

Review Article

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Towards more balanced dietary guidelines: connecting climate, culture, and nutrition

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Abstract

Objective: The transformation of food systems has emerged as a critical component of global climate action, with food-based dietary guidelines (FBDGs) increasingly recognised as a key policy tool to promote both public health and environmental sustainability. However, despite their importance, many national FBDGs fail to integrate sustainability considerations or adequately support diverse plant-based dietary patterns. **Design:** This review proposes a socioecological framework for enhancing the inclusivity and adaptability of FBDGs, enabling them to better reflect evolving food systems and consumer behaviours while strengthening their role in promoting sustainable and health-conscious diets. **Results:** Five key gaps in current FBDGs worldwide were identified: (1) the need for more inclusive food-group classifications that accommodate plant-based protein sources; (2) clearer recommendations for limiting the consumption of animal-sourced foods (ASF) for health and environmental reasons; (3) guidance on obtaining essential macro- and micronutrients from plant-based sources; (4) the inclusion of plant-based alternatives to ASF within dietary recommendations; and (5) comprehensive advice on well-planned vegetarian and vegan diets. **Conclusion:** Addressing these gaps is crucial to ensuring that FBDGs remain relevant to a broad spectrum of dietary preferences, including those motivated by ecological, ethical, religious, and cultural factors.

In 2023, the United Nations Climate Change Conference (Conference of the Parties (COP)) Presidency moved food-system transformation firmly onto the global climate-change agenda. In this context, countries are urged to put food systems at the centre of their climate ambitions⁽¹⁾. To improve the sustainability of food systems, governments can use various policy instruments. The Intergovernmental Panel on Climate Change (IPCC), as well as the the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) describe food-based dietary guidelines as one of the important instruments to mitigate climate change in the food sector while also improving public health outcomes^(2,3). As an information-based tool, national food-based dietary guidelines (FBDGs) form the basis for the development of numerous food, agricultural, and public health policies⁽⁴⁾. They provide advice to citizens about healthy eating and serve as an information source for dietitians and health professionals. Furthermore, FBDGs form the basis for catering recommendations in institutions such as kindergartens, schools, company canteens, and hospitals^(4,5).

Despite the important socio-political relevance of dietary guidelines, large-scale international evaluations have shown that governments are lagging behind in integrating health and sustainability goals into FBDGs^(6–8). Moreover, FBDGs have been criticised for not being culturally responsive and sufficiently relevant^(9–11).

The FAO and WHO defines sustainable healthy diets as ‘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’⁽³⁾. In a joint statement published in 2024, the FAO and WHO urged all governments to develop (or update) their national FBDGs and to support healthy dietary patterns for all from sustainable agrifood systems⁽¹²⁾.

In this context, the need to shift to more plant-based diets and food systems is increasingly evident^(13–20). While animal-sourced foods (ASF) can represent an important nutrient source, overconsumption, and intensive animal agriculture also contribute to the major global challenges that humanity is currently facing, including climate change and biodiversity loss, animal welfare, and public health^(13–15,21,22). The environmental impact of food production varies significantly by food type^(15,16,23). The livestock sector is known to have the greatest environmental impact, contributing to higher greenhouse gas emissions (GHGE), greater land and nitrogen use, and substantial negative effects on biodiversity^(14–16). It is estimated that the livestock sector accounts for about 20 % of global GHGE, with ASF responsible for close to 60 % of food-related emissions⁽¹⁶⁾. In addition, overconsumption of ASF – in particular red and processed meat – is associated with an increased risk of obesity, CVD, type 2 diabetes, and some forms of cancer^(13,18–20,24).

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As a result, plant-based dietary patterns are widely supported by professional and medical organisations and societies^(25–29). Plant-based dietary patterns exist on a spectrum from flexitarian to vegetarian to vegan⁽⁹⁾. While vegetarian and vegan diets exclude some or all animal-sourced foods (ASF) respectively, in flexitarian diets ASF are generally reduced without eliminating them completely⁽³⁰⁾. Plant-based diets are considered particularly healthy and sustainable if they are based mainly on vegetables, fruits, legumes, and whole grains, as well as nuts and seeds⁽¹³⁾.

However, large-scale evaluations show that current dietary guidelines primarily promote the consumption of ASF. Most guidelines recommend mainly ASF in the protein group^(8,31) and present milk and dairy as a standalone food group without providing any information about alternative food choices⁽⁹⁾. 18 % of FBDGs do not even mention plant-based sources of protein, 30 % do not mention plant-based sources of iron, and 39 % do not discuss plant-based sources of calcium⁽⁹⁾. Ultimately, 60 % of FBDGs contain no position on vegetarian diets (including vegan diets)⁽⁹⁾, even though 1.5 billion people worldwide follow some form of vegetarian diet⁽²⁾. This lack of information poses a problem for people who eat little or no ASF, either by choice or due to economic necessity^(2,9).

