



SPECIAL ISSUE: CLIMATE CHANGE AND HEALTH IN THE NORDIC COUNTRIES

What is a sustainable diet in the Norwegian context?

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Abstract

Introduction: Sustainable diets promote health and wellbeing and have low environmental impact. They should be accessible, affordable, safe, equitable and culturally acceptable. Translating these general principles into Norwegian-specific dietary recommendations is essential, as foods beneficial for health tend to also be environmentally sustainable. Following the dietary recommendations is an important step towards sustainability. **Aim:** To identify challenges and potential solutions for transitioning towards more sustainable diets in Norway. **Methods:** We used scientific articles, reports, policy documents, and statistics on Norwegian food production and consumption to discuss a sustainable diet in a Norwegian context. **Results and discussion:** There is a large gap between dietary guidelines and actual consumption. More than 60% of the calories in the Norwegian diet are based on imported foods and feed. Changing people's diet is identified as central in transforming the food system to become more sustainable, as is prioritizing the use of local resources. Good animal health and welfare are also fundamental premises for a sustainable food system. **Conclusions:** Transitioning to a more sustainable diet requires comprehensive efforts at multiple levels. There is considerable room for action to increase the use of Norwegian resources in a sustainable and responsible way. Potential strategies include reducing meat intake in favour of plant-based foods and fish, consuming more local products, decreasing food waste and supporting agricultural practices that promote environmental and social sustainability. A more sustainable diet may also lead to significantly increased self-sufficiency and food security in Norway.

Keywords: Dietary recommendations, Norway, sustainability, climate, environment, self-sufficiency

Background

Today's diet in Norway is not sustainable from a health, environmental or social perspective [1,2]. In 2019, the Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO) published 16 principles for a sustainable diet [3] and defined a sustainable diet as follows (shortened):

Sustainable Healthy Diets are dietary patterns that promote all dimensions of individuals' health and wellbeing; have low environmental pressure and impact;

are accessible, affordable, safe, and equitable; and are culturally acceptable. Sustainable Healthy Diets achieve optimal growth and development of all individuals and support functioning and physical, mental, and social wellbeing at all life stages for present and future generations; contribute to preventing all forms of malnutrition (i.e. undernutrition, micronutrient deficiency, overweight and obesity); reduce the risk of diet-related non-communicable diseases; and support the preservation of biodiversity and planetary health. Sustainable healthy diets must combine all the dimensions of sustainability to avoid unintended consequences.

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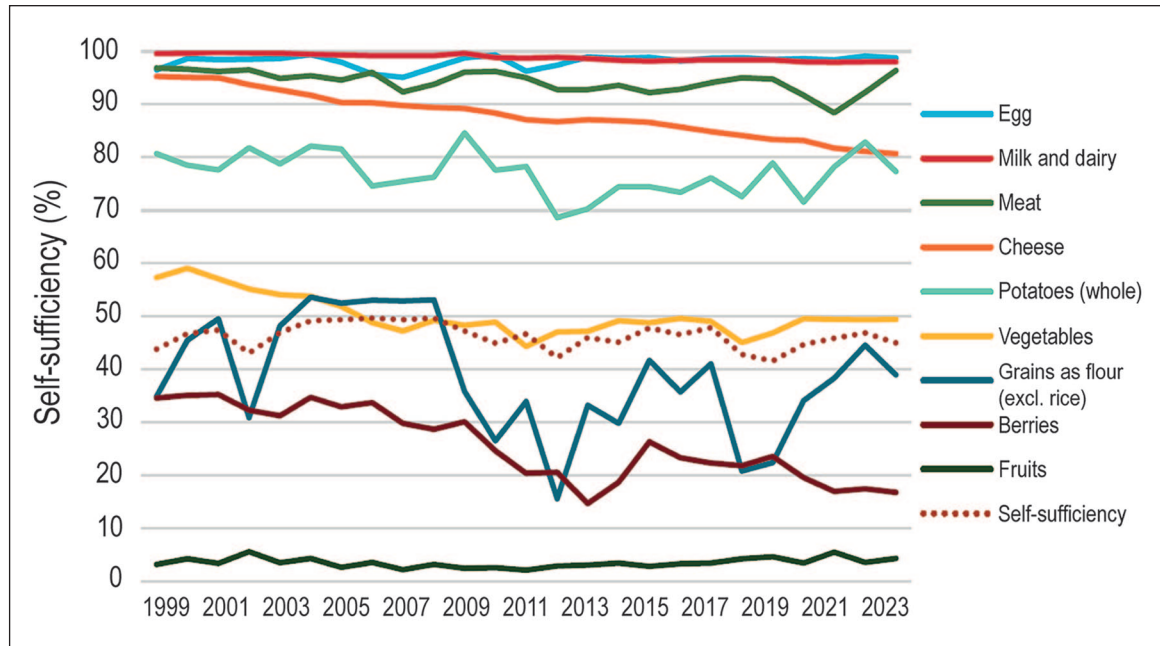


