

Factsheet

Plant-based nutrition



A dietary approach that emphasises plant-based foods over animal-based products, in alignment with scientific nutritional guidelines, benefits both the environment and public health. In this factsheet, we will discuss the environmental and health benefits of adopting a more plant-based diet, key considerations associated with such a dietary shift, and the rapid expansion of plant-based substitutes for animal products.



Key messages

- Leading health organisations, including the Health Council of the Netherlands and the World Health Organization, all recommend a more plant-based dietary pattern and reduced consumption of animal foods due to the proven positive impact on health and the environment.
- A dietary pattern consisting of 60% plant-based and 40% animal-based proteins is healthier for most Dutch people and is estimated to reduce environmental impact by 25%.
- Scientific research indicates that a more plant-based dietary pattern is beneficial for health, reducing the risk of coronary heart disease and other conditions.
- Key considerations for a fully plant-based diet include ensuring adequate intake of protein, calcium, iron, and vitamins B₁, B₂, and B₁₂.
- Various (predominantly) plant-based dietary patterns, such as veganism, vegetarianism, and flexitarianism, are growing in popularity. For instance, the number of people identifying as flexitarians in the Netherlands has increased from 14% in 2011 to around 43% in 2019.



Environmental benefits of plant-based nutrition

Global temperatures are rising due to an increase in greenhouse gases in the atmosphere (see **Box 1**). The food system is estimated to contribute about one-third to global greenhouse gas emissions, with emissions from animal-based food production (meat, eggs, dairy) being approximately twice as high as those from plant-based foods^{1,2}. Particularly beef production results in significant emissions. Additionally, the water usage is generally higher in the production

of animal-based foods compared to plant-based foods. For example, the average water consumption per calorie of beef is twenty times higher compared to grains³. **Table 1** provides an overview of the greenhouse gas emissions and water usage of various animal and plant-based products. From an environmental perspective, it is therefore crucial that we shift towards a more plant-based diet.

Box 1: Different types of greenhouse gases

The primary greenhouse gases are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O , also known as laughing gas). The main sources of carbon dioxide emissions include the use of fossil fuels and changes in land use (such as deforestation or the draining of peatlands). Methane, which is about 28 times more potent than CO_2 as a greenhouse gas, largely originates from livestock farming. During digestion, ruminant animals such as cows, sheep, and goats produce methane, which is released into the atmosphere through gas emissions. Nitrous oxide primarily forms in wastewater treatment, but it can also result from denitrification processes in the soil. These processes occur with the use of both animal manure and artificial fertilizers, where bacteria first convert ammonium with oxygen through nitrite to nitrate, which is taken up by plants. Any remaining nitrate is converted with organic matter into nitrogen gas (N_2). Nitrous oxide (N_2O) is an intermediate in this process and is released when there is insufficient oxygen available for complete conversion by bacteria^{4,5}. The impact of these gases on the greenhouse effect varies considerably. To quantify the influence of all these greenhouse gases, emission figures are therefore converted into CO_2 equivalents.

Table 1. The National Institute for Public Health and the Environment (RIVM) has compiled data on the environmental impact of approximately 250 food products to provide insight into the burden of consumption in the Netherlands. This table presents an overview of the average greenhouse gas emissions (expressed in CO₂ equivalent) and water usage per 1 kg of product from production till consumption for a selection of food items⁶.

	Greenhouse gas emissions in CO ₂ eq	Water usage in m ³
Beef steak	31.3	0.25
Minced beef	30.0	0.24
Tuna, canned	14.5	0.06
Pork	12.4	0.12
Chicken breast	10.9	0.15
Farmed salmon filet	6.9	0.05
Vegetarian mince, mycoprotein-based	4.4	0.10
Chicken egg, boiled	4.3	0.11
Vegetarian burger	3.8	0.04
Brown beans (jar)	2.0	0.07
Green beans	1.1	0.06
Peas, frozen	1.1	0.02
Whole wheat bread	1.0	0.02
Potatoes, peeled	0.9	0.01
Frozen fries, pre-baked	6.2	0.09
Sugar	0.7	0.01

Health benefits of a more plant-based diet

In addition to environmental benefits, a more plant-based diet also brings significant health advantages. Both the Health Council of the Netherlands and the World Health Organization (WHO) have conducted extensive literature reviews on the relationship between plant-based nutrition and health. They conclude that there is convincing evidence for the reduction of the risk of coronary heart disease by consuming vegetables, fruits, whole grains, legumes, nuts, and plant oils. Additionally, the consumption of vegetables, fruits, and whole grains lower the risk of stroke. Entirely vegetarian and vegan diets have been found to lower the risk of coronary heart disease^{7,8}.

