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Achieving a planetary health diet: red meat and legumes availability in Portugal

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(Ema Margarida Gonçalves Melim)

Trabalho apresentado à Universidade Fernando Pessoa como parte dos requisitos para obtenção do grau de licenciado em Ciências da Nutrição

Orientador:
Professor Doutor João Costa Leite

To my parents, for allowing me to follow my dreams.
To my sister, for accompanying me during this last year.

To my friends, from Madeira, from my first bachelor's degree and the ones I got to know during these last few years, thank you for giving me strength, support and for believing in me.

Index

I. Tables and pictures index

II. Abbreviations list

CAP – Common Agricultural Policy
EIPAS – Integrated Strategy for the Promotion of Healthy Eating
FAO – Food and Agriculture Organization of the United Nations
FBS – Food Balance Sheet
GHG – Greenhouse gas
MD – Mediterranean Diet
NFNPAS – National Food, Nutrition and Physical Activity Survey
PHD – Planetary health diet
PNPAS – National Programme for the Promotion of Healthy Eating
SP – Statistics Portugal
WD – Westernized Diet

Achieving a planetary health diet: red meat and legumes availability in Portugal

Alcançar uma dieta de saúde planetária: disponibilidade de carne vermelha e leguminosas em Portugal

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IV. Abstract

Aims: The global food system has strong implications in the depletion of natural resources, biodiversity loss, greenhouse gas emissions and climate change. To face the current challenges, a planetary health diet was recently proposed by the EAT-Lancet Commission, serving as a guide to the implementation of diets aligned with the environmental boundaries of the planet. The aim of this paper is to compare the planetary health diet recommendations with the current consumption of legumes and red meat in Portugal, exploring different policy strategies that promote healthy and environmentally sustainable eating patterns in the country.

Methods: Data from the Food and Agriculture Organization's Food Balance Sheets regarding legumes and red meat supply was used, as well as Statistics Portugal data for production and consumption of red meat, and National Food, Nutrition and Physical Activity Survey concerning consumption of both legumes and red meat.

Results: The national consumption of red meat is four times above (68g/day) the recommendations for a healthy and sustainable diet while legumes consumption is three times below (24g/day) what is recommended, reflecting a nutritional transition to a westernized food pattern, both unhealthy and unsustainable.

Conclusions: Integrated policies that promote increased information and awareness regarding sustainable diets and effective changes in the food environment that facilitate sustainable food choices by consumers are essential to support a dietary shift in the country towards plant-based diets aligned with the planetary boundaries and sustainable development goals.

Keywords: legumes, red meat, sustainable diets, planetary health diet, environmental sustainability, food policy

V. Resumo

Objetivos: O sistema alimentar global tem fortes implicações na degradação ambiental do planeta e alterações climáticas. Recentemente, foi proposta uma dieta de saúde planetária pela EAT-Lancet Commission que serve de referência para a promoção de padrões alimentares alinhados com os limites ambientais do planeta. O objetivo deste estudo é analisar o consumo de leguminosas e de carne vermelha em Portugal no âmbito da recente referência planetária, explorando possíveis estratégias políticas que promovam a transição para uma alimentação ambientalmente mais sustentável no país.

Metodologias: Foram utilizados dados das Balanças Alimentares da Food and Agriculture Organization relativos à disponibilidade de leguminosas e carne vermelha, dados estatísticos do Instituto Nacional de Estatística sobre produção e consumo de carne vermelha, e dados do Inquérito Alimentar Nacional e de Atividade Física relativamente ao consumo de leguminosas e carne vermelha.

Resultados: O consumo nacional de carne vermelha encontra-se aproximadamente quatro vezes acima (68g/d) das recomendações para uma dieta de saúde planetária enquanto que o consumo de leguminosas se encontra três vezes abaixo (24g/d) do recomendado, refletindo uma transição nutricional para um padrão alimentar mais ocidentalizado, pouco saudável e insustentável.

Conclusões: Políticas integradas que promovam a informação e a sensibilização para uma alimentação sustentável e a modificação do ambiente alimentar que facilite escolhas mais sustentáveis pelos consumidores são essenciais para que o padrão alimentar em Portugal se aproxime da dieta planetária, contribuindo ainda para os objetivos de desenvolvimento sustentável e alterações climáticas.