Figure 1. The self-sufficiency rate, excluding the import of feed ingredients, in Norway over the past 25 years, reproduced with permission from the authors [9,10]. In 2023, the self-sufficiency rate was 45% (39% when corrected for the import of feed ingredients) [11]. The self-sufficiency rate for fish (not included in the figure) was 80% in 2023 [9]. excl.: excluding

The definition and principles of FAO/WHO are of a general nature. Each country must adapt dietary advice to local conditions, available resources and food culture [4,5]. Therefore, knowledge is needed about local prerequisites and adaptations in Norway. This is challenging when many considerations must be taken into account, and conflicts often arise between different goals and dimensions. Large consensus exists among different professional communities regarding the need to change our diet; however, there is often disagreement about which considerations should weigh the heaviest, and therefore which diet can be considered the most sustainable.

In Norway, the debate on a more sustainable diet has largely focused on how much meat we can consume, that we should eat more domestically produced food and increase self-sufficiency. The debate reflects increasing pressure on resources, greater crop variations, price fluctuations and higher political conflict levels globally [6–8]. Currently, self-sufficiency is just below 40% of the calories when the import of feed ingredients is taken into account (Figure 1 [9–11]). This means that around 60% of food consumption is either imported or produced with imported feed ingredients for livestock and aquaculture. The climate and environmental footprint of the food we eat can therefore be significant in the countries we import from [12,13].

Norwegian dietary guidelines have so far been based on optimal health. The revised Norwegian dietary guidelines, to be published later in 2024, are also based on the health effects of diet, but with the assistance of the Norwegian Environment Agency, each of the guidelines has an additional paragraph incorporating climate and environmental aspects [14]. The climate footprint of food is given great emphasis, but also the feed situation, water consumption, deforestation, carbon storage, use of pesticides, biodiversity, erosion, disease spread and chemical emissions are mentioned. The benefits of consuming locally produced food are only mentioned in connection with fruits and vegetables, highlighting lower transport emissions and less food waste [14]. In 2017, the Norwegian Nutrition Council published a report showing significant alignment between what is good for health and what is good for the environment [15], which was also confirmed in 2023 by the new Nordic Nutrition Recommendations (NNR2023) [16]. Following the dietary guidelines will therefore be an important step towards sustainability.

Aims

The Centre for Sustainable Diets at the Norwegian Institute of Public Health, by the authors of this article, aims to identify the challenges and potential solutions for shifting the diet in Norway in a more

sustainable direction. We emphasize food security and our resource base; in other words, the types of food that Norway can produce for its own population, as a starting point for how the diet can be shaped. The article can complement the new Norwegian dietary guidelines by addressing topics that are not specifically covered there, such as self-sufficiency, food safety, animal health and welfare, food waste and organic food. Our primary focus is on the connections between the dietary guidelines and the environmental and climate dimensions of sustainability. This is justified by these sustainability dimensions being addressed in NNR2023 and the draft of the new Norwegian dietary guidelines. We do not include a comprehensive discussion of the other dimensions (social, economic and governance) that would otherwise be part of a comprehensive exploration of the links between diet and the impact of the food system on sustainability [17].

Methods

The first three authors compiled this review summarizing international and Norwegian scientific articles, reports and policy documents, as well as statistics on Norwegian food production and consumption. A systematic literature search was not conducted to cover this broad theme. The article was further developed through active interaction with co-authors and resulted in a discussion of what a sustainable diet in Norway could entail. In Norway, concrete dietary guidelines and food safety warnings are provided by the Norwegian Directorate of Health and the Norwegian Food Safety Authority, respectively.

The article includes three factual boxes, available in the Supplementary material online:

- Explanation of terms and phrases;
- Examples of dietary guidelines in other countries that incorporate sustainability;
- Nordic and European Union's (EU) goals relating to sustainable diets.

Results and discussion

Norwegian challenges must be viewed in connection with global challenges. In the following text, we start with the global perspective. We then describe current challenges and opportunities regarding Norwegian dietary habits, food production, self-sufficiency and the importance of food for animal welfare, and briefly touch on social and economic aspects for producers and consumers. We want to emphasize that the topics we address do not necessarily provide a complete

picture of the international or national situation, as food systems are vast and highly complex.