The World Cancer Research Fund (WCRF) concludes in its report that there is convincing evidence that consuming whole grains protects against colorectal cancer. Additionally, consuming a fibre-rich diet protects against colorectal cancer, weight gain, overweight, and obesity⁹. Furthermore, these organizations have identified a link between the consumption of red and processed meats and a higher risk of stroke, diabetes, and colorectal cancer⁷⁻⁹.

Guidelines and reports

Leading health organizations recommend a dietary pattern with more plant-based and fewer animal-based products due to the proven positive impact on health and the environment. In the Dutch Dietary Guidelines of 2015, the Health Council of the Netherlands advises consuming a more plant-based and less animal-based dietary pattern⁷. Until now, health has been the focus of the Dutch dietary guidelines. However, with growing attention for sustainability, integration of this aspect with health in nutritional counselling is explored¹⁰. The Health Council of the Netherlands published an advisory on a healthy protein transition (see **Box 2**).

Other guidelines and reports also recommend a more plant-based dietary pattern. For instance, plant-based nutrition plays a significant role in the Swedish dietary guidelines. Using the slogan 'Find your way to eat greener, not too much and be active,' efforts are made to encourage healthier

eating habits among the Swedish population¹¹. The Nordic Nutrition Recommendations, which form the basis for the guidelines in Denmark, Finland, Iceland, Norway, and Sweden, also emphasize a shift from an animal-based to a more plant-based diet¹².

In the EAT-Lancet report (2018), 37 international researchers recommend a diet rich in plant-based foods and lower in animal-based foods¹³. The WHO concludes in its report titled 'Plant-based diets and their impact on health, sustainability, and the environment' that there is sufficient evidence that shifting towards a more plant-based diet has a positive effect on health and the environment⁸.

In the ten recommendations for reducing the risk of cancer by the WCRF, it is advised to consume plenty of whole grains, vegetables, fruits, and legumes. They also recommend limiting the intake of processed and red meat⁹.

Box 2: Protein transition

The shift from a diet predominantly based on animal protein sources to one primarily based on plant protein sources is also known as the 'protein transition'. In 2018, The Council for the Environment and Infrastructure (Rli) advised to strive for a ratio of 40% animal and 60% plant protein in the food in 2030 because of climate targets¹⁴. According to the Dutch National Food Consumption Survey 2019-2021, the ratio of protein intake for the Dutch population is about 57% animal and 43% plant protein¹⁵. This recommendation highlights the role of diets in achieving sustainability goals and encourages a shift to more plant-based proteins.

Advice Healthy protein transition

The Health Council of the Netherlands' Protein Transition Committee studied the health implications of the protein transition and drafted an advisory report on this¹⁶. The committee specifically focused on shifting to a diet with 60% plant and 40% animal protein. The research revealed that a more plant-based dietary pattern better aligns with the Dutch Dietary Guidelines of 2015 than the current dietary pattern. Additionally, for most Dutch people it is possible to reduce consumption of animal products without causing nutrient deficiencies. Finally, this shift is estimated to reduce the environmental impact of our food consumption by approximately 25%. This reduction applies to both greenhouse gas emissions and land use.

The committee also investigated the implications of the protein transition for specific population groups. Pregnant women, lactating women and people with low protein and energy intake (e.g. due to illness or fragile health) require more attention. Good guidance is important for these groups if they intend to consume more plant-based foods¹⁶.

Shift to a more plant-based diet for health and the environment

Considerations for plant-based nutrition

A more plant-based diet, in line with dietary guidelines, is healthier and more sustainable. However, when shifting to a more plant-based diet, some aspects must be considered.

Micronutrients

Vitamin B₁₂ occurs naturally only in animal products. Therefore, it is advised for vegans and vegetarians who consume little or no dairy and eggs to take vitamin B₁₂ supplements and/or consume vitamin B₁₂ fortified products.

Dairy is an important source of calcium. With a more plant-based diet, it is important to replace dairy with plant-based alternatives that are fortified with calcium. Sometimes these products also contain vitamin B₁₂.

In addition to vitamin B₁₂ and calcium, the Netherlands Nutrition Centre recommends an individual consuming a diet with less or no meat, to ensure sufficient intake of protein, iron, vitamin B₁ and B₂¹⁸.

Protein

The Protein Transition Committee concludes that sufficient intake of protein of good quality is possible with a more plant-based diet¹⁶. When adopting a more plant-based diet, protein is a point of consideration as protein quality of plant-based foods is generally lower compared to animal-based products.

