

Healthy and Sustainable Diets for European Countries

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Executive Summary

Despite convincing evidence of the very considerable impact that food systems and human diets exert on public and planetary health, concerted guidelines and policy action that include sustainable aspects, in addition to healthy nutrition, are lacking in Europe. Sustainable diets are nutritionally adequate, safe, and healthy, while having low environmental impact. They are also culturally acceptable, accessible, equitable, economically fair and affordable, contributing to food and nutrition security and to healthy lifestyles for present and future generations. Food and nutrition policies can be powerful instruments for the promotion of population health and provide key levers for improving food systems; however, sustainable development involving food systems has been limited and fragmented.

Key issues necessary to improve the quality of diets and to reduce damaging environmental impacts are increasing the consumption of more plant-based diets, including more vegetables, pulses, fruits and whole-grain cereals, as well as decreasing the consumption of animal-origin foods (i.e. red meat and processed meat), in particular when not coming from sustainable sources (e.g. over-exploited fish species), and avoiding foods and beverages containing trans fats, or with high content of saturated fats, added sugar or salt.

Strategies to promote sustainable healthy nutrition should be planned and implemented at both EU and nation state levels, involving all sectors of society and all levels of the food chain, including governments, local authorities, farmers, environmentalists, and representatives of the food industry, of retail organisations, of catering, of marketing, of the media, of academia, of NGOs, of civil society and of consumers themselves. Public health professionals may provide an alternative, independent source of authority, suitably positioned to harness political and public support to prioritise implementation and monitoring of these strategies, through development of suitable metrics to measure both health and sustainability, and evaluation of the impacts of implementation in both the public and private sectors of the economy on population and planetary health. The private

sector and all those implicated in the food chain should produce, promote and distribute sustainable and healthy products, with reliable and user-friendly consumer information (including food labelling), and implement commitments they have made regarding sustainable healthy nutrition.

A new research agenda for Europe in the field of sustainable food systems is needed. Recent experience has demonstrated that there are many separate, relevant domains of research (e.g. involving nutrition, food science, sustainability, agriculture, economics, social science as applied to farmers and farming communities, research into acceptability of food products to the public, and other research fields as well), but that researchers in these various areas rarely interact with each other. Accordingly, what is needed is a new European research infrastructure devoted to the multidisciplinary aspects of food research, "from field to fork", as is often stated.

Regarding policy, the European Commission and governments of non-member states of the EU should each establish a statutory Sustainable Nutrition Task Force, the responsibilities of which would be, in each jurisdiction:

- to identify essential key features of a healthy and sustainable food system;
- to formulate and to recommend a strategic plan for moving from current food systems towards healthy and sustainable alternatives, including by adopting a multi-disciplinary approach to food and nutrition;
- to plan and recommend a programme for implementation of the strategy for sustainable and healthy food systems;
- to monitor progress towards implementation of such policies;
- to supervise the evaluation of outcomes in relation to both healthy nutrition and sustainability.

In addition, the Common Agricultural Policy (CAP) must be reformed and integrated with the system described above, and European food and agriculture policies must be designed so as to avoid damage to developing countries. The Regional Office for Europe of WHO should take a lead in the development of appropriate sustainable dietary guidelines,

and of accountability systems, such that commitments made can be tracked. The private sector should be encouraged to cooperate fully with policies for healthy and sustainable nutrition, once promulgated.

EUPHA will:

- facilitate and promote the engagement of the European public health community in processes related to sustainable healthy nutrition;
- advocate for the integration of sustainable and healthy diets into public food services;
- continue to advocate for a WHO Convention on Sustainable Healthy Nutrition;
- share lessons learned concerning food and nutrition policies for the promotion of healthy and sustainable diets in Europe.

The Challenge addressed

Dietary habits are a major determinant of the global burden of non-communicable diseases. Public health organisations have traditionally focussed on the adverse direct physiological effects associated with specific dietary components. However, dietary habits have far broader impacts on population health and health of the planet, including threats to climate, biodiversity and ecosystem resilience. While there have been substantial improvements in some aspects of European diets over the past decades, concern has been expressed that health agencies, including the World Health Organisation Regional Office for Europe (WHO Europe), have not included sustainability as an integral part of multi-sectoral food policy.

In October 2015, Martin McKee, the then President of the European Public Health Association (EUPHA), suggested that the Food and Nutrition Section of EUPHA might assist public health leadership in this field by preparing a policy paper calling for a greater alignment of its health and sustainability messages on diet and nutrition. Such a statement would be targeted at European leaders operating in the fields of health and nutrition, agriculture, food safety, education, consumer affairs and environmental protection. The aim was to encourage a broader perspective on sustainable food and nutrition policy, to bring together the dual objectives of tackling the present burden of diet-related non-communicable diseases with future priorities for public and planetary health. Of note, sustainability is defined here as according to the concept of "sustainable development", to include also the three pillars of economy, society, and environment.

To prepare this EUPHA policy paper, a working group of the EUPHA Food and Nutrition Section was formed. The following members contributed to the development of this report: Christopher Birt (FRCP, FFPH, Department of Public Health and Policy, University of Liverpool, UK), Tatjana Buzeti (MBA, Ministry of Health, Slovenia), Giuseppe Grosso (MD, PhD, NNedPro Global Centre for Nutrition and Health, St John's Innovation Centre, Cambridge, UK), Lise Justesen (PhD, Department of Nutrition and Midwifery, Metropolitan University College, Denmark), Carl Lachat (PhD, Department of Food Safety and Food

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The first aim of this report is to summarise the scientific background related to the topics of health and sustainability in the domains of diet and nutrition. The second aim is to provide evidence-based policy recommendations addressing these issues. Nevertheless, this report should not be considered as an exhaustive review of the literature on sustainability of diets in Europe. Instead, it provides a starting point to inform and stimulate discussion and further research, both inside EUPHA, and beyond.