Palavras-chave: leguminosas, carne vermelha, dietas sustentáveis, dieta de saúde planetária, sustentabilidade ambiental, política nutricional

1. Introduction

Food systems include all actors and intertwined activities throughout the whole food chain – from production to actual consumption and even disposal of food products originated from agriculture, fishery or forestry (1). As the world population grows, so does food production, as it becomes more and more unsustainable due to a lack of new land for agriculture and increasing water scarcity (2). In addition, unsustainable food systems is one of the largest culprits of climate change, responsible for an estimated 18% of global anthropogenic greenhouse gas (GHG) emissions mostly from livestock production (3–5). Comparing with plant-based foods production, livestock systems require an increase in energy resources, being a major contributor to environmental degradation, responsible for increased soil erosion caused by overgrazing and reliance on intensive feed production, increased usage of fresh water, environmental pollution and GHG emissions with an impact on climate change (4,6,7). Recently, a hallmark report released by the EAT-Lancet Commission highlighted the urgency of promoting a dietary shift towards plant-based diets at a global scale to achieve sustainable food systems. This work resulted in the first scientific-based global diet for health and planet sustainability, known as planetary health diet (PHD), which aligns healthy diets with the planet's environmentally safe operating boundaries (7). Overall, it is highlighted that, at global level, the consumption of red meat needs to be reduced by over 50% and the consumption of vegetables, legumes, fruits and nuts needs to be double of actual consumption (8). Legumes play an important role in the dietary transition towards a PHD as a valuable sustainable alternative food option to animal protein. Compared to meat protein sources, legumes require less energy input to build protein available for human consumption. Thus, it is linked to substantial lower GHG emissions and less land and water use, while playing an important role in the sequestration of carbon in soils and reduce overall fossil energy inputs (9). It is not surprising that legumes are linked to future sustainable farming systems, since its ability to fix nitrogen complements through natural soil fertilization and minimizes future nitrogen fertilizer use (10,11).

The dry, edible seeds known as pulses is a subgroup of legumes; combined with cereals such as rice, they can support healthy diets by ensuring the protein content and quality while providing additional essential nutrients (6,12,13). In contrast with red meat, legumes are high in fiber, contain various phytonutrients and are also rich in thiamin, riboflavin, pyridoxine and folic acid (13,14). It has soluble fiber, known to decrease total

and LDL cholesterol which are acknowledged risk factors for heart disease; and insoluble fiber has been shown to improve colon health. The phytonutrients, including antioxidants, present in legumes may also have anti-cancerous properties (14). The promotion and maintenance of a good health throughout our lives are achieved through nutrition and diet (15). Primary prevention is currently the most cost-effective, sustainable and affordable strategy to deal with the present worldwide chronic disease epidemic, and diet is one of the risk factors for chronic diseases such as ischemic heart disease, stroke or diabetes – traditional diets, mostly plant-based, have been replaced for diets dense in energy and in animal-based foods (15,16). In high-income regions, replacing animal sources of protein with plant sources of protein, such as legumes, whole grains and nuts, is known to decrease the risk of coronary heart disease, stroke, type 2 diabetes and mortality overall (7,17). In addition, red meat and processed meat consumption has been linked to cancer, mainly colorectal cancer (17–19).

After the Kyoto Protocol came into force, from 2008 until 2012 Portugal managed to limit emissions to 20% and successfully outperformed the goal set – a maximum of 27% emissions (20). In 2015, the 21st Conference of Parties (COP21) had the purpose of achieving a new global climatic agreement so as to limit the increase of the global average temperature to 2ºC until the end of the century. The Paris Agreement, adopted during COP21, had the goal of achieving decarbonization of world economies and limit the increase of Earth's average temperature, knowing it will significantly lower risks and impacts of climate change (21). The Sustainable Development Goals (SDG) on pair with this paper are 3, 12 and 13, concerning health and well-being, sustainable consumption and production and combatting climate change, respectively (22), emphasizing SDGs 12 and 13. To ensure SDG 12 and 13, the Portugal 2020 programme was created to prioritize sustainable growth from an efficient use of resources, including waste management, responsible purchasing and environmental education, and decarbonization of the economy and sustainable mobility, including better use of resources (23). Thus, the Portuguese government committed to achieving carbon neutrality by 2050, by preparing a Roadmap for Carbon Neutrality 2050, which came into force in July of 2019 (24). The aim of this roadmap is to explore different trajectories' viability for carbon neutrality, identify the main vectors of decarbonizing and estimate the potential for reduction of various areas of the national economy – energy and industry, mobility and transportation,

agriculture, forests and other soil uses, and residues and residual waters. Considering the urgency and the recent political shifting directions towards environmental sustainability, it is important to evaluate how Portugal can contribute to climate change and environmental degradation mitigation strategies from a food system perspective. In particular, consumer behavior and buying choices play an essential role in changing the food system's behavior towards sustainability while promoting good health to the population. Thus, the present review paper aims to answer the following questions: when comparing to the planetary health diet, how close is the consumption of legumes and red meat in Portugal to a healthy and sustainable diet? How do trends in consumption, through food supply, affect the adherence to a more sustainable diet? What impact does it have on the population's health? What events from national history play in the availability, production and consumption of legumes and red meat? In Portugal's current political state, how do national food policies act on sustainability? And what options do we have to include sustainability in food policies to achieve healthy and sustainable diets, aligned with current national commitments towards sustainable development and climate change?