The global perspective

Global factors are relevant for understanding the Norwegian food system and how it needs to change to become more sustainable. The diet in Norway relies heavily on imported food and feed resources. Therefore, a fundamental issue for a sustainable Norwegian food system lies in determining how to base the diet more on Norwegian resources, while minimizing carbon leakage – where emissions decrease in Norway but increase in other countries [18].

The world is exceeding planetary boundaries [19] and food production is a significant contributor to human impact on climate and nature [20,21]. Globally, food production accounts for 25–35% of all greenhouse gas emissions [22–24]. Deforestation and the destruction of wilderness for agriculture have been and continue to be the primary drivers of reduced biodiversity worldwide [25]. Globally, 44% of the Earth's inhabitable land is used for agriculture, nearly twice as much as in the year 1900 [26]. Livestock production currently occupies about 80% of this area and, together with fish farming, contributes 17% of the calories to human consumption, while plant-based foods occupy about 16% of the area but contribute 83% of the calories [26].

Approximately 40% of all grain grown in the world is used directly for human consumption. An equal amount is used for animal feed, and the remainder is used for purposes such as alcohol production and biodiesel [27]. Although there is enough food globally to meet current and future energy and protein needs [27], factors such as the redistribution of resources for animal feed, food waste and unequal access to food, as well as war, conflict, poverty, climate-related weather challenges and loss of arable land, mean that nearly 800 million people today are living on the brink of hunger [28].

Climate and environmental challenges present many dilemmas and trade-offs. The overall environmental impact of different food items is assessed differently depending on how the parameters involved in the assessment are weighted. Food items with low greenhouse gas emissions, for example, may require a significant amount of water, pollute the local environment, or be produced under poor working conditions. In contrast, food items leading to high greenhouse gas emissions, such as meat from ruminant animals, can contribute to food production using Norwegian resources that support jobs and preserve cultural landscapes [17].

Norwegian dietary habits

We know a lot about what constitutes a healthy diet, as expressed in the dietary guidelines from 2016 [29] and the upcoming dietary guidelines [14]. However, a challenge lies in the significant gap between what the guidelines recommend eating and what the population actually consumes. For example, only about 15% of people consume fruits and vegetables in line with the recommendations [30], and especially young men eat far more red meat than recommended [31].

Currently, Norwegians consume much more protein than necessary for good health, and meat is a key driver of this high intake. We need around 0.8 g of protein per kilogram of body weight daily, but the average intake in Norway is nearly double that [31]. Meat consumption has more than doubled since the 1950s [32]. Back then, milk and dairy products provided twice as much protein as did meat, but today, it is the reverse [33]. The increased consumption of white meat (poultry) and pork has been driving the rise in Norwegian per capita meat consumption over the past 20–25 years, while the consumption of meat from ruminant animals has remained stable [32].

Deviation from dietary guidelines is a significant contributor to overweight, obesity, non-communicable diseases and loss of healthy years of life [34]. In Norway, one in four adults is obese [35], and one in six children and adolescents is overweight or obese [35].

Animal products account for about 37% of the calories in the Norwegian diet, distributed among dairy products (20%), meat (13%), eggs (2%) and fish (2%) [9]. Although meat is an important source of high-quality protein, vitamins and minerals (but also saturated fat) [31], from a health perspective it is possible to replace some of the meat intake with plant-based foods without compromising protein requirements. Consumer surveys show that Norwegians' meat consumption has levelled off and slightly declined in the period 2022–2023 [36], which may indicate that more people are concerned about reducing their consumption [37].

Norwegian food production and self-sufficiency rate

Norway seemingly has limited agricultural land since only 3% of the total land area can be used for this purpose. However, with low population density, we have 0.15 hectares of arable land per capita, according to the World Bank, which is at the global median, and more than major food exporters such as New Zealand, the Netherlands and Israel [38]. Today, 90% of Norwegian agricultural land is used to cultivate animal feed, including most of the cereal crops

[29]. However, approximately half of the cultivable land is primarily suitable for grass production [40,41]. Therefore, ruminant animals such as cows, sheep and goats are needed for efficient resource utilization.

Large areas in Norway are not suitable as agricultural land but can be used as outfield pastures [42]. However, the grazing season for outfield pastures is only 2–6 months. This means that a large percentage of winter feed occupies the cultivated lands [43]. If overgrazing is avoided, ruminant animals can help maintain cultural landscapes by reducing overgrowth, which is important for many endangered plant and animal species.