1. Introduction

1.1. Health and environmental consequences of dietary habits: state of the art and policy options

Poor diets are characterised by low intake of whole grains, vegetables and fruit, nuts and seeds, seafood, and milk, whereas intakes of salt, sugar-sweetened beverages, red and processed meat are typically high, associated with low intakes of omega-3 fatty acids, polyunsaturated fatty acids, calcium and fibre [1]. Poor diets are associated with considerable health burdens in European countries. Indeed, they are responsible for a large share of the cancer burden (with an estimated impact of 5.8% of respiratory and gastro-intestinal cancers being related to at least one of the above risk factors), cardiovascular diseases (nearly 50% of myocardial infarction being attributable to dietary risk factors [2], as well as 5.1% of ischemic stroke), type 2 diabetes (3.0%) and chronic kidney disease (2.2%) [3]. Red meat, and especially processed meat products, are associated with an increased risk of cancer [4]. Fruit and vegetable consumption reduces the risk of developing some types of cancer, and it also reduces cardiovascular disease risk. Low saturated fat intake also lowers risk of cardiovascular diseases [4], as does also consumption of fatty fish (containing omega-3 fatty acids).

Poor health outcomes create a burden on society as a whole, for example by increasing health care costs, as well as by affecting work productivity [5]. Meanwhile, current food consumption patterns are also linked to deleterious environmental consequences, such as climate disruption and GHGEs, excessive use of water, food waste, and ecosystem exploitation [6–9]. In turn, these environmental factors may have repercussions on human health and on human economic activities: food production and food security for healthy nutrition being only one of many examples [10].

Both health and environmental consequences have uneven distributions. According to a study conducted in the WHO European Region in 2009-2010, the health burden of non-communicable diseases in Europe is associated with low socio-economic status (usually measured by education level, household income and/or occupational status) [11]. High

socioeconomic status is associated with healthier diets [12,13]. The anticipated global increase in demand for meat, dairy and fish products is likely to increase their costs as well as those of soya and cereals, which could hurt the poor selectively [14]. Among other socioeconomic determinants, levels of education have a strong influence on household food choices, purchases and eating patterns: this relationship has been documented, for example in purchases of fish, of fruit and vegetables, and of fats and cheese [15–17].

There is also a gender aspect: men eat more meat than women [18]; this is also reflected in greenhouse gas emissions (GHGEs): in a Dutch study, 4.6 kg CO2 per man versus 3.7 kg C02 per woman per day were recorded. Meat, eggs and fish contributed most to the overall GHGE count, especially for boys. However, people consuming diets associated with high GHGE levels also consumed more alcohol, soft drinks, fat and protein and less poly-, mono- and disaccharides, as compared to those consuming diets with lower environmental load [19]. The environmental burden related to food consumption is not only observed in European countries: there is strong evidence that poor populations in low- and middle-income countries are strongly affected and that they are highly vulnerable to environmental disruption, such as climate change, droughts and natural disasters [20].

1.1.1. Global action and commitments: the momentum towards better nutrition and health in the context of greater prosperity and healthier environments

Both nutrition and sustainability are high on the global political agenda as reflected in the “2030 Agenda for Sustainable Development” resolution accepted by the United Nations (UN) General Assembly in 2015[21].

The significance of food and diets in sustainable development can be further observed in the UN 17 Sustainable Development Goals (SDGs) document [21]. Examples include:

- Goal 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture" has challenging targets about ending all forms of malnutrition, improving agricultural productivity, with equal access to land, coupled with sustainable food production systems and resilient agricultural

practices, genetic diversity, appropriate trade measures and the proper functioning of food commodity markets;

- Goal 3 "Ensure healthy lives and promote well-being for all at all ages" is also important, as healthy nutrition is related both to child health (target 3.2) and to the reduction of non-communicable diseases mortality (target 3.4);
- Goal 12 "Ensure sustainable consumption and production patterns" requires sustainable management and efficient use of natural resources, reduced food waste and losses from harvest to consumer, and the promotion of sustainable procurement patterns;
- Goal 14 "conserve and sustainably use the oceans, seas and marine resources" requires the prevention of nutrient pollution (target 14.1) and the end of overfishing and destructive fishing practices (target 14.4).

In Figure 1, all SDGs have been classified within the framework of sustainable food systems. Three SDGs are included in all four categories. Stability refers to the ability to withstand shocks to the system. Four different categories are used to classify the SDGs:

1. environmental aspect at regional level;
2. availability aspect at national level;
3. accessibility aspect at household level; and
4. utilisation aspect at individual level.



Figure 1. Sustainable food (secure) systems and Sustainable Development Goals. An exercise in positioning all the 17 SDGs within the framework of Sustainable Food Systems. Courtesy of Elliot Berry.

In late 2015, the United Nations Framework Convention on Climate Change adopted the Paris Agreement [21,22]. Parties signing the Paris Agreement, in Article 2, agreed to strengthen the global response to climate change, by "*increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production*" [22]. Lastly, in April 2016, a decade on nutrition was declared, which is an unprecedented window of opportunity to develop and to implement sustainable food systems that deliver the best possible health outcomes for all [23,24].