2. Methods

The main reference of the present work is the planetary health diet proposed in the EAT-Lancet Commission's report "Food in the Anthropocene" (7). The report references pulses as legumes and thus, for the purpose of this paper, the term legumes is being used throughout. In order to evaluate sustainability in the Portuguese diet, some targets were set according to the PHD recommendations, for a daily intake of 2500kcal: 14g/day for red meat and 75g/day for legumes (8). To compare actual consumptions in Portugal with the reference diet, red meat and legumes consumption reported in National Food, Nutrition and Physical Activity Survey (NFNPAS) were adjusted to match the suggested daily energy intake (25). The available Portuguese Food Balance Sheets (FBS) reported by Statistics Portugal (SP), from 1963 through 2016 (the most recent), were initially used to compare the changes in food availability for red meat and legumes. However, since data in some time periods were missing – specifically from 1975 through 1980 and 1997 through 2003 – the data from the FBS of the Food and Agriculture Organization was used, from 1961 through 2013, year of the last FBS available. FBS

provide information on a country's food supply pattern during a specific time period (26). They indicate, for each primary product and for a reduced number of processed foods, the available quantities of food made for human consumption – through apparent consumption from the food supply perspective (27). Thus, annual FBS display trends in the national food supply and, consequently, changes that may have occurred in consumption, how that supply is suitable to nutritional requirements (26) and also, for the purpose of this review, how that supply is sustainably adequate. Apart from the FBS, data from SP was analyzed concerning production of legumes and red meat. Some data was also retrieved from the recent NFNPAS to integrate information at consumption level (25). A literature search was conducted to identify existing recommendations regarding food policies towards environmental sustainability. In particular, actions were reviewed that addressed the reduction of meat consumption and increased consumption of legumes, using the terms "food policy", "legumes", "red meat", "consumption" and "sustainability". As for Portugal's history, present and how it affects the results, the terms "Portugal", "diet", "health", "food" and "environment" were used. During the reviewing process some articles were identified according to their relevance and through the references cited.

3. Results

Table 1 contains data concerning national average consumption of legumes and red meat, from the latest NFNPAS in 2016, adjusted to a daily energetic intake of 2500kcal to meet the recommendations of the PHD, and the recommendations for each food group according to the PHD. The table demonstrates a gap between national average consumption of legumes and red meat in 2016 when compared to the PHD recommendations. Legumes consumption in Portugal was 24g/day, compared with 75g/day recommended by the PHD, while red meat consumption was 68g/day, compared with 14g/d suggested by the reference diet. Actually, the ratio between the Portuguese dietary consumption and the reference diet showed that legumes stand at approximately 32% of the PHD goal while red meat was at 386% above the recommendations (Figure 1).

Figure 2 illustrates the food supply *per capita* changes from 1961 to 2013 for legumes, red meat in general, bovine, pork and lamb. From 1964 until 1977 there was a

constant rise in red meat supply, which plateaued until 1986. From then onwards, red meat availability increased, mostly due to an increased supply of pork, which kept rising with a few stabilizations in-between. Bovine availability, on the other hand, rose from 1961 until 1977, where it dropped until 1984. From 1984 until 1994, bovine meat supply increased slightly and then dropped again in 1996. Overall, bovine availability maintained a stable supply until 2013. Lamb maintained a stable *per capita* supply throughout the years, not suffering any significant increases or decreases. As for legumes, its supply has been on a slight constant decrease from 1961 until 1987, contrary to red meat supply in general. Starting in 1988, there was a supply increase but was followed by another decrease by 1992. However, in 2011 legumes' supply sees a small increase. Since there is a big difference in the supply of bovine meat and pork, especially in the last 30 years, data available in the SP site concerning human consumption *per capita* and production of both, from 1981 through 2017, was collected. There is no available data regarding legumes' production which is why it is not included. The ratio between consumption and production was then calculated by dividing production by consumption.

Figures 3 and 4 show the production/consumption ratio for bovine meat and pork, respectively. In 1981, the ratio for bovine meat was at 100% (Figure 3). A slight increase in 1982 showed there was more consumption than production; however, it is a persistent decline with minor increases from 1984 onwards. While it is not possible to report the contribution from national production to consumption, in 2017 there was more bovine meat consumption than its national production, corresponding to a production to consumption ratio of an estimated 46%. Contrary to the previous figure, the production/consumption ratio of pork is less unstable, as there are few changes across the years (Figure 4). In 1981, with a ratio slightly over 100%, consumption and production of pork was practically the same. Throughout the years, there aren't any significant drops; there is barely more consumption than what is nationally produced. Again, while it is not possible to compare the linkage between production and consumption in the country, in 2017 the consumption of pork is somewhat higher than its national production (production/consumption ratio of 84,6%) but these differences are less contrasting than the bovine meat ratio.

4. Discussion/Conclusions

In the present study, the unsustainable balance between red meat and legumes consumption in Portugal is evidently clear in comparison to the reference guidelines proposed in the PHD. This highlights the importance of developing effective actions to reduce the environmental footprint of food consumption at national level, which can be achieved by an increased consumption of plant-based food sources, such as legumes, and by reducing red meat consumption. Shifts in dietary patterns towards plant-based diets are beneficial for both health and the environment due to the replacement of animal products with plant-based foods, which reduce environmental footprints and have multiple health benefits (28,29).