In addition to ecological and health-related aspects, ethical considerations and religious or cultural precepts are strong motivators for consuming little or no ASF^(32,33). Concerns about animal welfare have been expressed by consumers around the world as a reason for following plant-based diets^(33–36). And all major religious groups have a long tradition with forms of vegetarian diets, with religious proscriptions often relating to the consumption of meat and other ASF^(37–39). Devout Ethiopian Orthodox Christians, for example, fast for more than 200 d of the year, and include the adoption of a vegan diet⁽³⁸⁾. It is estimated that 44 % of the Ethiopian population adheres to the Ethiopian Orthodox church⁽⁴⁰⁾. While these religious fasting practices might have the potential to reduce the rising prevalence of obesity and associated non-communicable diseases, practitioners need to make well-informed food choices in order to avoid nutritional deficiencies^(38,39). This example highlights the importance of inclusive FBDGs that provide information on the broad spectrum of plant-based diets.

Moreover, foods recommended in FBDGs should be affordable to everyone. Research shows that people in low-income areas consume less ASF, suggesting that these products are often too expensive or simply unavailable^(41,42). A modelling study on food-price data from 150 countries analysed the affordability of different diets and found that vegetarian and vegan diets were generally the most affordable globally⁽⁴²⁾. Given the financial challenges many people face in buying ASF, dietary guidelines must provide clear advice on meeting nutritional needs through plant-based foods. Including more plant-based food options in FBDGs could therefore make recommendations more healthy, sustainable, and affordable to all⁽⁹⁾.

In 2019, independently of the development of national FBDGs, the EAT-Lancet Commission introduced the Planetary Health Diet (PHD) to guide a transformation of the food system towards healthier and more sustainable diets⁽¹³⁾. This global reference diet has a strong plant-based approach and focuses on vegetables, fruits, nuts, whole grains, plant proteins, and unsaturated oils, with limited dairy, meat, and fish⁽¹³⁾. A modelling study published in 2020 compared the potential of 85 national FBDGs with the planetary health diet⁽⁶⁾. It was found that following current national guidelines could reduce premature mortality from diet-

related noncommunicable diseases by 15 % and food-related GHGE by 13 %⁽⁶⁾. However, adopting the EAT-Lancet recommendations could achieve even greater impacts, with 34 % lower premature mortality and over three times the reduction in emissions⁽⁶⁾.

In addition to the strong support for the PHD from the academic community⁽⁴³⁾, this global reference diet has also inspired the recent revision of national FBDGs, including in Mexico⁽⁴⁴⁾, the Nordic countries⁽⁴⁵⁾, and Germany⁽⁴⁶⁾. It is estimated that eating patterns that align with the new Mexican FBDG, published in 2023, could contribute to a substantial reduction of land use and carbon emissions while costing 21 % less than current diets. This is especially the case in Mexico City and other urban areas where there is a higher prevalence of Westernised diets⁽⁴⁴⁾.

While the PHD provides an important framework for sustainable and health-promoting dietary patterns, it has faced criticism regarding potential micronutrient shortfalls⁽⁴⁷⁾. Key areas for improvement include enhancing nutrient bioavailability in plant-based foods, integrating indigenous foods and practices, exploring fortification and supplementation strategies, promoting dietary inclusiveness, addressing gender-based differences, and reconsidering the role of processed foods⁽²¹⁾.

A socioecological framework for advancing dietary guidelines

To ensure that both the PHD and national FBDGs effectively support health within a sustainable food system, further refinement and development are necessary. This review proposes the use of a socioecological framework⁽⁴⁸⁾ to guide the development of more balanced dietary guidelines—ones that account not only for nutritional and environmental considerations, but also for ethical, cultural, religious, and economic aspects influencing people's food choices.

The socioecological framework highlights the dynamic interplay between individual, social, and environmental factors, acknowledging that dietary decisions are shaped by a web of influences operating at multiple levels⁽⁴⁸⁾. Rather than viewing food choices in isolation, this approach situates them within broader social and systemic contexts⁽⁴⁸⁾.

Guided by this framework, five gaps⁽⁴⁹⁾ have been identified in how the current spectrum of plant-based diets is reflected in FBDGs globally. Each of these gaps is described in the following sections, with best practice examples from existing guidelines used to illustrate potential approaches for narrowing them in practice.

Inclusive food groups

Dietary guidelines categorise foods into food groups, with approaches varying from country to country. However, the overarching principle remains the same – each food group should be part of one's diet, but different foods can be chosen within a group. Therefore, the ways in which foods are grouped together is key. Many FBDGs around the world present meat/fish/eggs and milk/dairy as single food groups. This food grouping gives ASF a prominent status and suggests that ASF should be on the daily menu or even part of every meal, and that no plant-based options are suitable as alternatives. This contradicts the current evidence on healthy, sustainable diets. In some cases, it even contradicts other recommendations within the same dietary guideline⁽⁹⁾.

However, some countries have found ways to make food groups in FBDGs more inclusive and suitable for the broad spectrum of plant-based diets. The first option is an inclusive protein group which includes all ASFs along with plant-based protein sources such as pulses, beans, tofu, tempeh, nuts, and seeds. This approach can be found in the FBDG of Canada⁽⁵⁰⁾, Ecuador⁽⁵¹⁾, Fiji⁽⁵²⁾, Namibia⁽⁵³⁾, the Netherlands⁽⁵⁴⁾, Spain⁽⁵⁵⁾, and Switzerland⁽⁵⁶⁾.