Meat from ruminant animals is, however, associated with significantly higher emissions of greenhouse gases, particularly methane, than meat from monogastric animals such as chickens and pigs [44,45] (Figure 2 [22,46,47]). Emissions also increase with higher proportions of roughage (e.g. grass, hay and straw) that ruminant animals consume [48]. However, meat production from Norwegian cows used for both milk and meat production ('combination cows') has lower climate footprint than production from pure beef cattle (suckler cows) because the emissions are distributed between the meat and the milk, as shown in Figure 2. According to the Centre for International Climate Research (CICERO), reduced meat consumption can make a significant difference for the climate, as meat consumption in Norway accounts for 46% of the greenhouse gas emissions related to our diet [49].

Scientists at the Norwegian Institute of Bioeconomy Research (NIBIO) have also calculated that the climate footprint of Norwegian food production could be significantly reduced if we decrease our intake of red meat [50,51]. Three national reports – NIBIO's *Climate cure 2030* report [52], the report from the Norwegian 2050 Climate Change Committee [46] and the Norwegian Environment Agency's report *Climate measures in Norway* [53] – all highlight that reducing meat consumption in favour of fish and plant-based food is one of the most cost-effective climate measures in Norway. Plant-based foods are much less land-intensive and usually have significantly lower carbon footprints than meat and dairy products [46].

Although Norway is mainly self-sufficient in meat, eggs and milk, excluding feed ingredient imports, this varies from year to year (Figure 1). Some meat is imported through trade agreements from countries such as Namibia, but most imported meat comes from Germany and Denmark. In 2022, approximately 10% of the total meat consumption (around 30,000 t) was imported [36]. About 50% of the