The PHD's possible range for legumes goes from 0 to 100g/day, with a recommended target of 75g/day, from which 50g should be from beans, lentils and peas and 25g from soy (7). National legumes consumption remains far from what is recommended, standing at less than a third of the goal (figure 1) of a sustainable and healthy diet for the planet. Regarding meat, and most specifically red meat, its range goes from 0 to 28g/day with a recommended target of 14g/day; but, because its intake is not essential, optimal intake might actually be 0g/day. The higher consumption of meat in Portugal and particularly red meat, which accounts for almost 50% of the total national meat consumption (table 1), is 4 times the goal for red meat consumption (figure 1), even almost doubling the limit for total red meat consumption for a healthy and sustainable diet. Compared to plant-based protein, meat settles its status as a primary protein source and legumes continue being an overlooked alternative to protein intake. Unsustainable diets are characterized by a high consumption of meat, especially red meat (5,7,30,31), and in order to reverse climatic change and its consequences, reducing those consumptions is essential to mitigate GHG emissions (32), for example. Strategies for climate change mitigation should include reducing meat consumption and not just relying on technological advances or reducing food waste, as they alone are insufficient to meet the emission reduction targets (5). Looking at the red meat supply, pork has a growing trend, settling at 103,9g/day in 2013, while bovine meat remains constant over the years and stands at 45g/day (figure 2). Since FBS display trends and changes in consumption, this explains why the national consumption of red meat is well above what is recommended for a sustainable diet (figure 1). Still, those numbers should not be disregarded, since 22,5% of the Portuguese population consume over 100g of red meat (25) and red meat consumption should remain a concern for its environmental and health consequences.

In Portugal, cardiovascular diseases and cancer are the most frequent causes of death in the country and chronic conditions are one of the leading factors of poor health (33). Over 26% of overall disease burden is due to behavioral risk factors, with dietary risks being one of the biggest contributors (33,34), and high obesity rates are still one of the main concerns for population health. In contrast, high levels of consumption of plant foods, such as wholegrain and legumes, are linked to decreased risk of type 2 diabetes, cardiovascular disease and some cancers (7,11,17,35), which are known to have adverse health impacts derived from red meat consumption (18,19,35). Thus, from a health perspective, a dietary shift concerning the replacement of protein of animal source for plant-based protein can be an important achievement to reduce the global burden of disease related to food consumption, with legumes being a relevant healthy option ensure the nutrition value of diets (36,37). It is then essential that the importance of legumes is uplifted, and its consumption promoted, while mentioning the need for reducing red meat consumption. In order to understand what caused fluctuations and increases or decreases in supply, consumption and production, it is important to understand how sociocultural aspects and historical events promoted a dietary transition in Portugal in the last decades.

Historical perspective

For instance, increased red meat availability observed in figure 2 is likely to be linked to Portugal's integration in the European Union (38). As a result, the country had access to a single market, enjoying the free movement of goods and financial incentives, amongst others, without any customs barriers between member states. This transition had a critical impact on the country's access to new but mostly processed, unhealthy food – mostly animal products which are usually more expensive than vegetable foods (28) – but also to a competitive subsidized agriculture through the Common Agricultural Policy (CAP) (39,40). As a result of this new free dynamic food trade market, the national production of pork accompanied an increased availability for national consumption (figure 4), while bovine meat production reduced when compared with a stable availability for consumption (figure 3). This could also explain the ratio of production/consumption of bovine, relying on exports for its consumption rather than national production. Thus, it is possible that such a change on living conditions and socio-economic development in the country during this period had a particular impact on existing dietary patterns in the country. Portugal, although not bathed by the