The Canadian example is worth taking a closer look at, as the revision of the country's FBDG and the adoption of an inclusive protein group have been well-documented. Canada's public consultation on dietary guidelines took place in two phases, with participation enabled through an online survey on the health ministry's website. In Phase 1 (2016/2017), Canadians shared their needs and expectations for a revised guideline, while in Phase 2 (2017/2018), they provided feedback on the proposed recommendations. Over 26 700 responses were received from individuals, non-governmental organisations, health professionals, and business associations⁽⁵⁷⁾. The findings, published in a report on the ministry's website, revealed that many Canadians found the existing food groups less compatible with plant-based diets due to the inclusion of separate meat and dairy groups^(58,59). Additionally, health and nutrition experts advocated for a stronger focus on vegetables and a reduced emphasis on meat and dairy. These insights were incorporated into the updated Canadian dietary guideline⁽⁵⁸⁾. An assessment of how evidence was utilised in the development of the Canada Food Guide applied the framework of 'good governance of evidence,' which integrates scientific and democratic principles to enhance advisory systems. The findings suggest that institutionalising an evidence-use process rooted in these principles can strengthen the role of evidence in the making of nutrition policies⁽⁶⁰⁾.

The second option that is found in several current FBDGs is an inclusive protein group that includes legumes, beans, and tofu, as well as meat, fish, and eggs, alongside a dairy group that incorporates both traditional dairy products and plant-based alternatives such as soya milk and soya yogurt. Notably, this approach is present in the FBDGs of Australia⁽⁶¹⁾, New Zealand⁽⁶²⁾, Thailand⁽⁶³⁾, the United Kingdom⁽⁶⁴⁾, and the United States⁽⁶⁵⁾.

A third approach structures food groups by combining meat and plant-based alternatives into one category and dairy and plant-based alternatives into another, while classifying beans and legumes as a distinct, separate group. This method is exemplified in Qatar's FBDG⁽⁶⁶⁾.

Recommendations to limit animal-sourced foods

Dietary guidelines should not only incorporate inclusive food groups but also provide recommendations to reduce ASF consumption. These recommendations should highlight both the health and sustainability benefits while taking socio-economic feasibility into account.

Significant health concerns underscore the need for an upper limit on meat consumption in FBDGs^(67–70). In 2015, the World Health Organization (WHO) classified processed meat as a Group 1 carcinogen, indicating that there is sufficient evidence from epidemiological studies linking products like bacon, sausage, and ham to cancer risk⁽⁶⁷⁾. This cancer risk arises from compounds such as sodium, nitrites, and saturated fats, as well as substances formed during high-temperature cooking, including heterocyclic amines and polycyclic aromatic hydrocarbons. The International Agency for Research on Cancer concluded that each 50 g portion of processed meat consumed daily increases the risk of colorectal cancer by 18 %⁽⁶⁸⁾. Additionally, red meat, including beef, veal, and

pork, was classified as a Group 2A carcinogen, meaning it is probably carcinogenic to humans⁽⁶⁷⁾. The large-scale UK Biobank study found that higher intake of unprocessed red meat and processed meat was associated with increased risks of ischemic heart disease, diabetes, and gastrointestinal diseases⁽⁶⁹⁾. Participants who consumed meat frequently (three or more times per week) tended to have poorer health behaviours and characteristics, and, although BMI adjustments weakened the observed associations, the link between meat intake and adverse health outcomes remained⁽⁶⁹⁾. Given that individuals adhering to plant-based diets generally have lower BMI, shifting dietary patterns toward plant-based foods while reducing meat intake could be an effective strategy for improving health outcomes^(18,71). A 30 % reduction in processed-meat consumption in the US has been estimated to prevent approximately 352 900 cases of type 2 diabetes, 92 500 cases of CVD, 53 300 cases of colorectal cancer, and 16 700 deaths over the course of a decade⁽⁷⁰⁾. These findings underscore the need for clear upper limits on meat intake in order to mitigate the risk of chronic disease and reduce preventable mortality.

In addition to the health risks associated with excessive meat consumption, there are significant environmental considerations that support the case for limiting ASF in dietary guidelines. Evidence indicates that providing clearer advice on limiting the consumption of ASF, particularly beef and dairy, has the greatest potential for improving the environmental sustainability of dietary guidelines⁽⁶⁾. The production of beef and dairy is resource-intensive, contributing to high greenhouse gas emissions, deforestation, and water use^(13–16). By encouraging reductions in these foods, dietary guidelines can promote more sustainable food systems, thus helping to address climate change and reduce the environmental footprint of food production^(6,13).

The EAT-Lancet reference diet recommends a daily meat intake of 0–86 grams, translating to a maximum of approximately 31 kg per person per year⁽¹³⁾. However, in high-income countries, per-capita meat consumption far exceeds this guideline, averaging 50–80 kg annually^(41,72). Similarly, the EAT-Lancet Commission suggests a daily intake of 0–500 grams of milk equivalents⁽¹³⁾, with an upper limit of 182.5 kg per year. In contrast, the current annual per-capita consumption stands at 200–400 kg in terms of milk-equivalent^(41,72). These discrepancies highlight the significant gap between recommended dietary patterns and actual consumption trends, underscoring the need for stronger policy interventions to align diets with health and sustainability targets.