1.1.2. Food and nutrition policy development in Europe from a sustainability perspective

Building on Scandinavian successes in the last few decades, the WHO Regional Office for Europe has been instrumental in providing guidance for food and nutrition policy in Europe. Three consecutive versions of the Action Plan for Food and Nutrition Policy have been prepared since 2000. As reported by a 2013 review of nutrition policies in the world,

91% of the countries in the European region had policies for obesity and diet-related non-communicable diseases [25]. Progress can be summarised as follows:

- In the First Action Plan for Food and Nutrition Policy 2000-2005, sustainability was mainly considered in the context of food security: "*A sustainable food supply (food security) strategy to ensure enough food of good quality, while helping to stimulate rural economies and to promote the social and environmental aspects of sustainable development*" [26]. No specific goals or targets were proposed in this regard;
- In the Second WHO European Action Plan for Food and Nutrition Policy 2007–2012 [27], a similar approach was adopted. Action area 2 aimed to ensuring safe, healthy and sustainable food supplies, with particular attention to programmes for the protection of vulnerable and low socioeconomic groups. The emphasis on sustainability was largely to ensure adequate availability and accessibility to healthy foods (i.e. fruit and vegetables, water for all - in particular through publicly owned organisations - product reformulation and financial interventions);
- The Food and Nutrition Action Plan 2015–2020 [11] calls for action on healthy diet over the life course, to achieve affordable, balanced and healthy nutrition, with a further aim to assure equity (including gender equality) in accessing healthy and culturally acceptable nutrition for all citizens resident in the WHO European Region, through inter-sectoral policies in the context of Health 2020 [11]. With regard to healthy and sustainable diets (see definition in 1.2) stronger collaboration and governance efforts are proposed.

1.2. Defining sustainability and sustainable diets

The concept of "sustainability" emerged in the late 1980s and culminated with the definition of sustainable development in the UN report "*Our common future*" (1987), (also known as The Brundtland report): "*Sustainable development seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future*" [28]. A

well-established framework to address sustainable development is people / profit / planet (or society / economy / environment), where sustainability is situated at the intersect of firstly what is beneficial for society, secondly the economy, and thirdly the environment [29]. This concept has been taken forward as Planetary Health [30].

A first definition of "sustainable diet" was given by Gussow and Clancy (1986), who defined it as being "*composed of foods chosen for their contribution not only to health but also to the sustainability […] of the agricultural system*" [31]. According to FAO, *"Sustainable Diets are those diets with low environmental impacts, which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimising natural and human resources"* [32], where "*nutrition security*" and "*healthy life*" clearly imply healthy and sustainable eating, indicating synergies between environmental and human health. As already mentioned, WHO Regional Office for Europe defines healthy and sustainable diets as "*diets high in vegetables, fruit and whole grains, with limited intake of saturated fat, trans fats, sugar and salt*" [11].

In 2014, Aiking stated that "*sustainability is not a static notion but a moving target which should be understood as a challenge to preserve the adaptability and resilience of the natural (biotic and abiotic) systems that form the basis of economic and social development*" [33]. Particular attention to the time dimension is given by Berry and colleagues (2015), as presented in Figure 2 [34]. Berry and colleagues (2015) present the interrelations between Food Security and Sustainability. Stability is considered as the short-term dimension, and sustainability as the long-term dimension in the scheme [35].

While acknowledging the importance of the future dimension (for future generations), given for example by the FAO definition, and its dynamic inferences, underlined by Aiking (2014) [32,33], the working group decided to use the WHO definition as the reference definition for this report, in light of the prominent role of the WHO on health matters generally.

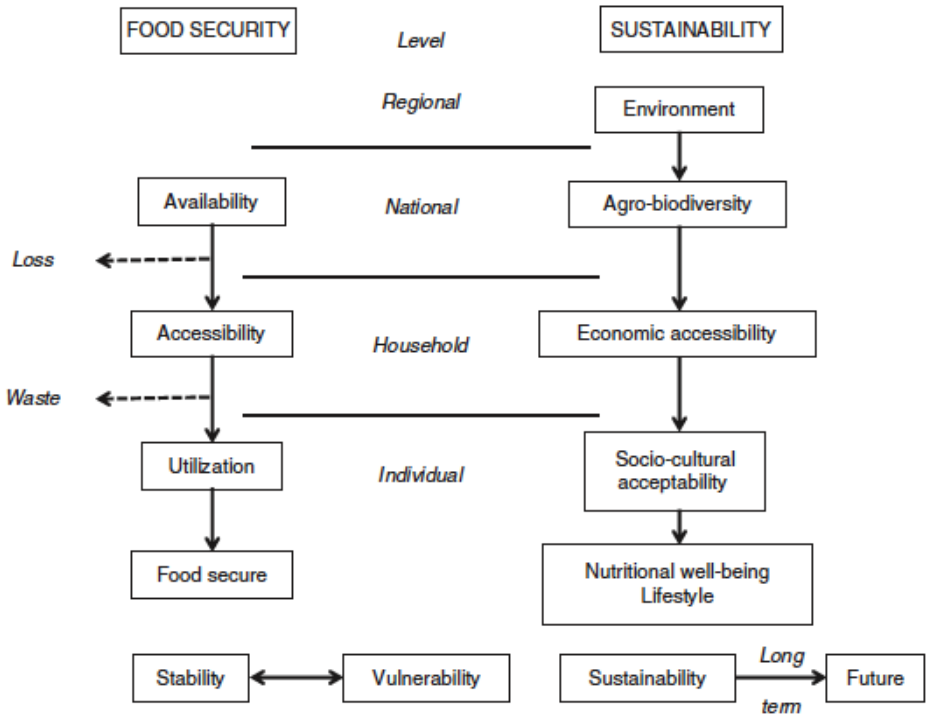


Figure 2. The elements and time dimensions of food security and sustainability [35]

2. Aim and purpose

The Governing Board of EUPHA requested the EUPHA section on Food and Nutrition (hereafter EUPHA (FN)), following its 2015 conference workshops[1], to address the absence of a coherent plan in Europe for healthy nutrition and food security that encompasses sustainable dietary guidelines, taking account of climate change and other environmental challenges. The Governing Board's proposal was that EUPHA (FN) should publish evidence-based policy recommendations addressing these issues.