Mediterranean Sea, is considered a Mediterranean country linked to a traditional Mediterranean Diet (MD) that favours fresh, seasonal and local products and includes extra-virgin olive oil, red wine in moderation, fish, cereals, fresh vegetables, nuts and light dairy products (26,28,41,42). The MD also promotes more than four servings of legumes per week and reduced red meat consumption, being regarded as a healthy and sustainable diet for its minimal environmental impacts (36,42,43,44). However, looking at the current Mediterranean Adequacy Index in Portugal, the Mediterranean pattern has, overall, been on the decline. Between 1992 and 2006, the changes observed in the food supply for consumption in Portugal reflect a decreased adherence on MD, while from 2006 to 2012 there was a reversal in trend, although it was still far from the values achieved in the early 1990s (27,43). The adherence dropped again from 2012 to 2014 and then gained some traction until 2016, where it stood at less than 1,15 (27). Comparing to the data from the FBS (figure 2), the MD index agrees with the increase in red meat *per capita* supply, as a lower adherence would imply a consumption increase of foods that aren't considered being part of the MD, such as red meat. This implies changes in nutrition and a transition from a healthier, more sustainable diet to a westernized diet (WD), nutritionally rich in saturated and unsaturated fats and low in fiber (44). When looking at the national food supply (figure 2), the difference between red meat – rich in saturated fatty acids – and legumes – high in fiber – is evident, linking even further to a transition to a WD, moving away from the MD. In addition, during the recession period of 2008 and until mid-2013, as a result of the national financial crisis, it was observed a 30% cut in essential goods in surveyed households, as those who are vulnerable are more inclined to reduce quantity and quality of food consumption during these periods (45,46). Regarding the evolution of the price of pork, between 2005 and 2010 it decreased slightly, had a sudden rise between 2010 and 2015 and, right before 2015, it drops; as for bovine meat, its price kept rising from 2010 through 2015, when it hit its peak (47). This is also around the time the economic crisis hit the country, which could explain the difference between bovine meat and pork supply in that period. However, despite price fluctuations, the ratio of production/consumption of pork maintains between 80 and 100% (figure 4), unbothered by the rise in price between 2010 and just before 2015. This value is well above the bovine production/consumption ratio of 46% indicating the relevance of pork production industry compared with the bovine sector. Meat production is an inefficient resource comparatively to the production of grain or other plant-based products, and it is not just a direct response to consumer demand; it is also influenced by government

subsidies and industry groups (48). Current data support an increased production and consumption of red meat in the last decades. While such changes reflect a socio-economic development and a nutrition transition towards unsustainable eating, it is important to explore possible policy interventions that can shape food choices aligned with environmental sustainability. In addition, recent trends suggest that a major effort is needed to reverse the business as usual paradigm and shift the food system to support both sustainable food production and healthy, environmentally friendly diets.

Policies

Only very recently was a national food policy implemented in Portugal. The National Programme for the Promotion of Healthy Eating (PNPAS) was launched in 2011, as one of eight priority programmes developed by the Ministry of Health (29,49). The goal is to improve the population's nutritional status, promoting physical and economic availability of foods as part of a healthy eating pattern and creating conditions for the population to value, appreciate and consume them while being integrated in their daily routines (49). However, in order to promote healthy food environments, there was the need to have a multi-sectoral approach, involving the different government sectors, which the PNPAS didn't have (29). Thus, an interministerial strategy was created in 2016, the Integrated Strategy for the Promotion of Healthy Eating (EIPAS). Some important achievements by EIPAS in these first years include implementation of initiatives on food product reformulation, improvement of food availability in the catering sector, improvement of nutrition labelling on food, restriction of marketing on unhealthy foods to children, implementation of local strategies for the promotion of healthy eating, improvement of food and nutrition literacy from the pediatric age, promotion of the MD with emphasizing traditional national seafood, amongst others. However, integrating environmental sustainability is one of the challenges of these strategies, as it often involves other sectors and stakeholders, in spite of the EIPAS being, for example, an interministerial approach. Achieving sustainable food systems is one of its current challenges, which should be addressed with an integrated strategy concerning food and nutrition since food choices can be impactful on environmental degradation and climate change. Thus, despite focusing mostly on achieving public health from good nutrition, a few policies within the PNPAS and EIPAS programmes have been adapted to include sustainability, by combining, for instance, healthy diets with environmental sustainability

considerations – for example, organic farming, food waste reduction and the promotion of the MD at local level have been identified as areas of intervention (52,53). The challenges of achieving environmental sustainability through food policies have been largely addressed by a number of reports and publications (7,16,51). For instance, recent efforts to include environmental considerations in the Australia National Food Plan have failed due to the prevailing political environment resistant to change (52). Overall, promoting a strong governance that engages all the food systems actors for discussion and reflection while ensuring a focused direction towards environmental outcomes is a first step towards effective actions. In addition, a dietary shift towards plant-based diets relies on integrative actions that link national, regional and local policies. For that purpose, a number of policies have been recommended to be integrated to achieve the food system environmental sustainability (Table 2). Providing adequate information concerning environmentally impactful foods may increase consumers' awareness regarding the differences between plant-based and animal food products. Marketing and educational campaigns also help increase awareness to sustainability and the impact of foods on the environment, most specifically red meat. Fiscal measures such as taxes and incentives have been used to promote healthier diets but could be applied to promote environmental sustainability, as influencing prices can affect consumer choice. In addition, labelling can inform consumers regarding environmental footprints while the development of national dietary guidelines should engage all the food system actors and stakeholders to discuss how to integrate environmental sustainability to better inform consumers and decision makers. Some policies can be considered due to the proximity to strategies already being implemented in Portugal – for instance, through public procurement the implementation of a vegetarian option in school canteens and public cafeterias is an important example of a food policy action that promotes both health and sustainability (53). Increasing the availability of plant-based foods, like the implementation of a mandatory vegetarian dish on a daily basis, may improve available options and likely increase its acceptance, increasing adherence to foods with a lower environmental impact. Curiously, a recent survey in Portugal that addressed food sustainability issues reported that 45,1% of the surveyed participants were willing to substitute meat for plant protein (54). In addition, society initiatives can be very important to influence the development of policies, as increased interest and actions towards sustainable diets facilitate political decisions. Thus, a strong governance that engages all the food system actors is relevant to achieve a food environment that facilitate sustainable