In response, an increasing number of countries have incorporated upper limits for meat consumption into their FBDGs to align with these targets. An example of such an effort is the revised German FBDG published in 2024, which follows the PHD model, and which recommends reducing weekly meat consumption to a maximum of 300 grams and limiting dairy intake to two portions per week^(13,46). However, an analysis of FBDGs from 83 countries revealed that only 45 % of them addressed environmental sustainability. Among these FBDGs, the most frequently mentioned sustainability principles were respecting local culture, followed by the recommendation to increase plant-based food consumption while reducing ASF consumption⁽⁷³⁾.

While promoting meat reduction may be beneficial in high-income countries (HICs), dietary guidelines in low- and middle-income countries (LMICs) should prioritise preserving and improving traditional plant-rich diets to support both public health and environmental sustainability⁽²¹⁾. For example, increasing red meat consumption to address undernutrition could inadvertently raise the risk of non-communicable diseases such as

cancer and obesity. Therefore, it is essential to implement carefully balanced strategies that consider both nutritional needs and long-term health outcomes⁽⁷⁴⁾.

In general, ASF consumption recommendations in FBDGs can be presented in two ways: quantitatively or qualitatively. Quantitative guidelines provide specific limits, such as portions or grams per week. For example, Spain's dietary guidelines allow for a diet with zero meat consumption while capping intake at three servings per week⁽⁵⁵⁾. Finland's 2024 updated dietary guidelines have significantly reduced the recommended intake of red meat from a maximum of 500 g per week to 350 g per week⁽⁷⁵⁾. The Finnish guidelines now explicitly promote legumes as a beneficial choice for both health and environmental sustainability, setting a daily intake target of 50–100 g⁽⁷⁵⁾.

In contrast, qualitative recommendations offer general guidance on reducing meat intake by emphasising associated benefits, including improved health outcomes, environmental sustainability, and cultural considerations. For example, the Zambian FBDG highlights the growing evidence supporting the health benefits of plant-based diets, emphasising the positive impact of whole grains, legumes, nuts, fruits, and vegetables on human health⁽⁷⁶⁾. They recommend reducing the consumption of red and processed meats, such as bacon, ham, sausages, and burgers, in favour of healthier alternatives such as plant-based foods, insects, and fish⁽⁷⁶⁾. This shift is encouraged to help lower the risk of obesity and related non-communicable diseases, including heart disease, diabetes, and cancer. Additionally, the guideline emphasises that a predominantly plant-based diet is not only beneficial for individual health but also contributes to planetary health⁽⁷⁶⁾. Canada's FBDGs encourage a shift towards plant-based protein sources by recommending that, among protein foods, plant-based options should be chosen more often⁽⁵⁰⁾. But it's not just about protein sources. Finland's⁽⁷⁵⁾ and Germany's⁽⁷⁷⁾ FBDGs, for example, advise limiting the consumption of animal-based butter and tropical oils in favour of vegetable oil-based spreads that are rich in unsaturated fatty acids^(75,77).

In order to effectively implement clear upper limits on animal-sourced food consumption in FBDGs, while also increasing the number of plant-based options, it's crucial to consider consumer understanding of dietary messages. Research indicates that nutrient-based terminology is often poorly understood by the public compared to food-based terminology, since consumers engage with specific foods rather than individual nutrients^(78,79). As such, FBDG committees should prioritise simple, food-focused messaging as way to enhance clarity and compliance⁽⁸⁰⁾. For example, straightforward guidance like 'Choose legumes and tofu instead of red meat' is more easily understood than nutrient-focused statements such as 'Reduce saturated fat intake by selecting foods high in unsaturated fat'. However, since FBDGs are primarily used by health-and-nutrition professionals, the guidelines also need to provide scientifically precise recommendations. Ultimately, both target groups – consumers and professionals – must be effectively served in order to ensure that dietary guidance is both easily actionable for the public and sufficiently robust for expert application. It is also important that FBDGs are given a more prominent position in public life, given the lack of broad engagement with them by consumers.

Key macro- and micro-nutrient intakes with plant-based food sources

FBDGs provide recommendations on foods as sources of macro-nutrients (carbohydrates, proteins, fats) and micronutrients

(vitamins and minerals)⁽⁹⁾. However, a large-scale evaluation of 95 FBDGs revealed a predominant emphasis on animal-sourced foods for specific nutrients, overlooking plant-based food options⁽⁹⁾. This approach contrasts with current scientific evidence, which indicates that individuals following balanced plant-based dietary patterns often achieve more favourable diet quality compared to those following typical Western diets or other conventional diets high in ASF^(17,25,81).

While a plant-based diet is often associated with a higher intake of dietary fibre and several essential micronutrients^(82–84), certain nutrients require particular attention in order to ensure their adequate intake (see Table 1). While neither a conventional diet nor a plant-based diet inherently guarantees protection against nutrient deficiencies, a well-planned plant-based diet that includes all essential nutrients can offer significant health benefits^(82–84). It is thus crucial that FBDGs encourage healthy and sustainable food choices and provide advice for the broad spectrum of plant-based diets. Table 1 outlines key nutrients that should be addressed in FBDGs to support individuals following plant-based dietary patterns. These recommendations are intended as a complement to existing guidelines, not as limitations, and aim to broaden the scope of nutritional information relevant to plant-based diets within FBDGs.