EUPHA (FN) established a working group that was specifically asked to:

- identify the most appropriate evidence and programmes available to inform coordination of food policy, taking account of all the principal issues surrounding both health and sustainability;
- develop a policy position for EUPHA on food, sustainability and health, and to raise awareness amongst key policymakers of the need for an integrated approach to food policy;
- summarise the available evidence in an accessible manner, such that this might subsequently inform policy makers, in order to help raise the profile of an emerging European food policy.

In preparation for this task, a background document was prepared summarising the vast literature on the topic, with specific emphasis on the following aspects:

- description of current European diets;
- individual and societal costs and benefits of sustainable healthy diets;

[1] Pre-conference "*Can we feed Europe sustainably and equitably?*", and workshop "*Public health nutrition: major policy areas in need of decisions*", organised during the eighth EPH Conference, held in Milan in October 2015.

- interests of the different food “actors” and stakeholders, both at European and nation state levels;
- description of political processes, actions and experiences (e.g. integration of sustainability within Food Based Dietary Guidelines, labelling of sustainable food choices, fiscal measures and sustainable public procurement - all defined in the following sections of the document);
- tracking of impact and successes.

Health and socio-inequalities are treated herein across chapters, rather than in a separate section.

During the preparation of this document, the working group reported regularly to EUPHA (FN), concerning what material to present to the Board.

3. Methods

The working group was established in November 2015 and met at regular intervals, mainly using Skype communication. A face-to-face meeting was organised in Slovenia on June 29-30, 2016 to discuss the findings of the work, which involved essentially six rapid reviews on the following topics (the working group was divided into pairs of researchers, with each pair addressing one of these topics):

1. Descriptions of European diets (including trends and social patterning), their determinants, and implications for other countries;
2. Consideration of individual and societal costs and benefits of sustainable healthy eating, including study of methods of estimating costs and benefits;
3. Sustainable dietary guidelines that consider both health and environmental sustainability;
4. Available conceptual models and tools to inform decision-making on food, sustainability and health;
5. Mapping out the range of food "actors", including the agricultural sector and various commercial organisations active at European level, and actors at other levels where they exert a substantial impact on European policy decisions for future sustainable agriculture, food and nutrition;
6. Identifying evidence-informed food and nutrition policies most likely to provide health and sustainability gains, especially those with indicators to measure the effects of sustainable food and nutrition policies, to track progress and to measure success.

Literature on the above topics was reviewed according to the reported search syntax (see Appendix). A total of 92 papers was selected, after the first screening. Then, the bibliography of each paper was carefully checked for other relevant sources. Moreover, each pair of researchers added papers deemed important from expert knowledge of the field. A data extraction template was prepared to summarise the findings of the papers.

After the above meeting, the working group drafted a summary of the conclusions and prepared a brief statement on Food, Sustainable Nutrition, and Health which was presented to the EUPHA Governing Board in November 2016. This statement summarised the findings

from the aforementioned reviews. Meanwhile and subsequently, work on this main report proceeded.

4. Evidence on healthy and sustainable diets

4.1. Dietary patterns in European countries

Food consumption in Europe is changing: some countries are moving towards healthy and environment-friendly diets, maybe driven by rising awareness of determinants of health or of climate change [36–38], while others are moving away from them; some changes are seen on a global scale, such as an increase in meat consumption, while others are more local. In Europe, countries are still in various positions, both economically and geographically; despite these differences, the direction of change seems to be towards a common European dietary platform, with local and regional variations.

The following changes are evident:

1. Considering food supply, more meat is becoming available, quantities of available poultry are growing (see Table 1), and, in parallel, the availability of vegan proteins is increasing.
2. A common European diet is becoming established across different parts of the continent, following a process of westernisation [36]. For example, the supply of dairy products in South and East Europe is reaching levels equivalent to those observed previously in North and West Europe [38].
3. Eating out of the home is becoming increasingly common [39], and changes in eating environments (e.g. availability of fast food outlets) are themselves affecting diets [40–42].
4. Although food deserts (as defined by the United States Department of Agriculture (USDA) as "areas where people have limited access to a variety of healthy and affordable food"[43]) are not yet common in Europe [44], more healthy eating environments are needed [45].
5. The observed influence of both regional preferences and urbanisation on diet quality highlights the importance of planning and implementing nutrition strategies at regional level [46].

Table 1. Food supply in European regions from 1961 to 2013. Based on FAOSTAT[20] supply in kilograms per capita per years.