options. For instance, choice arquitecture and nudging consist on minor changes that unconsciously influence and help shaping consumers choices. This can include product placement in food retailers or changing portion sizes in restaurants. The promotion of innovation and food technology can also provide more sustainable food products such as legumes and plant-based protein rich food sources or cultured meat products available to consumers. Finally, implementing such a number of actions at local, regional and national level need effective monitoring programs such as regular dietary surveys or food systems mapping to evaluate progress towards environmental sustainability.

While multiple strategies can contribute to sustainability, this paper has focused on achieving sustainable diets by looking at red meat and legumes consumption trends and reviewing potential policy strategies that could be integrated at a national level. Nevertheless, improving environmental footprints of Portuguese dietary patterns is not only limited to governmental policies towards sustainable consumption. While a reduction on red meat consumption is well regarded to promote both environmental sustainable and healthy diets, future policies should also focus on promoting innovative and environmental sustainable farming practices: silvopastoral models, monitoring tools to assess environmental impact, or more effective fertilization strategies (51). Such policies will benefit from a stronger CAP, supportive of environmentally sustainable agriculture.

Overall, the present paper identified environmental issues at food consumption level in Portugal. As this reflects a nutrition transition towards westernized diets linked to the socio-economic development of the country affected by free food trade, the existing complex cultural and economic barriers will challenge the dietary shift towards plant-based diets. Thus, new ways of thinking and integrating food policies at national, regional and local levels is urgently needed to align the current national consumption with the planetary goals. Such actions should engage the various actors of the food system while facilitating good practices and sustainable initiatives. Integrated policies that promote increased information and awareness regarding sustainable diets and effective changes in the food environment are essential to support a dietary shift in the country towards plant-based diets aligned with the planetary boundaries and sustainable development goals.

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7. Tables, pictures and figures

Table 1. National average consumption of legumes and red meat in 2016 adjusted to match the suggested daily energy intake and the Planetary health diet recommendations

	National Food, Nutrition and Physical Activity Survey (25)	Planetary Health Diet (8)
Fruit, vegetables and legumes	408g/day	575g/day
Legumes	24g/day	75g/day
Meat	153g/day	43g/day
Red meat	68g/day	14g/day

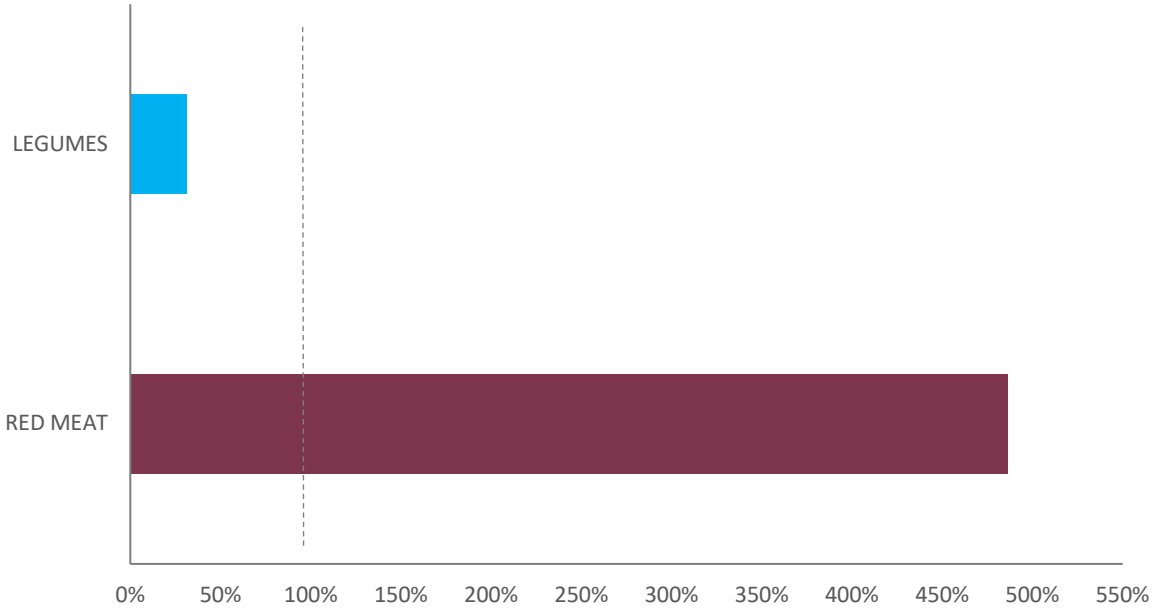

Figure 1. National mean consumption of legumes and red meat in 2016 (25) versus Planetary health diet recommendations (7) (%)