As a key resource for health and nutrition professionals, FBDGs should offer more comprehensive guidance on meeting micro-nutrient needs through plant-based diets. Information on essential minerals such as calcium, iron, and zinc is often predominantly centered around ASF, primarily due to their higher bioavailability and the presence of anti-nutrients in plant-based sources⁽⁹⁾. However, this perspective overlooks well-established traditional techniques that enhance the bioavailability of plant-derived nutrients while minimising anti-nutritional factors. Methods such as milling, soaking, cooking, autoclaving, germination, and fermentation have long been used to improve the nutritional quality of pulses, grains, and oilseeds, making them viable and effective sources of essential micronutrients^(21,83,85,86).

In the following section, iron and protein are discussed as examples in order to illustrate the needed level of information supplied by FBDGs. When it comes to iron, a more nuanced approach to addressing iron deficiency is essential, particularly given its status as a major global public health concern⁽⁸⁷⁾. According to the World Health Organization, iron-deficiency

Table 1. Nutrient supply of plant-based diets^(24,82–84) (table adapted from ProVeg International 2024)

Nutrient supply of plant-based diets	
Especially well supplied	Need attention
Complex carbohydrates	Essential amino acids (protein)
Dietary fibre	Vitamin B ₁₂
Beta-carotene (provitamin A)	Calcium
Vitamin C	Zinc
Vitamin E	<i>n</i> -3 fatty acids
Biotin	Iodine*
<i>n</i> -6 fatty acids	Iron*
Magnesium	Vitamin D*
Folate	

*Common insufficiency in general population.

anaemia affects approximately 40 % of children aged 6–59 months and 30 % of women of reproductive age worldwide⁽⁸⁷⁾. Despite this, many FBDGs predominantly emphasise meat as the primary dietary source of iron while providing limited guidance on plant-based iron sources and strategies to enhance bioavailability⁽⁹⁾. This information gap in dietary recommendations is particularly problematic for women, who globally consume less meat and often follow more plant-based dietary patterns, either by necessity or by choice^(21,88–91).

In order to ensure adequate iron intake, FBDGs should highlight plant-based sources such as legumes (e.g. lentils and beans), pseudograins (e.g. amaranth, buckwheat, and quinoa), fortified cereals, and dark green leafy vegetables^(83,87). Their iron-bioavailability can be significantly improved through appropriate preparation methods and by pairing them with foods that are rich in vitamin C, such as fruits and vegetables. Conversely, certain dietary components can inhibit iron absorption when consumed at the same time. These include tea, coffee, cocoa, bran-containing cereals, and calcium-rich foods^(83,87). In order to maximise iron uptake, these foods should be consumed at different times from iron-rich meals. Additionally, FBDGs should acknowledge that, in some cases, iron supplementation may be necessary, and individuals should consult a medical professional if needed to determine whether supplementation is appropriate^(92,93).

The Lebanese FBDG exemplifies a comprehensive approach to iron-related dietary guidance by including a dedicated section on 'how to achieve the recommended daily intake of iron'⁽⁹⁴⁾. This section provides clear and practical recommendations, making the guidance accessible while still being evidence-based. It covers key strategies such as enhancing iron absorption through the consumption of vitamin C-rich foods and mitigating the inhibitory effects of tea, coffee, and caffeine-containing carbonated beverages. Additionally, it includes guidance on iron supplementation when necessary and highlights the role of iron-fortified breakfast cereals as a practical dietary source⁽⁹⁴⁾. This level of detail ensures that individuals receive clear and actionable recommendations for optimising iron intake.

Protein is another important nutrient for which FBDGs need to provide clearer and more comprehensive guidance. Rather than over-emphasising total protein intake – which is generally adequate in people following balanced plant-based diets – the focus should shift to protein quality^(83,95). The quality of dietary protein varies based on factors such as amino-acid composition, digestibility, the presence of antinutritional compounds, and the effects of food processing. Again, traditional preparation techniques – such as soaking, fermenting, and cooking – can help reduce antinutritional factors and enhance protein digestibility^(83,95).

In order to ensure adequate intake of all essential amino acids, FBDGs should promote dietary diversity by recommending a variety of plant-based protein sources, including legumes, nuts, and seeds, alongside foods from the carbohydrate/grains food group, such as grains, potatoes, and corn, which help to balance the amino-acid profile by complementing the limited amino acids in certain plant proteins^(83,96). Current evidence indicates that consuming these complementary protein sources throughout the day is sufficient to meet amino-acid requirements, rather than needing to combine them in every single meal^(83,96). Among plant-based protein sources, soya stands out for its high digestibility and complete amino-acid profile, making it one of the most nutritionally valuable plant-based options^(83,96). As such, FBDGs should explicitly encourage the consumption of soya and soya products as a healthy, high-quality, and sustainable protein source.