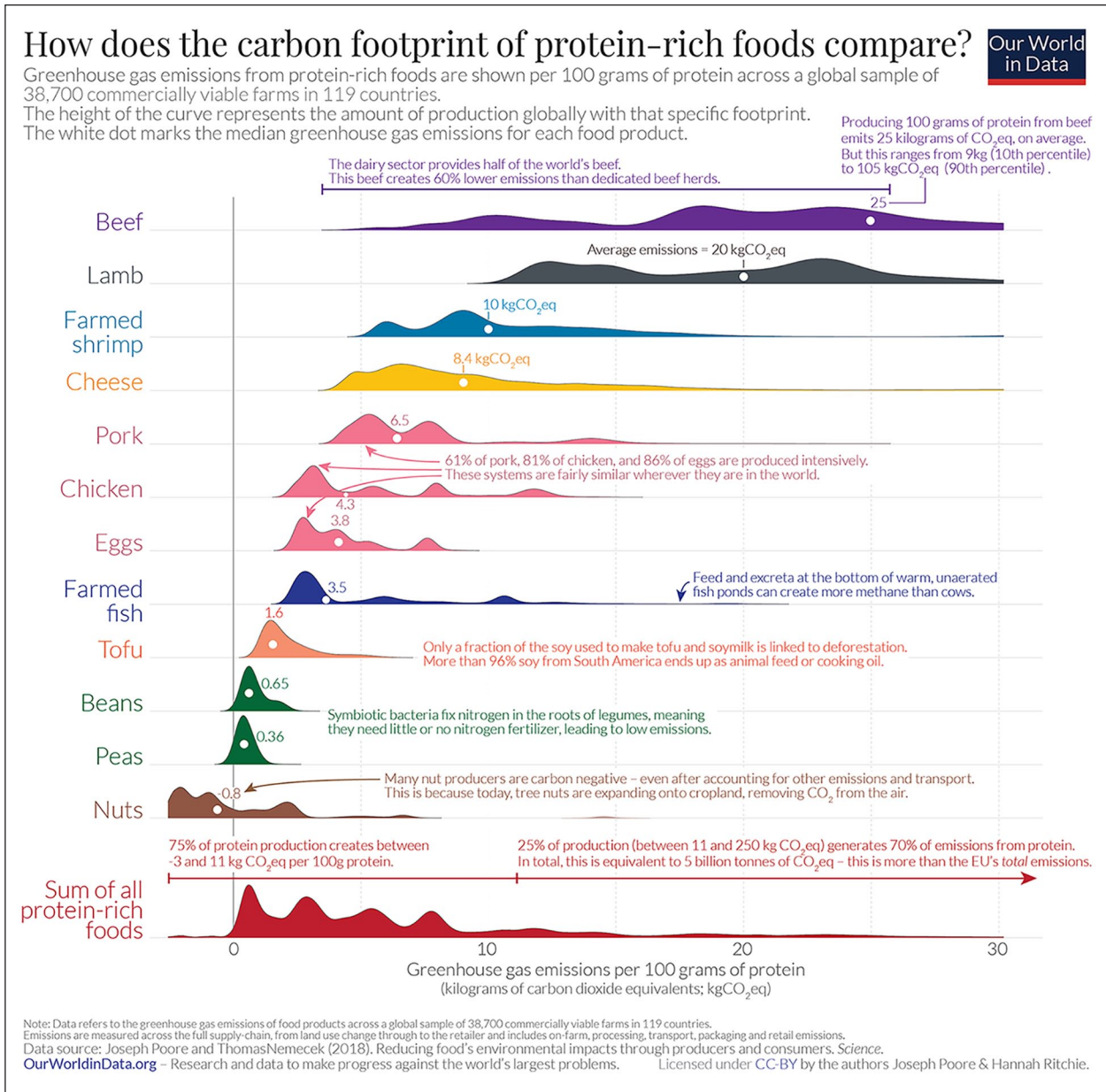


Figure 2. Greenhouse gas emissions for different food products, reproduced with permission from the Ministry of Climate and Environment [46]. The numbers are from 38,700 farms and aquaculture sites in 119 countries. Bread and cereal products are not included in the figure, but they have a very low carbon footprint [22]. Source material for the figure: Poore and Nemecek [22] and Ritchie [47].

vegetables we consume are produced in Norway, but only about 5% of the fruit [9,32].

The self-sufficiency rate of cereal crops varies from year to year depending on temperature and other weather conditions, ranging from over 85% in good years to under 30% as in 2023 due to drought in the early summer and heavy rain in the autumn, or as in the summer of 2018 with severe drought throughout the season [9,54]. Approximately 85% of domestically grown grain is used for animal feed, often because it does not meet quality requirements or has too high

levels of mycotoxins for human consumption [55]. There is an ongoing discussion about lowering the protein content requirements in bread wheat so that more of the grain can be used for human food [56]. There is significant potential to increase the production of barley and oats for human consumption in Norway [57]. Norway has high production of both wild-caught and farmed fish and seafood, and most of it is exported [58]. The consumption of fish and seafood can be greatly increased as an important contribution to our national food security [11].

Norway has a high import of feed ingredients, including fat, carbohydrate and protein raw materials, for both livestock and fish farming. Although rapeseed cakes are now the most important protein feed ingredient [29], the annual soybean import for current livestock (as of 2022: 113,383 t) could cover approximately 50% of the basic protein needs of the Norwegian population. This illustrates a global sustainability issue regarding human food versus animal feed. Increasing the share of Norwegian raw materials in feed has been investigated [59] and is part of the objectives in several research projects, including the ‘Foods of Norway’ project at the Norwegian University of Life Sciences [60]. A prerequisite is that unused resources are utilized, such as insects fed with waste, rather than raw materials that can be directly used for human food.

A Norwegian report from 2014 calculated the amount of meat it would be possible to produce in Norway if only Norwegian resources were available, illustrating that such a scenario would require radical changes in the diet towards more fish and plant-based food [59]. Recently, new forms of livestock production, such as ‘livestock on grass and leftovers’, have been discussed [60–62]. This approach aims to limit meat, milk and egg consumption to what can be produced using available grass resources, by-products of plant production, and food waste [63–65].

There is significant room for increasing plant production for human consumption, reducing dependence on imported food and feed ingredients, and increasing the utilization of Norwegian feed resources in an ecologically sustainable manner that preserves soil and nature [9,36]. For example, we have the land and resources to increase potato and vegetable yields by 5–6 times [51]. However, this must be balanced against the necessity of maintaining trade relationships to ensure food security when Norwegian crops are affected by drought or floods, such as in 2018 and 2023 [8,66]. Coffee, tea, bananas, oranges and similar products will always be imported because they cannot be produced at our latitudes, so achieving a self-sufficiency rate close to 100% is not possible.

Animal welfare

Good animal health and welfare are fundamental to a sustainable food system and are rooted in social and economic sustainability by addressing societal norms and ethics, in addition to natural science and veterinary medicine. In Norway, we have strict regulations with provisions that promote good animal welfare and respect for animals [67]. Animal welfare in Norway is generally good, and the health of land animals is among the best in the world, with low antibiotic consumption and a low incidence of antibiotic

resistance [68,69]. However, a significant number of breaches of animal welfare regulations have been uncovered [70], and there may be challenges associated with outbreaks of avian influenza and other diseases [71]. Consumers state that animal welfare is a very important factor when they purchase food [72], but research shows that animal welfare often loses out to economic considerations [73].