Consumption of plant-based nutrition in the Netherlands

The Dutch National Food Consumption Survey 2019-2021 shows that consumption of plant-based foods, such as fruits and vegetables, unsalted nuts and legumes, increased among Dutch people (aged 7 to 69). Red and processed meat consumption decreased by 20% since 2007-2010¹⁷.

This can be attributed to several factors¹⁹:

1. Protein content in food;
2. Essential amino acid content of the protein;
3. The extent to which the protein is digested in the intestine and the absorption of the released amino acids by the body (the bioavailability).

The recommended dietary allowance of protein for men and women aged 18 and above is 0.83 grams per kilogram of body weight per day. For sufficient intake of all (semi-)essential amino acids, vegans are recommended by the Health Council of the Netherlands to eat 1.3 times more protein, or 1.08 grams per kilogram of body weight²⁰. The higher protein recommendation for vegetarians is no longer necessary according to new calculations by the Health Council of the Netherlands¹⁶.

More information on plant-based protein and protein quality is provided in the [Factsheet Plant-based proteins](#).

Plant-based dietary patterns

Several definitions are used for people who consume little or no animal-based food²¹:

- Vegan – someone who does not eat meat, fish and animal products (such as dairy, eggs and honey) and does not use animal products (such as leather and wool)
- Vegetarian – someone who does not eat anything from a killed animal
- Ovo-vegetarian – someone who does not eat meat, fish or dairy, but does eat eggs
- Lacto-vegetarian – someone who does not eat meat, fish or eggs, but does eat dairy
- Lacto-ovo-vegetarian – someone who does not eat meat and fish, but does eat eggs and dairy
- Pescotarian – someone who does not eat meat, but does eat fish
- Flexitarian – someone who replaces meat with a vegetarian alternative at least one day a week

In the Netherlands, about 5% of people are estimated to be vegetarian and 1% vegan. There is an increasing popularity for plant-based diets. The number of individuals identifying as flexitarian has increased in recent years from 14% in 2011 to about 43% in 2019²². Research by the Statistics Netherlands shows that urban residents, highly educated people and women are more likely to eat no or less meat. In addition, young people more often completely refrain from consuming meat, while older people more often choose to eat less meat²³.

Plant-based meat and dairy substitutes

In recent years, sales of plant-based meat and dairy substitutes have sharply increased²⁴. Plant-based meat and dairy substitutes often greatly differ in nutritional value. Some products are fortified with vitamins B₁₂, B₁, calcium and iron, but not all of them. The products that are enriched with iron and vitamin B₁₂ easily meet the criteria set by the Netherlands Nutrition Centre. Meat substitutes often contain less saturated fat, fewer calories and more dietary fibre than meat from the same category. Moreover, a similar percentage of energy comes from protein²⁵. Salt content in meat substitutes and meat is often comparable²⁵⁻²⁷. Some plant-based cheese alternatives are made from coconut oil, which consists mainly of saturated fat²⁸. In addition, there are plant-based alternatives for cheese based on potato that contain less or no fat²⁹.

When choosing a plant-based meat and dairy substitute, it is important to read the nutrition label. According to the Netherlands Nutrition Centre, a nutritious ready-to-eat meat substitute should contain the following (quantities of) nutrients³⁰:

- Protein (more than 20% of the total energy content in product)
- Iron (more than 0.8 milligram per 100 gram)
- Vitamin B₁ (more than 0.06 milligram per 100 gram) and/or vitamin B₁₂ (0.24 micrograms per 100 gram)
- Low saturated fat content (no more than 2.5 gram per 100 gram)
- Low salt content (no more than 1.1 gram per 100 gram)
- No added sugars

More research is needed on the environmental impact of manufactured plant-based meat and dairy substitutes. Given that the production process of these products differs from traditional plant-based foods such as vegetables, fruits, and legumes, their environmental impact will also be different^{31, 32}. However, because these products do not contain ingredients of animal origin, the environmental impact will be significantly lower than that of the animal variant³³.

Meat and dairy substitutes, and food processing

According to the NOVA classification system for the degree of processing, meat and dairy substitutes are classified as ultra-processed foods (UPF). The NOVA classification system categorizes various food products as UPF, such as cookies, ready-to-eat meals, but also whole grain supermarket bread, baby formula, and meat and dairy substitutes. The UPF group comprises a broad and heterogeneous group of foods for which no clear definition exists. Therefore, ultra-processed food is a topic that is still evolving with much uncertainty surrounding it. More research is needed into UPF and its health effects.