Several national FBDGs provide valuable examples of clear and practical guidance on protein intake. The Argentinian FBDG, for instance, emphasises the importance of protein diversity by recommending the combination of legumes and cereals as an alternative to meat in certain meals⁽⁹⁷⁾. Similarly, the Austrian FBDG⁽⁹⁸⁾ advises consuming at least three portions of legumes and legume products per week for omnivores and at least four portions for those who do not consume meat or fish. It also highlights soya products, such as tofu, tempeh, and textured soya protein, as high-quality protein sources⁽⁹⁸⁾. The Sri Lankan FBDG reinforces the importance of combining pulses and cereals to ensure the intake of all essential amino acids and specifically notes that soya beans and soya products provide complete proteins⁽⁹⁹⁾. These examples demonstrate how FBDGs can offer culturally relevant and practical recommendations for optimising protein intake across different dietary patterns.

A similar level of detail is essential for certain other nutrients (listed in Table 1) and should be developed by the respective national scientific committees, based on an evidence-based approach. In this way, FBDGs can play a crucial role in disseminating and revitalising knowledge about food pairings and traditional food-preparation methods, thereby ensuring that various stakeholders – from consumers and health professionals to food manufacturers – recognise their value in enhancing nutrient availability⁽²¹⁾.

This diversification of dietary recommendations also offers a perfect opportunity to re-establish forgotten crops and indigenous foods, which have long been overlooked despite their significant contributions to human nutrition and environmental sustainability^(100,101). Indigenous foods – species naturally occurring in specific regions and traditionally consumed by local populations – are often nutritionally dense, resilient to harsh and varying climates, and require fewer resources such as water and inorganic fertilisers^(100,102). Many of these foods, sometimes referred to as 'hidden food treasures', have been cultivated and maintained for generations, offering a wealth of dietary diversity that modern food systems frequently neglect⁽¹⁰⁰⁾. Despite the existence of nearly 7000 cultivated crop species worldwide, global agriculture remains heavily dependent on just a few staple crops – primarily rice, maize, and wheat⁽¹⁰¹⁾. This lack of diversity contributes to both widespread nutritional deficiencies and environmental strain^(100,101). In many low-income countries, diets rich in pulses, nuts, seeds, and diverse fruits and vegetables offer the most cost-effective means of meeting nutrient requirements⁽¹⁰³⁾. FBDGs should leverage the potential of indigenous foods by integrating them into dietary recommendations, promoting their benefits in terms of meeting micronutrient needs, and fostering their consumption in order to enhance dietary diversity and sustainability.

The Brazilian FBDG⁽¹⁰⁴⁾ exemplifies this approach by emphasising plant-based diets and the role of indigenous foods. It highlights the social, economic, and environmental advantages of dietary patterns centered around staple plant-based foods such as rice, beans, corn, cassava, potatoes, vegetables, and fruits. According to the Brazilian FBDG, these foods not only support local economies and small-scale farming but also contribute to biodiversity, reduce the environmental impact of food production, and mitigate climate change through lower greenhouse gas emissions and reduced deforestation⁽¹⁰⁴⁾.

Inclusion of plant-based alternatives to animal-sourced foods

Healthy, sustainable plant-based diets should primarily focus on whole foods, including a variety of fruits, vegetables, grains, nuts,

seeds, and legumes^(13,25–27). However, transitioning from a meat-and-dairy-focused diet to a plant-based one can be facilitated by offering nutritious plant-based alternatives that mimic the taste and texture of animal-based products^(21,105).

While plant-based alternatives like soya milk and tofu, as well as wheat-based meat (seitan), have long been integral to the diets of certain cultures, these foods are now becoming increasingly popular in others^(105,106). Furthermore, the global market for novel plant-based alternatives, such as meatballs based on pea protein isolate, fermented nut-based cheeses, and plant-based protein drinks, has expanded rapidly in recent years^(105,107). Growing health awareness and increasing consumer acceptance have driven rising sales, investment growth, and market share, particularly in Europe, North America, and Asia^(105,107).

Current evidence suggests that both classic and novel plant-based alternatives can provide health benefits and have a smaller environmental footprint than their animal-based counterparts^(105,107,108). Generally, these alternatives are higher in fibre and lower in saturated fat and energy, making them a valuable option, particularly in high-income settings where diet-related diseases are prevalent^(105,108). Fortified plant-based alternatives can, in some cases, provide nutrient profiles comparable to their animal-based counterparts^(105,107). However, the nutritional quality of these products varies widely, with some containing too much salt, sugar, or fat – especially those made with coconut oil, which is high in saturated fat. Additionally, not all plant-based alternatives are fortified, which may lead to nutrient gaps⁽¹⁰⁷⁾. Therefore, clear dietary guidance is essential in order to assist consumers with making informed choices that optimise the health and environmental benefits of plant-based alternatives.