Fish farming has ongoing challenges with diseases and poor fish welfare leading to high mortality. The Norwegian Fish Health Report 2023 revealed a record-high mortality rate for salmon, in terms of both numbers and percentage [74]. The government is working on a new white paper on animal welfare, expected in 2024 [75].

Organic and regenerative agriculture

Internationally, there is an ongoing debate about whether organic production is more sustainable than conventional production. Organic food is produced without chemical pesticides and has stricter requirements for animal welfare than conventional production [76]. Globally, for organic meat and milk, the carbon footprint is roughly the same as conventional production [44]. Organic plant production, on average, yields about 20% lower crop yields and will therefore require more land to produce the same amount and type of food [76]. Conventional farming methods are harmful to many aspects of the environment, and in several contexts they are less resilient to new climate challenges than more ecologically based farming systems [77]. With reduced meat consumption and less food waste, organic production can still provide enough food for everyone without changing the land requirements [78–81]. Regenerative agriculture, as a compromise between organic and conventional, utilizes many of the same methods as organic but allows some use of mineral fertilizers. Both methods are associated with greater biodiversity, but regenerative agriculture maintains higher production levels [82].

Social and economic considerations

It is a human right to have access to enough safe and healthy food, and Norway, like all other countries, has an obligation and a right to ensure food supply for its own population through the best possible use of national land resources and local cycles. The food sector provides significant employment in primary industries, processing, wholesale and retail. Food production in Norway sustains jobs and settlement in rural areas, which is a political goal and holds important social value. Significant investments have been made to streamline production, particularly in the

livestock sector, making any changes in production resource-demanding [83,84]. Ensuring decent living conditions, working conditions and framework conditions for primary producers is important, while also realizing a shift towards more plant-based agricultural production.

The price of food is among the most influential factors in determining what we eat [85]. In Norway, households with low incomes spend a considerably larger portion of their income on food compared with households with higher incomes [86] and are severely affected by increased food prices [87].

Fact box. Goals and measures in Norway.

Policy reports and government publications, committees and commissions have investigated Norway's climate and environmental situation and described goals, strategies and measures [46,52,89–91]. Norway has 24 climate and environmental goals divided into six main areas: biodiversity, cultural heritage and environment, outdoor recreation, pollution, climate, and polar regions [92]. The goal is to reduce greenhouse gas emissions by 50–55% by 2030 compared with 1990 levels. The biodiversity goals focus on ecosystem preservation, species conservation, and safeguarding Norwegian nature for future generations. War in the European region, weakened supply chains, and climate change with drought in key import countries have brought Norway's low self-sufficiency rate into focus [13,93]. In the spring of 2024, the government increased the goal for Norwegian self-sufficiency from approximately 40% to 50% [11,94].

Three different reports published in 2023 support the government's decision to increase food self-sufficiency:

1. The report *Now it's serious* from the Total Preparedness Commission (Totalberedskapskommisjonen) highlighted that increased Norwegian food production and self-sufficiency are important measures for overall food security [95].
2. The Office of the Auditor General's (Riksrevisjonen) report *Food security and preparedness in agriculture* concluded that there is a need for increased national grain production. The report also stated that it is deplorable that agricultural land resources are not being managed in a fully sustainable manner, including the significant conversion of high-quality agricultural land to other uses. The report also highlighted deficiencies in food emergency planning [13].
3. A report by Oslo Economics examined the vulnerability of global food supply chains. The main finding was that Norwegian supply lines are robust, but there is high and increasing dependency on international trade [93].

Reports on a more sustainable food system include *Climate action 2030*, which focused on reducing greenhouse gases and concluded that 'Transition from red meat to plant-based diets and fish and reduced food waste are effective measures' [52]. Norway's goal is to halve food waste between 2015 and 2030. The government-appointed Food Waste Committee, with representatives from the food industry and interest groups, has proposed measures throughout the value chain and a food waste law [96].

The 2050 Climate Panel assessed Norway's choices to become a low-emission society by 2050 and published its report in 2023 [46]. A whole chapter was dedicated to the food system, and one of many concluding pieces of advice was 'Reduce the production and consumption of emission-intensive products such as meat.' In February 2024, Norway's Nature Risk Commission (Naturrisikoutvalget) published the report *In harmony with nature* [97]. The report described what natural risk is, assessed how actors in Norway and society could be affected by the loss of nature and described how actors in the public and private sectors can analyse and handle natural risk in the best possible way. In April 2024, the Norwegian Environment Agency published the report *Climate measures in Norway* [91], which also emphasized the importance of dietary changes and reduced food waste.