	EU	Eastern Europe	Northern Europe	Southern Europe	Western Europe
Meat					
1961	47.37	41.69	63.00	27.27	66.06
2013	77.34	68.75	82.28	81.94	85.28
change	+63%	+65%	+31%	+201%	+29%
Poultry					
1961	4.61	3.71	5.39	3.74	6.65
2013	23.35	25.27	27.94	21.28	19.64
change	+407%	+581%	+418%	+469%	+195%
Pig					
1961	21.63	20.34	24.62	9.79	31.74
2013	34.61	28.92	28.38	39.54	42.57
change	+60%	+42%	+15%	+304%	+34%
Fish and seafood					
1961	13.91	11.51	20.71	17.30	12.59
2013	21.85	17.02	25.34	29.07	21.45
change	+57%	+48%	+22%	+68%	+70%
Milk and butter					
1961	171.08	157.36	245.98	115.93	202.95
2013	215.11	171.05	261.44	211.55	261.29
change	+26%	+9%	+6%	+82%	+29%
Pulses					
1961	3.54	3.28	2.38	7.20	1.80
2013	2.56	1.78	3.12	5.19	1.34
change	-28%	-46%	+31%	-28%	-26%
Animal Fat					
1961	11.16	9.57	19.01	3.87	15.97
2013	10.99	9.19	9.81	7.81	16.93
change	-2%	-4%	-48%	+102%	+6%
Vegetable Oil					
1961	8.00	5.12	9.37	11.25	10.13
2013	17.65	14.24	15.82	24.08	18.64
change	+121%	+178%	+69%	+114%	+84%
Sugar & Sweets					
1961	32.47	30.91	50.54	21.76	34.75
2013	41.75	44.43	42.09	31.68	45.64
change	+29%	+44%	-17%	+46%	+31%
Fruits					
1961	49.42	23.66	54.00	80.30	73.35
2013	94.93	67.79	122.67	112.62	107.64
change	+92%	+187%	+127%	+40%	+47%
Vegetables					
1961	85.39	78.61	51.96	123.82	85.56
2013	115.10	67.79	96.46	136.75	97.50
change	+35%	-14%	+86%	+10%	+14%

Meat, fish and dairy products are primary sources of protein, but in European countries protein intake is higher than that recommended by WHO [38]. Moreover, red meat consumption is twice as high as recommended by the World Cancer Research Fund [38]. Consumption of livestock products, including eggs, has shown a modest rise in Europe, whereas consumption of milk is declining, with no changes being apparent in cheese or butter consumption. Animal fat consumption generally seems to be declining [37]. While the supply of fish is increasing in most countries, Europeans consume only half of the recommended quantities of this [38]. Similarly, the supply of fruit and vegetables is also increasing, but consumption of fruit and vegetables remains too low: more than half of Europeans eat less than 400 g per day as recommended by WHO [15,47].

North-south as well as the east-west gradients in vegetable availability are evident: in northern countries, the availability and supply of vegetables are lower than in the south and east. Geographical gradients are observed for fruit as well, whose availability and supply are at their lowest in eastern countries [15,20,48]. Northern Europe appears to be adopting a healthier diet by increasing consumption of fruit, vegetables and fish, and by reducing fat consumption [37].

Daily fruit and vegetable intake varies also by gender, for both children and adults [49,50]. In 2013/14 the highest daily consumption of fruit was found in girls in Albania (55% reported daily consumption of fruit), and in Denmark and Switzerland (both at 51%), while the lowest consumption in boys was observed in Finland (12%), and in Latvia and Sweden (both 19%) [50]. The situation for daily vegetable intake is similar. The highest consumption (though still lower than recommended consumption levels) is found in girls in Belgium (61% reported daily consumption), while the lowest was in boys in Finland (15%) and in Germany (16%). In these studies the boys and girls referred to were aged 15 years old. Similar gender differences are found in adults: the highest consumption of vegetables was found in women in Belgium (roughly 80%), while the lowest was in men in Germany (less than 30%) [49]. There is also a clear difference in fruit and vegetable consumption by educational level, in favour of more highly educated adults. However, only 5% of the well-educated people in Romania

and 33% of well-educated people in Denmark ate the recommended amount of five portions of fruit and vegetables per day [49].

The rise in food energy intake seems to be a two-sided phenomenon. Extra calories come partly from cheaper foods as well as from the shift from carbohydrate-rich staples towards vegetables oils, animal products and dairy foods [37]. Predictions up to 2050 suggest that cereals will remain the most important food source in developing countries (54% of calories) but much less than this (30%) in UK [37]. Supply and consumption of sugar and sweeteners have increased generally in the European Region, the Northern European countries providing an exception to this [15,20].

4.1.1.Examples of traditional European diets

Regional diets, like the Mediterranean Diet (see Box 1) , the Traditional Nordic Diets and the New Nordic Diets (see

Box 2), have been promoted as solutions to the demand for healthier and more sustainable nutrition [34,51]. Certain traditional European dietary patterns promote sustainability within the context of a healthy diet: they include high intakes of olive oil or nuts, fruit, vegetables, pulses and cereals, and low consumption of meat and dairy products [52–54]. In addition, diet is considered as an integral part of local lifestyles which include traditional recipes, seasonality, socialisation, and regular physical activity [55,56].

Box 1. Example: the Mediterranean diet

The Mediterranean diet has been marketed as both healthy and sustainable [57]. It is characterised by low consumption of saturated fatty acids and high intake of carbohydrates [58]; however, the decreasing adherence to such traditional food patterns often results in diets of lower quality [36,37,48,59]. There is evidence that adherence to a Mediterranean diet may decrease the risk of diet-related chronic diseases, while also promoting longer lifespans and healthy aging [60]. Yet a literature review of the data on dietary habits, food consumption and nutritional status of adolescents in Southern European countries found that the traditional low consumption of saturated fatty acids and high intake of carbohydrates have been lost [61]. The Mediterranean diet has lower environmental impact but higher cost than current Italian diets [62].