A global analysis of 95 guidelines found that 45 % of all FBDGs already mention plant-based alternatives to meat and dairy⁽⁹⁾. Another review of seven FBDGs worldwide suggested that including specific recommendations for plant-based dairy alternatives could substantially reduce GHGE associated with the dairy food group⁽¹⁰⁹⁾. Moreover, integrating plant-based milk alternatives into FBDGs with a single dairy group can enhance inclusivity, accommodating the large number of people who either choose not to consume animal milk or for whom the consumption of milk causes health issues due to lactose malabsorption^(9,21). Their inclusion should be accompanied by guidance to prioritise fortified products—particularly those fortified with calcium, iodine, and vitamins B₂ and B₁₂—or to ensure that these nutrients are obtained from alternative sources such as green leafy vegetables, iodised salt, or supplements⁽¹¹⁰⁾. In several countries, fortification with calcium, vitamin B₂, and vitamin B₁₂ is already common in plant-based milk alternatives, whereas iodine fortification remains limited^(111,112). Clear recommendations in FBDGs could therefore serve as an incentive for producers to improve the nutritional adequacy of these products, while also helping consumers to overcome potential nutrient deficiencies.

Examples can be found in the FBDGs of Australia⁽⁶¹⁾, the Netherlands⁽⁵⁴⁾, the UK⁽⁶⁴⁾, Qatar⁽⁶⁶⁾, the USA⁽⁶⁵⁾ and South Africa⁽¹¹³⁾, among others. The presentation of plant-based alternatives varies across countries, with some incorporating them directly into food graphics such as plates or pyramids, while others address them solely within the textual guidelines of their FBDGs^(9,64,66). Additionally, some countries supplement their recommendations with dedicated position papers that provide further guidance—though Germany is currently the only country with such a document specifically focused on plant-based milk alternatives⁽¹¹⁰⁾.

The position paper on plant-based milk alternatives by the German Nutrition Society (DGE), which is responsible for FBDGs in Germany, serves as a good example of how dietary guidelines can be culturally appropriate while remaining dynamic and responsive to changing consumption patterns^(110,114). Culture is not static: it continuously evolves in response to internal and external influences. Consequently, FBDGs must also adapt to reflect societal shifts. In Germany, cow's milk consumption has been steadily declining, and is currently at a record low, while the demand for plant-based milk alternatives has risen sharply^(110,115). Recognising this trend, the DGE published a position paper acknowledging the role of plant-based milk alternatives, particularly for individuals who consume little or no cow's milk or whose intake of ASF exceeds recommended levels^(110,114). The paper highlights both the environmental advantages of plant-based milk and provides practical guidance for consumers, such as prioritising calcium- and iodine fortified options and avoiding added sugars^(110,114).

The Netherlands, in particular, stands out as a leading example of how comprehensive guidance on plant-based alternatives can be effectively integrated into national dietary recommendations. The Netherlands Nutrition Centre, which oversees the country's FBDG, has set clear nutritional criteria for plant-based alternatives that are intended to replace meat and dairy⁽¹¹⁶⁾. These guidelines establish, for example, upper limits for saturated fat and salt while setting concrete minimum requirements for key nutrients such as vitamin B₁₂ and calcium, thereby ensuring that plant-based alternatives meet essential health standards⁽¹¹⁶⁾. By providing both consumers and manufacturers with clear guidance, the Netherlands is fostering a healthier and more sustainable food environment, making it easier for people to choose nutritious plant-based options.

In this context, it is also important to have a nuanced discussion about ultra-processed foods. In recent years, food classification systems such as NOVA have shifted the focus from nutrient composition to the degree of processing, linking the consumption of ultra-processed food to adverse health outcomes, including cardiometabolic diseases and obesity⁽¹¹⁷⁾. While limiting certain highly processed foods such as potato chips and chocolate bars is widely accepted as being beneficial, grouping all ultra-processed foods together – regardless of their nutritional value – can be misleading^(21,118). Foods such as packaged wholegrain bread or calcium-fortified soya milk are also classified as ultra-processed, yet they contribute important nutrients to a healthy and sustainable diet^(21,118). Strict recommendations to avoid all ultra-processed foods risk removing affordable and accessible nutrient sources, which is impractical given that processed foods account for approximately two-thirds of global energy purchases^(21,117). Instead of focusing solely on processing levels, FBDGs should assess foods based on their overall nutritional quality and environmental impact. This discussion is particularly relevant for plant-based alternatives, which are often categorised as ultra-processed despite offering health benefits and having smaller environmental footprints, compared to ASF^(21,107). These alternatives, including oat milk, tofu sausage, and plant-based burgers, play a crucial role in supporting dietary transitions by providing familiar taste and texture profiles. Dismissing these products, based only on the degree of processing, could hinder the shift towards more sustainable diets. As such, a more nuanced approach is needed – one that balances concerns about food processing with the recognition that some foods which are classified as ultra-processed can contribute positively to both human and planetary health^(21,118).

Consequently, as a key tool for public nutrition education, FBDGs should help consumers to determine which plant-based alternatives align with a sustainable, healthy diet. This would enhance the relevance of FBDGs, especially given the rapid rise in demand for such products in recent years⁽⁹⁾.

Guidance on well-planned vegetarian diets (including vegan diets)

Vegetarian and vegan dietary patterns are gaining increasing widespread interest across diverse population groups^(25,35,119). The motivations for adopting such diets are multifaceted, and include concerns about health benefits, environmental sustainability, animal welfare, socio-economic factors, and cultural or religious beliefs^(25,35,119). Given this growing interest, it is crucial that FBDGs provide clear and evidence-based guidance, in order to ensure the nutritional adequacy of vegetarian and vegan diets.