All evidence, from review articles including several meta-analyses, regarding associations between UPF consumption and health risks comes from epidemiological (cohort) studies which are known not to provide evidence of cause and effect^{34, 35}. Additionally, dietary guidelines are established for individual nutrients (e.g., sugar, fibre, salt), foods (e.g., vegetables and fruits, legumes, dairy), and dietary patterns (plant-based patterns).

Research by Cordova *et al.*³⁶ indicated that treating UPF as a single group is ineffective due to varying effects across different food groups. Seven groups of UPF, including plant-based alternatives to meat and dairy, showed no significant association with multimorbidity.

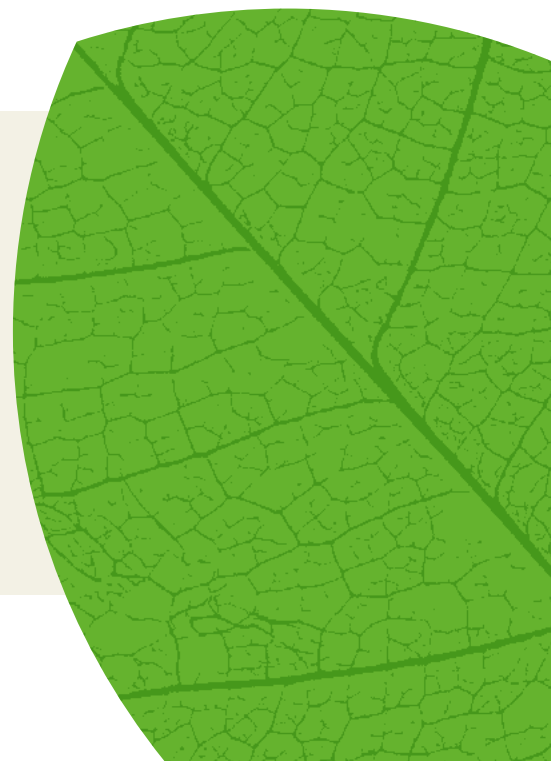


Conclusions

From both a health and environmental perspective, it is important to adopt a more plant-based and less animal-based dietary pattern. Despite the positive health effects of a more plant-based dietary pattern, there are some concerns. For instance, it is important to choose plant-based meat and dairy substitutes with sufficient protein, iron, vitamin B₁, vitamin B₁₂, and not too much saturated fat and salt.

Cosun Nutrition Center is grateful to its Scientific Advisory Board, consisting of experts in nutrition, health and sustainability, food safety and nutrition communication, for their critical contributions to this factsheet.