Box 2. Example: The Nordic diets

The Traditional Nordic diets have also had both good health and positive environmental impacts [63,64]. The New Nordic diet has shown improved dietary intake and nutrition content among children, and is associated with to weight loss and blood pressure reduction in centrally obese individuals, and it improves blood lipid profiles and insulin sensitivity [65–68]. It has been estimated that change towards New Nordic diets in Denmark would save 18,000 Disability-Adjusted Life Years (DALYs) per year by preventing non-communicable diseases [69].

4.1.2.Local food, organic food and food in season

Across Europe there is an increased demand for, and consumption of, locally produced food. While this trend, often used within marketing claims, is noted in political circles, there is no scientific evidence that local food production is universally superior to non-local food in terms of its impact on either climate or health [70]:

- Based upon a qualitative assessment, and taking UK as an example, Edward-Jones (2010) showed that GHGEs per item of food would probably be *greater* under a scenario of self-sufficiency than under current food systems [70];
- According to Garnett and colleagues (2008), transport contributes 12% of total GHGEs for many foods, although air-freighted refrigerated foods contribute a much higher proportion than this [71];
- Consumption of food from small geographical areas may also increase the risk of nutrient deficiencies, such as iodine deficiency [72], unless some foods are fortified.

Organic agriculture may have a role to play as it values traditional plant and animal species, thus improving biodiversity and diverse diet patterns [73]. Furthermore;

- Lindenthal and colleagues (2010) report substantial positive differences in GHGEs between organic production methods as compared to conventional farming in Austria [74]; on the other hand, organic farming tends to give on average 25% lower yields as compared to conventional farming, thus undermining the environmental benefits of organic practices. Benefits of organic farming are highly contextual [75].

- Organic production tends to improve biodiversity and sustainability within rural communities; on average 5% of EU land is being used for organic production, with Italy, Germany, and the UK ranking as the first three major organic producers in Europe [37].

Consumers who buy organic food consume significantly more fruit, more vegetables and more whole grains and less red meat, and they seem to align themselves well with sustainable diets [69]. Consumption of organic food is associated with health and healthier dietary behaviour, but organic food itself is not necessary healthier or safer than is conventional food [76,77].

As for seasonal products, according to Garnett (2006), consuming food in-season tends to be associated with lower GHGEs because of the reduced use of greenhouse production [78]; Macdiarmid presented similar findings [79]. However, low GHGE diets lead to reduced consumption of non-seasonal fruit and vegetables, and this could represent a public health problem in winter and spring in those countries where local availability is limited [78,80].

4.1.3.Towards a sustainable diet

Systematic data on the sustainability of European diets are not available; however, useful data come from:

- Pan-EU projects that offer valuable insights on diets and facilitate comparison among EU countries (one example is the EU Framework for National Salt Initiatives, through its call for effective mechanisms for monitoring salt reduction programmes, and the consequent EU Framework for National Initiatives on Selected Nutrients) [81];
- Food Balance Sheets of FAO, published from 1961 to 2011, containing data on total production, import and stocks of food [82];
- Household budget surveys, which provide national data on food availability at the household level [15].

Despite the lack of systematic data and comparable studies, a few conclusions can be drawn. Our current food system, which is characterised by *"low cost food at high cost to the environment"* [83] is unsustainable [84]. Diets that follow nutrition recommendations (for example the Nordic Nutrition Recommendation 2012) [55 85] are, as stated earlier, beneficial both for health and for the environment [51,57,86–89].

The ecological footprint, similar to water and carbon footprints, is related to meat, dairy and wheat consumption, but differs by region [83]. With respect to water footprint, animal products have been shown to have the greatest adverse role in relation to this [90].

Consumer actions alone can easily lead to a 25% reduction in GHGEs [91]. Considering climate change and carbon footprint, the largest reduction in GHGEs can be achieved by eliminating meat from the diet (35% reduction, compared to an UK average diet), followed by changing beef and lamb to less carbon-intensive pork and chicken (18% reduction) [92]. On the other hand, Vieux et al. (2012) claimed that isocaloric substitution of meat with fruit and vegetables does not reduce GHGEs [93]. Therefore, guidance to increase intake of fruit, vegetables, nuts and seeds for healthy sustainable diets is valid at population level, but, for individuals already having above recommended intakes, reducing amounts consumed does not help substantially to lower greenhouse gas emissions [94]. Moreover, nutritional quality of meat-free diets should always be assessed, together with their affordability, acceptability and environmental impacts [95]. According to a score system for health and sustainability, the best options are diets with a pesco-vegetarian orientation [64].

An attempt to analyse the relationship between dietary impacts and GHG emissions, land use and water use all together has been done by Aleksandrowicz and colleagues (2016), who systematically reviewed 63 studies and found proportionality between restriction in consumption of animal-based food and reduction in environmental footprints [96].Compliance with healthy eating guidelines leads to lower energy demands and a decrease in GHGEs, largely due to a lesser reliance on livestock-based food products. Furthermore, less arable land and grassland is needed for animal feed production; moreover, vegetable protein production requires much less farmland per unit of protein produced than does animal protein production [97]. Based on the above,

Table 2 summarises potential actions individuals might take to achieve a more sustainable and healthy diet. It is acknowledged that this table does not include all food groups.

Table 2. Summary of potential actions individuals might take to achieve a more sustainable and healthy diet.