Currently, 60 % of FBDGs worldwide do not address vegetarian or vegan diets⁽⁹⁾, leaving a significant information gap for the approximately 1.5 billion people globally who follow some form of vegetarian dietary pattern⁽²⁾. Furthermore, among the existing guidelines that do mention vegetarian diets, there are considerable differences in their framing. While many emphasise the health and ecological sustainability benefits and provide recommendations on key nutrients, approximately 30 % of these guidelines focus primarily on potential nutritional risks, with some even advising against following certain types of vegetarian diets or vegan diets⁽⁹⁾.

A well-balanced approach is needed – one that highlights critical nutrients while also providing practical recommendations for well-planned vegetarian diets, including vegan diets. Rather than focusing on deficiencies and risks, FBDGs should adopt a positive, empowering approach to nutrition education^(9,120). A useful parallel can be drawn from UNESCO's comprehensive sex-education guidance, which goes beyond risk-centered messaging to equip individuals with the knowledge and skills needed to make informed, responsible choices for a healthy lifestyle^(9,121). Similarly, FBDGs should ensure that individuals who are following vegetarian or vegan diets receive guidance on nutrient-dense food choices, meal-planning strategies, and supplementation, where necessary.

The Academy of Nutrition and Dietetics, the world's largest organisation of food and nutrition professionals, states in its 2025 position paper that well-planned vegetarian and vegan diets can be nutritionally adequate for adults and may provide long-term health benefits, particularly in reducing cardiometabolic disease risk⁽²⁵⁾. Dietitians and other health professionals play a key role in supporting individuals by providing tailored, culturally relevant, and evidence-based guidance to optimise nutrient intake while minimising concerns about deficiencies⁽²⁵⁾.

However, in order for health professionals to provide accurate and practical advice, FBDGs must offer clear and detailed guidance on vegetarian and vegan diets⁽⁹⁾. If official dietary guidelines fail to meet this need or do not present information in a way that is relevant to the target audience, people will seek information elsewhere, often online, where content quality and scientific accuracy can vary widely and is often unverified⁽¹²²⁾. To prevent misinformation and ensure that people receive reliable dietary guidance, it is essential that FBDGs incorporate well-structured, inclusive, and practical recommendations for vegetarian and vegan diets.

The Danish Veterinary and Food Administration recommends a varied plant-based diet for the general population and

provides additional comprehensive guidelines specifically for vegetarians and vegans^(123–125). These additional guidelines emphasise the importance of obtaining essential nutrients typically sourced from ASF, such as vitamin B₁₂, iron, calcium, iodine, and *n*-3 fatty acids. They offer practical advice on plant-based sources rich in these nutrients and recommend appropriate supplementation, when necessary. Additionally, the guidelines highlight the significance of consuming a varied and balanced diet in order to ensure adequate nutrient intake^(124,125). This targeted approach exemplifies how FBDGs can effectively cater to specific dietary practices, thereby ensuring that individuals receive relevant and actionable information for maintaining optimal health.

Conclusion

Given that adherence to national dietary guidelines remains low, it is crucial to enhance their relevance for a broader population while maintaining the principles of healthy and sustainable eating. This review proposed the use of a socioecological framework as a conceptual foundation for more inclusive and balanced FBDGs — one that accounts for the ecological, ethical, religious, and economic factors that shape dietary choices. Guided by this framework, five key gaps in the representation of plant-based diets in FBDGs globally were identified. Case studies illustrated how these gaps might be addressed by showcasing approaches for designing inclusive food groups, setting appropriate limits on ASF where socio-economically feasible, ensuring adequate macro- and micronutrient intake from plant-based sources, incorporating healthy plant-based alternatives to facilitate dietary transitions, and providing guidance on well-planned vegetarian and vegan diets.

Cultural appropriateness in dietary recommendations must go beyond preserving traditional food practices – culture is dynamic and continuously being shaped by internal and external influences. FBDGs must therefore also be adaptive and flexible in order to accommodate evolving food systems and shifting consumer behaviours. Recognising the importance of inclusivity and adaptability in dietary guidelines is essential to fostering long-term adherence and improving public-health outcomes across diverse populations.

Achieving the Sustainable Development Goals will require a global transition toward more plant-rich diets. Countries in the Global North bear a particular responsibility, given both their greater financial capacity and disproportionately high consumption of ASF, which impose significant costs on both public health and the environment on a global scale. At the same time, dietary guidance is critical for the many individuals in the Global South who already follow these plant-based diets, whether by necessity or choice. By integrating clear recommendations to reduce the consumption of ASF, while expanding access to diverse plant-based options, FBDGs can align public health objectives with environmental imperatives, ensuring that dietary policies remain both effective and culturally relevant.

The 30th UN Climate Summit (COP30) serves as a critical reminder that the time for action is now. Governments need to move beyond rhetoric and implement FBDGs that actively promote both health and sustainability. Clear, evidence-based guidance on plant-rich diets will be instrumental in shaping food environments that empower individuals to make choices that benefit both human and planetary health.

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