The new Norwegian dietary guidelines in a sustainability perspective

Norway has good conditions for a broad transition towards a more sustainable diet and, in this context, the Centre for Sustainable Diets proposes that the climate and environmental aspects of the new dietary guidelines be further emphasized. The following discussion is based on each of the dietary guidelines (which are currently under review), focusing on the climate and environmental aspects, while also suggesting an emphasis on dimensions such as self-sufficiency, food safety, animal welfare, food waste and food security.

Dietary guideline: have a varied diet, choose mostly plant foods, and eat with joy. In the dietary guidelines draft, it is emphasized that plant-based food generally has a lower climate and environmental impact, including protein-rich varieties such as beans, nuts and seeds (Figure 2). It is recommended to use plant oils in cooking.

Food waste

Approximately 450,000 t of edible food is wasted annually in Norway [88]. Reducing food waste can contribute to significant emissions reduction [46,52]. A food system adapted to a circular economy emphasizes measures to prevent food waste, redistributes excess edible food for human consumption, and transforms other useful food and food waste into byproducts and new products. Such a transformation is essential for addressing climate change and preserving soil and biodiversity.

The following additional elements should be considered from a sustainability perspective:

1. A varied diet ensures a broad nutrient intake while reducing the risk of high intake of specific environmental or natural toxins from individual foods. In Norway, food is the main source of several environmental contaminants [98,99].
2. Vegetable oils such as rapeseed and sunflower oil have low carbon footprints [16], and there is significant potential for rapeseed cultivation in Norway [100].

Dietary guideline: fruit or vegetables should be a part of every meal. The draft dietary guidelines mentions that fruits and vegetables have low greenhouse gas emissions per kilo, but there are challenges related to pesticide use and biodiversity. Choosing Norwegian grown and storable vegetables is also highlighted in the draft [14].

The following additional elements should be considered from a sustainability perspective:

1. Increased consumption of crops that Norway can efficiently grow will reduce the need for imports. Vegetables grown in open fields in Norway, such as potatoes, turnips, celery, carrots, beets, onions, lettuce, cabbage and kale, are healthy and climate-friendly choices. Blanching and freezing of non-storable vegetables like cauliflower, broccoli or beans should be promoted. Storage technology exists that can enable the sale of Norwegian apples throughout the year [101]. Such technology can increase the proportion of domestically produced fruits and vegetables in the future.
2. Calculations indicate that producing vegetables in heated greenhouses in Norway may result in lower emissions than importing vegetables, as some Norwegian tomato productions demonstrate [102]. A prerequisite is that the heating source is renewable and climate-friendly [103]. Approximately 65% of end-use of energy in Norway is presently renewable, the share steadily increasing [104].
3. Imported fruits and vegetables may involve challenges such as high water consumption, pesticide use and poor working conditions in the producing countries [105]. Results from the Norwegian Food Safety Authority's annual monitoring programme show fewer pesticide residues in domestically produced food compared with food from the EU and non-EU/EEA countries [106].
4. Utilizing local and seasonal foods reduces transport and supports local economies. One example is the use of farmers' markets, which can lead to an increased supply of fresh, locally produced vegetables, even though national production volume is still small [107]. An increase in Norwegian production of vegetables and food grains is primarily dependent on farmers having delivery opportunities and a viable economy for such production [51,108]. In practice, large producers located near major reception and packaging facilities controlled by Bama (owned by Norgesgruppen and Rema 1000) or Coop account for the majority of deliveries.
5. The total amount of wild berries (blueberries and lingonberries) in Norwegian forests is estimated at between 120,000 and 220,000 t annually [109], which is enough to cover two out of the 'eight a day' recommendation [110]. Approximately 90–95% of the berries are left unpicked in the Nordic region every autumn

[111]. Therefore, the consumption of wild berries could be at least doubled.

Dietary guideline: include whole grain bread or other whole grain products in multiple meals every day. The dietary guidelines draft emphasize that grains are climate- and environment-friendly but propose alternatives to rice based on their impact on climate and biodiversity [14].

The following additional elements should be considered from a sustainability perspective:

1. Norway aims to increase food self-sufficiency from 40% to approximately 50%, as stated in the Fact box [11,94]. According to Ruralis, CICERO and NIBIO, this can be most easily achieved by increasing the proportion of domestically produced cereal grains in flour [9,112].
2. Rice has a higher carbon footprint and water consumption compared with other grain varieties [113], and it contains inorganic arsenic, which is carcinogenic [114]. Encouraging higher consumption of Norwegian grain varieties such as barley, oats, rye and spelt can be beneficial, but this must be done within safe limits for levels of mycotoxins, especially deoxynivalenol, which may increase with climate change [55,115,116].