Cosun Nutrition Center, August 2024



References

- Xu X, Sharma P, Shu S, Lin T-S, Ciaia P, Tubiello FN, et al.** Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nature Food*. 2021;2(9):724-32.
- Crippa M, Solazzo E, Guizzardi D, Monforti-Ferrario F, Tubiello FN, Leip A.** Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*. 2021;2(3):198-209.
- Mekonnen MM, Hoekstra AY.** A Global Assessment of the Water Footprint of Farm Animal Products. *Ecosystems*. 2012;15(3):401-15.
- Milieu Centraal.** Wat is het broeikaseffect? [cited 2022. Available from: <https://www.milieucentraal.nl/klimaat-en-aarde/klimaatverandering/wat-is-het-broeikaseffect/>.
- Wageningen University.** Factsheet Broeikasgassen: lachgas.
- Milieu RvVe.** Database Milieubelasting voedingsmiddelen -Databaseversie 11 februari 2021. 2021.
- Gezondheidsraad.** Richtlijnen goede voeding 2015: Gezondheidsraad; 2015.
- World Health Organization.** Plant-based diets and their impact on health, sustainability and the environment: a review of the evidence: WHO European Office for the Prevention and Control of Noncommunicable Diseases. 2021.
- Shams-White MM, Brockton NT, Mitrou P, Romaguera D, Brown S, Bender A, et al.** Operationalizing the 2018 World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) Cancer Prevention Recommendations: A Standardized Scoring System. *Nutrients*. 2019;11(7):1572.
- Gezondheidsraad.** advies Voeding, gezondheid en duurzaamheid: een blik vooruit. 2020.
- Agency SF.** The Swedish dietary guidelines: find your way to eat greener, not too much and be active. Swedish Food Agency Uppsala, Sweden; 2015.
- Nordic Council of Ministers.** Nordic nutrition recommendations (NNR) 2012: integrating nutrition and physical activity. Copenhagen, Norden.; 2012.
- Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al.** Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *The Lancet*. 2019;393(10170):447-92.
- Raad voor de leefomgeving en infrastructuur.** DUURZAAM EN GEZOND. SAMEN NAAR EEN HOUDBAAR VOEDSELSTEL. 2018.
- Rijksinstituut voor Volksgezondheid en Milieu.** Verandering consumptie eiwitrijke producten. 2023 [Available from: <https://www.wateetnederland.nl/resultaten/veranderingen/verandering-consumptie-eiwitrijke-producten>.
- Gezondheidsraad.** Advies Gezonde eiwittransitie. 2023.
- RIVM.** Wat eet en drinkt Nederland? 2024 [16 februari 2024]. Available from: <https://www.wateetnederland.nl/>.
- Voedingcentrum.** Vegetarisch, veganistisch en flexitarisch eten [cited 2022. Available from: <https://www.voedingcentrum.nl/encyclopedie/vegetarisme-veganisme.aspx>.
- Tome D.** Criteria and markers for protein quality assessment—a review. *British Journal of Nutrition*. 2012;108(S2):S222-S9.
- Gezondheidsraad.** Voedingsnormen voor eiwitten. Referentiewaarden voor de inname van eiwitten. Den Haag; 2021.
- Vegetariërsbond.** Welke definitie hanteert de Vegetariërsbond voor vegetarisch en voor een vegetariër? [Available from: <https://www.vegetariers.nl/bewust/veelgestelde-vragen/welke-definitie-hanteert-de-vegetariersbond-voor-vegetarisch-en-voor-een-vegetarier>.
- Nederlandse Vegetariërsbond.** Consumptie Cijfers & Aantallen Vegetariërs. 2020.
- voor de Statistiek CB.** Klimaatverandering en energietransitie: opvattingen en gedrag van Nederlanders in 2020. 2021.
- Smart Protein Project.** Plant-based foods in Europe: How big is the market? ; 2021.
- Haperen Mv.** Hoe gezond zijn vleesvervangers? Analyse van de voedingswaarde van vleesvervangers in vergelijking met dierlijke vleesproducten. 2023.
- Deborah Winkel GH.** Hoe zout zijn vleesvervangers in de Nederlandse supermarkt? : Nierstichting; 2020.
- Organization WH.** Plant-based diets and their impact on health, sustainability and the environment: a review of the evidence: WHO European Office for the Prevention and Control of Noncommunicable Diseases. 2021.
- Consumentenbond.** Test gezondheid plantaardige kaas 2021 [Available from: <https://www.consumentenbond.nl/voedingstests/test-plantaardige-kaas>.
- PotatoCheezz.** PotatoCheezz Website 2024 [Available from: <https://www.potatocheezz.com/>.
- Voedingcentrum.** Vleesvervangers [Available from: <https://www.voedingcentrum.nl/encyclopedie/vleesvervangers.aspx>.
- Khandpur N, Martinez-Steele E, Sun Q.** Plant-Based Meat and Dairy Substitutes as Appropriate Alternatives to Animal-Based Products? *The Journal of Nutrition*. 2021;151(1):3-4.
- Macdiarmid JI.** The food system and climate change: are plant-based diets becoming unhealthy and less environmentally sustainable? *Proceedings of the Nutrition Society*. 2021:1-6.
- Fardet A, Rock E.** Ultra-Processed Foods and Food System Sustainability: What Are the Links? *Sustainability*. 2020;12(15):6280.
- Astrup A, Monteiro CA.** Does the concept of “ultra-processed foods” help inform dietary guidelines, beyond conventional classification systems? NO. *Am J Clin Nutr*. 2022.
- Marino M, Puppo F, Del Bo C, Vinelli V, Riso P, Porrini M, et al.** A Systematic Review of Worldwide Consumption of Ultra-Processed Foods: Findings and Criticisms. *Nutrients*. 2021;13(8).
- Cordova R, Viallon V, Fontvieille E, Peruchet-Noray L, Jansana A, Wagner K-H, et al.** Consumption of ultra-processed foods and risk of multimorbidity of cancer and cardiometabolic diseases: a multinational cohort study. *The Lancet Regional Health - Europe*. 2023.

With its products and ingredients, Royal Cosun contributes to the growing demand for plant-based food and food ingredients. Examples include: Tendra®, a high-quality protein isolate derived from fava beans that is used in plant-based dairy and meat alternatives; Inulin, a dietary fibre that grows naturally in the chicory root that contributes to a higher fibre content and calorie reduction in a product; Fidesse®, a functional ingredient for meat substitutes made from sugar beet pulp; Potato Cheezz®, a salt and fat-free plant-based cheese substitute made from potatoes.