Target to achieve a more plant-based diet	Prefer and use more	Avoid and use less
Fruits and vegetables	Use more and different varieties of fruits and vegetables. Prefer seasonal products.	Inform decisions about place of production, seasonality and excessive irrigation. Avoid juices with added sugar.
Meat and dairy	Consume in moderation. Prefer plant-based proteins. Have meatless days.	Eat less red meat (less often, and smaller portions). Avoid high content of saturated fats.
Pulses	Use as protein source. Use more varieties.	Avoid salt during cooking.
Fish	Use more and different varieties. Prefer oily fish from sustainable fishing grounds or aquaculture.	Avoid fish products with high salt content, e.g. preserved fish and fish sauces.
Cereals	Prefer whole grain cereals. Use different varieties.	Avoid processed products with added sugar and salt.

4.2. Consideration of individual and societal costs and benefits of sustainable healthy eating

In contrast to the solid evidence on eating patterns and their effects on health, evidence demonstrating the interaction between diet and environmental sustainability has emerged only more recently. Sustainable dietary guidelines need to take account of costs and benefits of healthy and sustainable diets at both individual and societal levels, as represented in

Table 3.

Table 3. Benefits and costs of a sustainable and healthy diet, at individual and societal levels.

	Costs	Benefits
Individual	• Monetary and non-monetary costs of a healthy diet.	• Quality and quantity of life (lower prevalence rates for overweight, obesity and non-communicable diseases).
Societal	• Costs related to policy making and to implementation of policy designed to move dietary choices towards healthy and sustainable diets.	• Lower economic losses related to overweight, obesity and non-communicable diseases; • Lower environmental impacts.

4.2.1.Individual costs and benefits of a sustainable healthy diet

Various problems arise regarding the estimation of costs of healthy diets. The first critical issue is about the unit of measure to be used when estimating these costs. Indeed, the same food could be defined as cheap or expensive, depending on the unit of measure used. This is true in particular in the case of fruit and vegetables. For example, using *price per energy* as a unit of measurement, fruit and vegetables, which are rich in nutrients and low in energy density, appear to be expensive when compared to foods containing a high content of saturated fats and added sugars. In contrast, when the unit of measurement considered is *price per edible volume* or *mass* or *portion*, fruit and vegetables (including pulses) appear cheaper than both most animal-origin protein foods and most energy-dense nutrient-poor foods [98]. A second issue is that additional costs associated with transport to markets, home cooking and related activities, such as washing and storage, are rarely included in price studies [98].

Low-income individuals and families are more likely to choose cheaper and more satiating energy-dense nutrient-poor processed foods [98], especially if groceries are bought in small-to-medium sized shops [99]. This effect may be driven by the cost of food, which is often not regulated by public health policy (traditionally mainly concerned with national food security issues). For instance, a study conducted in the UK showed that healthy foods and beverages are not only more expensive than are their standard counterparts, but had

also experienced comparatively higher price increases since 2002. Such a trend widens the price gap between healthy and unhealthy food items, imposing additional burdens on the most vulnerable socio-economic groups [100].

In addition to price, other factors are involved when dietary habits are formed, maintained or changed. For instance, individual preferences towards certain items affect purchases [101], and social norms (and the consequent social judgments, by which social norms are enforced) have been associated with the quantity and quality of foods consumed [102].

The benefits to health of a sustainable healthy diet are considerable. Various models have been proposed for the calculation of numbers of deaths attributable to unhealthy diets [103,104]. The Global Burden of Disease Study Group, amongst others, has made a comprehensive assessment of the burden related to diet and lifestyle in European countries, in terms of DALYs [105].

Increased fruit and vegetable consumption contributes to improved health and welfare. Indeed, an estimated 16.0 million (1.0%) DALYs and 1.7 million (2.8%) of deaths worldwide are attributable to low fruit and vegetable consumption. At the same time, consumption of high levels of high-energy foods, such as processed foods with high content of fats and sugars, is one of the causal determinants of obesity [106]. In the WHO European Region, in 2014, an estimated 2.4% of the overall burden of disease was attributable to low intake of fruit and vegetables [107].

4.2.2.Societal costs and benefits of a sustainable healthy diet

In the previous sections, evidence has been provided on the need for well-directed policies to influence consumers' behaviours towards healthy and sustainable food patterns. Their development is complex, and both time- and resource-consuming. Because of these constraints, such policies can only be developed at the expense of some others, and thus this becomes a question of national priorities.

Societal costs include those related to implementation (for instance, if fiscal measures are adopted in the form of subsidies, the necessary finance needs to be collected and/or

mobilised), and to surveillance and monitoring systems (which are essential for assessing whether a policy is working or not). Lastly, if a policy does not have an explicit focus on inequality, it is quite likely to widen inequalities and to create a more unequal (and therefore less healthy) society [108].

Major environmental problems include effects on climate change, loss of biodiversity, erosion, loss of soil fertility, salination of water tables, unsustainable rates of water extraction, and reliance on fossil fuel-derived energy [109]. As stated previously, a growing body of literature has examined the environmental impacts of dietary patterns using various indicators, including greenhouse gas emissions, land and agricultural capacity, primary energy use, and water use. However, research in this area is still limited and results are difficult to compare because of a lack of any standardised methodology for reporting results [110].

Some authors argue that significant reduction of GHGEs in developed countries could be achieved more effectively by means of interventions in other sectors, such as transport, rather than by population-based shifts in eating patterns [110,111]. On the other hand, dietary change could reduce by up to 50% the GHGs and land use demands of current diets [92,112], or even more, if more radical dietary changes could be achieved [113]. The reduction potential not only depends on the amount and types of meat in the diet, but also on the environmental impact of the foods used to replace meat [92].