Dietary guideline: fish and seafood, beans and lentils, and lean meat are good sources of protein – vary among these. Choose lean red meat and limit processed meat. The draft dietary guidelines mention that plant-based proteins have lower greenhouse gas emissions than animal-based proteins, and emphasize that seafood, eggs and poultry are the most climate-friendly animal-based foods. They also state that wild fish should be preferred, and the amount of red meat limited for climate and environmental reasons.

The following additional points should be considered from a sustainability perspective:

1. Historically, fish has been a very important part of the Norwegian diet, especially along the coast. Consumption today is far below recommended levels. Measures to increase consumption of sustainable wild-caught fish or environmentally certified farmed seafood by reputable organizations, are beneficial. Fish and seafood have low greenhouse gas emissions, but there are still issues related to the environment and animal welfare in fishing and aquaculture [117,118].
2. Fish and seafood can be an important source of environmental contaminants, but the

Norwegian Scientific Committee for Food and Environment (VKM) concluded in its most recent benefit and risk assessment of fish that ‘the benefits of increasing the intake of fish up to the recommended two to three dinner meals per week (equivalent to 300–450 grams, including at least 200 grams of oily fish in adults) outweighs the risk’ [119].

3. There is potential to increase production and consumption of legumes that can be grown in Norwegian conditions, such as field beans and peas. Peas have been cultivated in Norway for at least 800 years, and climate change is expected to increase cultivation potential.
4. Meat can represent important cultural traditions and to some extent good environmental management, such as utilization of marginal land, for example, grazing land, and by-products from the industry. However, animal products, especially ruminant meat, have high carbon footprints (Figure 2) and feed production requires large land areas.
5. Sustainable meat consumption should include good animal welfare and better utilization of the entire animal. Sheep, laying hens, and goats are used to produce lamb, eggs and goat cheese and are seldom consumed by people in Norway today. Increased use of such meat can also reduce food waste [120].

Dietary guideline: have a daily intake of milk and dairy products. Choose products with less fat. The draft dietary guidelines states that dairy products have relatively high greenhouse gas emissions, and that production requires large land areas in Norway and abroad (through imported feed), but also that grazing can have positive effects on biodiversity. Plant-based drinks have lower climate and environmental impacts and can be good alternatives (except for rice drink) [14].

The following additional point should be considered from a sustainability perspective:

1. Milk and dairy products contribute important nutrients to the Norwegian diet but should be consumed in moderation. Milk in a sustainable Norwegian diet should be based on the sustainable utilization of Norwegian feed and grazing resources [42].

Dietary guideline: food and drinks high in salt, sugar or saturated fat should be limited. The draft dietary guidelines highlight that coffee, tea and cocoa should be limited as they can have a negative impact on biodiversity [14].

The following additional point should be considered from a sustainability perspective:

1. Restricting the intake of energy-dense and nutrient-poor foods should primarily be done based on health concerns, but the production of raw materials, such as sugar and palm oil, often occurs in large monocultures that have a negative effect on biodiversity and occupy land that could be used differently [121].

Closing remarks

Great tensions exist between optimizing local supply and production conditions for the more resourceful social strata globally, and reducing the significant social and economic injustice that leads to widespread malnutrition and nearly 800 million people suffering from hunger. Norway’s reliance on low self-sufficiency contributes to environmental degradation and social and economic injustice in other countries. This is an example of a goal conflict related to all dimensions of sustainability that has been inadequately addressed.

In general, a sustainable diet in Norway involves (1) consuming lower on the food chain, that is, more plant-based food, (2) consuming less meat, (3) consuming more fish, especially sustainably harvested wild fish, (4) reducing food waste and (5) consuming more Norwegian or locally produced food.

Shifting the population’s diet towards a more sustainable direction will be an important component of a more sustainable food system. Everyone can contribute to this by following the dietary guidelines, with additional considerations as shown above. At a structural level, considering the three dimensions of sustainability – environment, social conditions and economy – in an integrated manner will be necessary. When doing so, many dilemmas will arise, and giving equal weight to all dimensions will likely not be possible. To make the diet and the entire food system more sustainable, structural measures will be necessary at multiple levels, and the use of price mechanisms and regulations may be considered [85]. At the societal level, making the necessary trade-offs is a political responsibility.

Authors’ note

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Declaration of conflicting interests

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