-based proteins, as every product in the top 20% of the combined scores was plant-based (tofu, beans, lentils, and chia seeds). The product type loser was animal-based proteins, as every product in the bottom 20% of the combined scores was animal-based (mozzarella, cheddar, eggs, and lamb).

BPI Score

To create the overall BPI Score, all scores were combined (Planet Score + People Score).

The product winner was tofu (with 36 points). The product loser was cheddar (with 13 points). The product type winner was plant-based proteins, as every product in the top 20% of the combined scores was plant-based (tofu, chia seeds, beans, and quinoa). The product type loser was animal-based proteins, as every product in the bottom 20% of the combined scores was animal-based (mozzarella, lamb, beef, and cheddar). A full breakdown of the scores can be found at the BetterProteinInsitute.com.

Discussion

When reflecting upon the limitations, it is important to note that not all critical factors have been included in V1, and some of those absent may be significantly more challenging to quantify—e.g., opportunity costs or ethical considerations.

Interestingly, if these were included, even modestly, then there would likely be a further divide between plant-based and animal-based proteins. Furthermore, there are logical arguments to be made that these, currently excluded factors, should be heavily weighted.

For example, the opportunity cost for land use could be monumental. It is estimated that if everyone transitioned from animal-based proteins to exclusively plant-based proteins, our land use for agriculture would fall from over 4 billion hectares to 1 billion, and if that land were then rewilded, we could sequester over 500 billion tons of CO_2–for reference, every year, we emit less than 40 billion tons of CO_2 from fossil fuels (Poore and Nemecek, 2018; Hayek et al., 2021; Ritchie, 2021a,b, 2023a). Even if we exclude additional benefits such as the protection and proliferation of biodiversity, the carbon-capture potential alone would warrant a high score.

Likewise, the ethical considerations are highly significant. As, even if legitimately held far beyond the highest possible welfare standards, it is difficult for many to look beyond the fact that products such as "beef steak" and "chicken breast" are the result of billions of sentient beings being confined in unnatural barren landscapes and then slaughtered (Barnett, 2007; Ritchie et al., 2017; Hayek, 2022; Molnár, 2022). Over 80 billion land animals are killed every year for meat production (Ritchie et al., 2017), and the majority are factory-farmed (Ritchie, 2023a). And for some industries under the umbrella of animal agriculture, the right to freely roam is fundamentally incompatible with the "product."

In the United States, for example, the dairy industry is highly mechanized and follows an inherently extractive cycle with inescapable confinement. First, a young female cow is artificially inseminated with semen from a genetically selected bull. The cow then becomes pregnant, and she carries her developing baby inside her for about the same amount of time as a human pregnancy. The act of giving birth triggers the natural hormonal cascade required to start producing milk. The newborn calf is then separated from its mother, and milking begins. The cow, on concrete floors, surrounded by metal bars, is connected to a milking machine. Milk production hits its peak at approximately 2 months. The cow is then artificially inseminated again to start the next pregnancy and the cycle is repeated. For the entirety of her life, she will be kept indoors. When milk production drops or if the cow is too exhausted or ill or fails to get pregnant, she is slaughtered.

In short, if ethical concerns were incorporated into V1 of the BPI Score, then cheese, which was identified as the loser, would likely receive a significantly lower score.

Furthermore, there is a lose-lose trade-off with regard to the ethical considerations of animal agriculture: increasing space can improve welfare standards for farmed animals, but increasing space for an already resource-intensive industry further decreases the space for wildlife and biodiversity. For example, "there are around 8.3 billion egg-laying hens worldwide, around the same number as humans" and most of these hens "live in cages that give them less space than an A4 sheet of paper" (Ritchie, 2023b). As a result, they spend most of their lives in pain (Ritchie, 2023b). Conversely, herd cattle are afforded significantly more space. However, wildlife suffers as a result—e.g., pasture expansion for cattle production is the main driver of deforestation in the Amazon (Skidmore et al., 2021; Donoso et al., 2024).

In short, there is an inherent lose-lose trade off: either more wild animals or more farmed animals will suffer. With this inconvenient truth in mind, it will be difficult to create a gradated measurement for such ethical considerations. In reality, the most accurate and fair method may require a blanket deduction for animal agriculture.

Another potential consideration for future scoring is antimicrobial resistance due to the routine overuse of antibiotics for growth promotion and disease prevention in animal agriculture (Manyi-Loh et al., 2018; Katz and Banerjee, 2024). It is also important to consider the risk of zoonotic diseases due to the high-density confinement and low genetic diversity of farmed animals (Jones et al., 2013; Subedi et al., 2025). Likewise, it may need to be factored in that the International Agency for Research on Cancer have classified processed meat as carcinogenic and non-processed red meat as likely carcinogenic (IARC, 2015, 2018; Shi et al., 2023).

Furthermore, a significant limitation of V1 lies in the external validity of its accessibility metrics. By anchoring affordability data to a single UK supermarket chain (Aldi) and defining availability through a UK retail binary, these metrics function as a localized proof-of-concept rather than a globally generalizable framework. In reality, cross-border external validity is highly constrained by regional variations in agricultural subsidies, trade tariffs, and socioeconomic disparities such as urban food deserts. While certain plant-based staples are highly affordable in the UK context, relative costs and access can shift dramatically in other global markets. To enhance external validity, subsequent iterations of the BPI Score must look beyond localized retail snapshots and integrate dynamically weighted regional datasets or purchasing-power-parity frameworks.

Another limitation of the current score is that the simplified five-point grading system doesn't sufficiently capture the diverse spread of values, nor does it sufficiently reflect outliers (e.g., beef in the pollution category as visualized in Figure 1). Accordingly, a new wider grading system will also be an important component of V2.

V2 of the BPI Score (already in development) will integrate some of these more challenging, yet important, considerations. My research has consistently sought to increase better dietary decisions (Macdonald, 2019, 2020, 2023, 2024, 2025a,b, 2026b), accordingly, I am committed to continuous improvement, driven by new data and guided by external critique. I will ensure that the BPI Score evolves to provide an increasingly comprehensive and accurate reflection of the best protein sources available. Leaning into inconvenient truths will be essential to its success.

Against deliberate corporate obfuscation and marketing myths, the goal of a holistic score is not to create a new label, but to foster a new literacy—one that empowers us to see the reality of the systems we are funding.

Ultimately, beyond the spreadsheets and scores, lies a fundamental reckoning: our protein choice is a referendum on the compassion we are willing to show to animals, to the planet, and to future generations.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

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