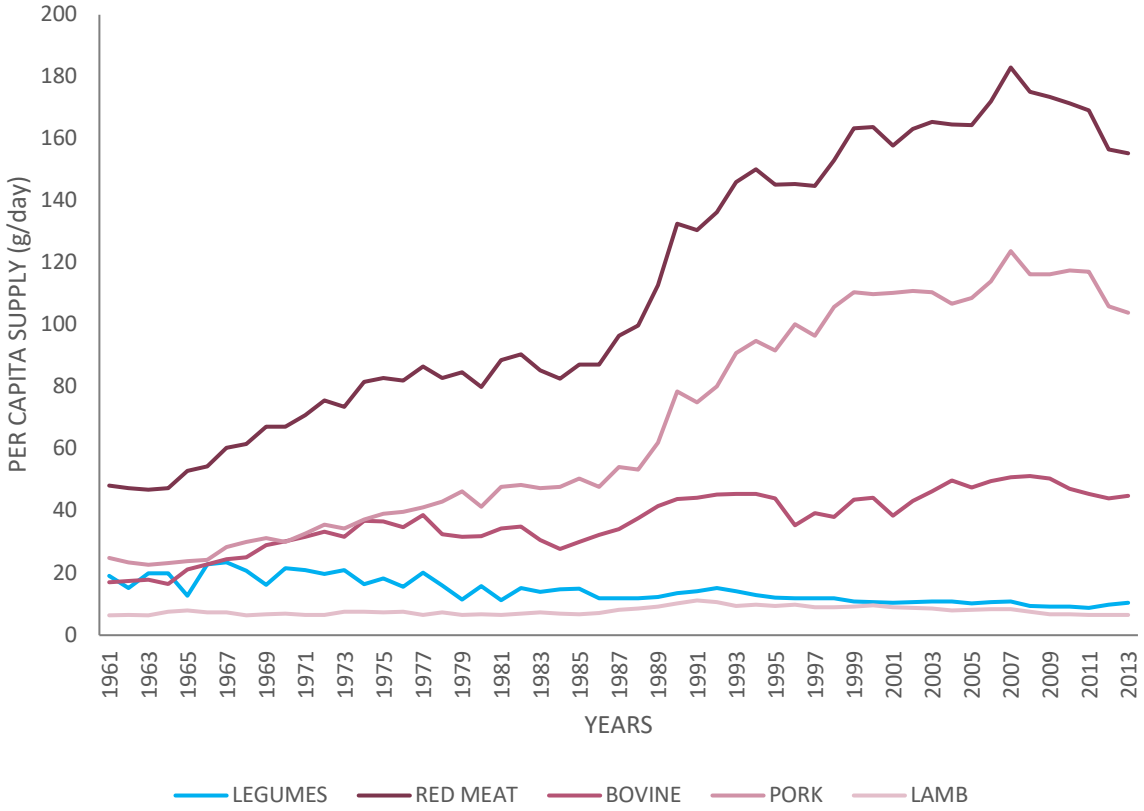

Figure 2. Food availability per capita of legumes and red meat, in g/day, throughout the years in Portugal (55)

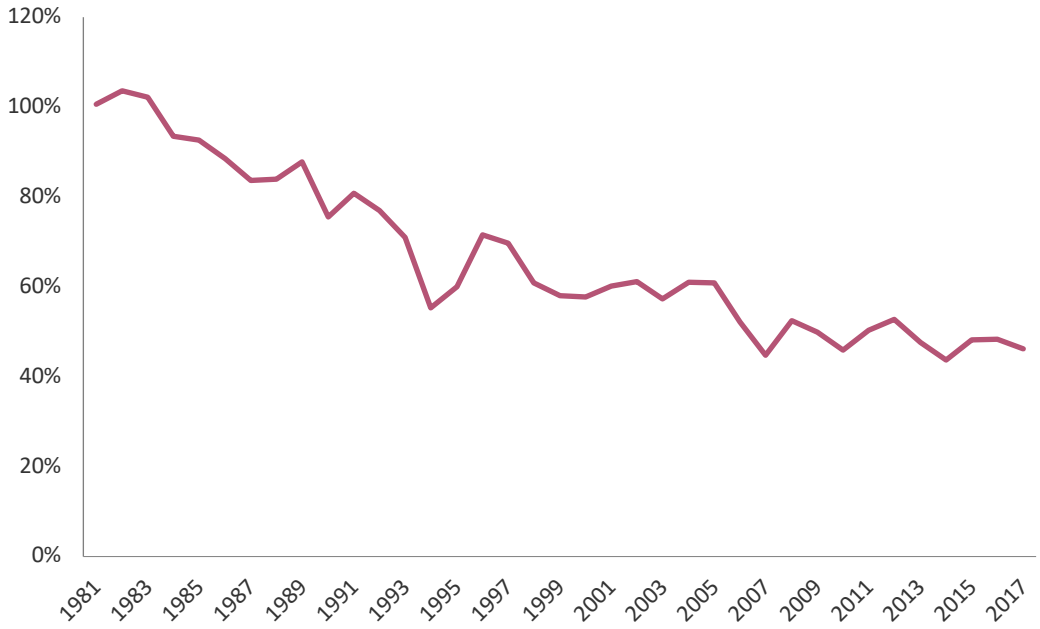

Figure 3. Production/consumption ratio (%) of bovine meat in Portugal through the years (56)

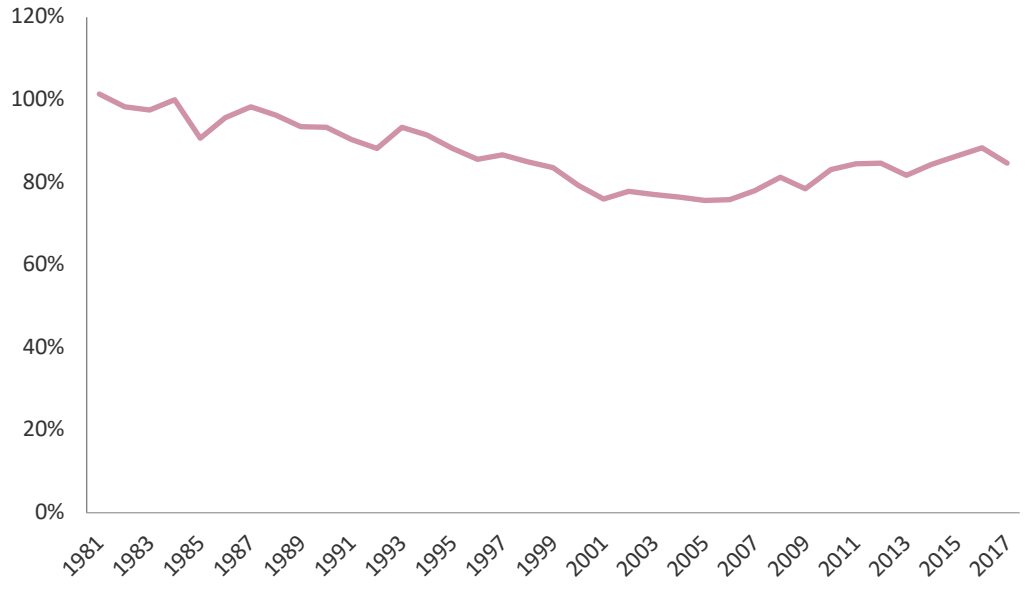

Figure 4. Production/consumption ratio (%) of pork in Portugal through the years (56)

Table 2. Expected outcomes from various policies

What	How	Outcome
Environmental footprint labelling for red meat (57,58)	Provide information about a product's environmental impact, taking into account the carbon/nitrogen emissions at every stage of its lifecycle (57)	Consumers will know if the meat they are buying is environmentally sustainable or not and will become conscious of their purchases in the future
Marketing and educational campaigns	Information campaigns to promote plant based diets may reduce trends towards meat consumption (30)	Increases consumers' awareness on the unsustainability of red meat
Public Procurement (58,59)	Implement a mandatory vegetarian option on public canteens and cafeterias, beyond schools; support sustainable farming and environmentally friendly diets	Increasing plant-based meals availability can increase acceptance and adherence towards low-meat or meatless meals
Integrate environmental sustainability in the national dietary guidelines	Aligning the current Food Wheel with the environmental impact of diets – value legumes over meat (60)	Consumers increase awareness regarding healthy eating that prevent disease and mitigate environmental issues such as climate change, fresh water depletion and GHG emissions
Tax food products with high GHG emissions (58)	Higher Value Added Tax (VAT) on meat	Increases in price, even if small, will most likely reduce its purchase
Incentivise sustainable consumption	Exempt fruit and vegetables from VAT	Increase access to plant-based foods including legumes
Incentivise sustainable production	Support diversified agroecological systems and leguminous crops (51); reduce environmental impact from livestock production	The increase in availability of healthy and more sustainable foods will lead to lower prices, which will lead to higher consumptions

Product placement in food stores (30)	Change the purchasing environment by emphasizing sustainable foods	This architecture can encourage consumers to purchase more sustainable foods
Social innovation and local food system policies	Encourage food system actors to promote plant-based diets through local actions; Support urban planning and local policies towards sustainable eating	Nudging strategies (ex: reducing meat portion sizes), consumer awareness regarding environmentally sustainable diets and foods; promoting social norm transition towards plant-based diets);
Incorporate environmental considerations in schools (61)	School-based interventions through school meal standards	Improves children's diets but also increases awareness about sustainability and climate change
Monitoring actions at national, regional and local level	Food consumption surveys, mapping food system actors, compliance with new regulations, guidelines and policies	Monitoring programs are crucial to evaluate implemented policies and progress towards environmental sustainability