Alternative production systems, for instance diversified farming systems, support biodiversity, soil quality, carbon sequestration, and water-holding capacity in surface soils. Compared with conventional farming systems, such farming systems have demonstrated increased efficiency in energy-use, with consequent reduction of global-warming potential, and resiliency to extreme weather events [114]. The way food is produced is of major significance if environmental improvement is to be achieved. For example, lands unsuitable for cropping and crop residues can be used for ruminant dairy and meat production, which, in turn, may increase food security, diet quality, and provide environmental benefits via nutrient cycling [115].

Climate is not the only relevant environmental issue. Natural resources are being depleted rapidly in the absence of economic and ecological systems that sustain them [116]. For example, it is estimated that irrigated agriculture globally accounts for 70% of the consumption of freshwater resources [6]. Production of livestock uses 70% of all agricultural land [8], and the links between land degradation and loss of biodiversity are increasingly recognised [6,8]. Furthermore, while fishery products are a great source of nutrients, providing proteins, vitamins, minerals, and omega-3 fatty acids [117–119], it is estimated that 53% of global wild fish stocks are fully exploited and 32% are overexploited [32]. Policy-oriented economic models that integrate ecosystem processes are needed, so as to address effectively ecological system failures, to monitor the food market, and to evaluate progress towards policy targets [116].

5. Relevant food actors in the European food policy landscape

All stakeholders, from policy makers to consumers, must be involved in future in the development of all programmes and policies that promote sustainable healthy diets [7]. Effective improvements in sustainable population dietary behaviour require for their success close collaboration between all of these stakeholders, who include academics, practitioners, managers of health systems, insurers, local communities, schools, workplaces, advocacy groups, policy makers, farmers, retailers, restaurants and food manufacturers [120] . There are numerous food actors operating in this field in Europe, who ultimately influence individual behaviours and choices towards (or away from) healthy and sustainable diets, as illustrated in Figure 3 [121].

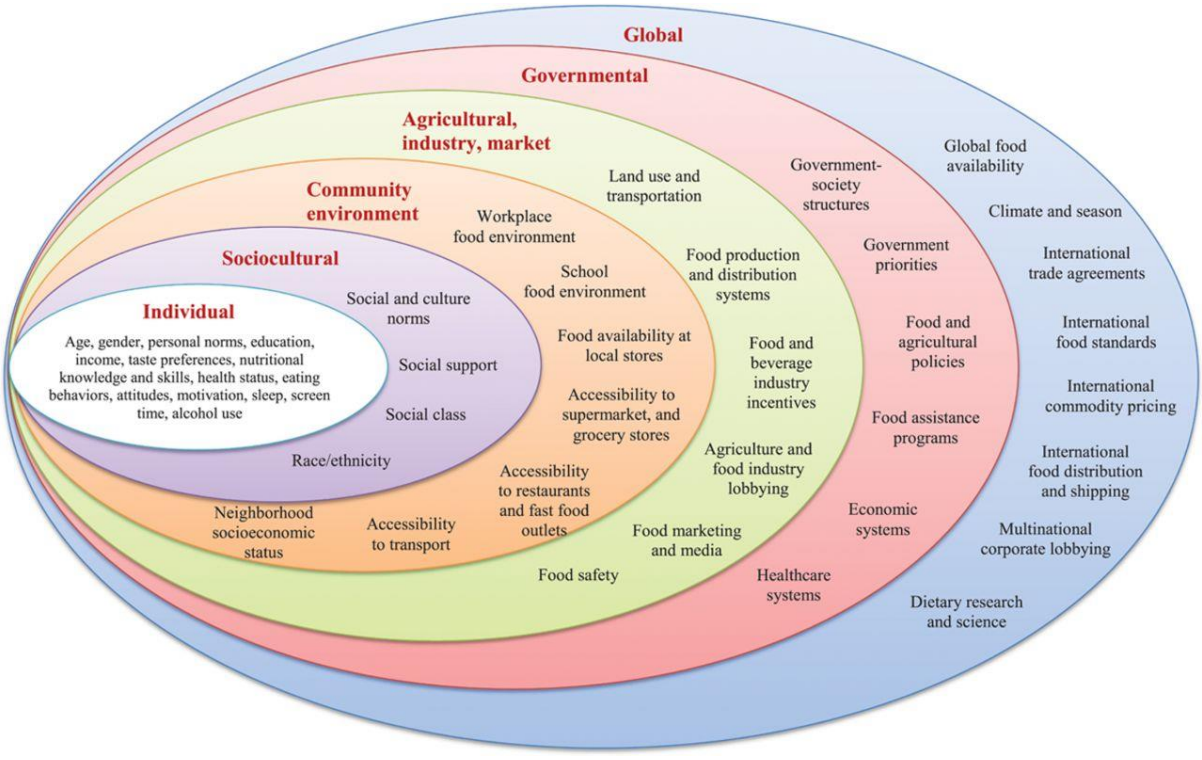


Figure 3. Barriers and opportunities for healthy eating. Reproduced from Afshin et al. (2014)[121] with permission of the publisher. Copyright © 2014, John Wiley & Sons, Ltd.

5.1. The European Union and its regulatory framework: information to consumers, and the Common Agricultural Policy

The European Union (EU) has a role in improving nutrition and in consumer health protection, according to the Lisbon Treaty, and based on the General Food Law Regulation. The General Food Law Regulation sets out an overarching and coherent framework for the development of food and feed legislation, both at Union and at member state levels. It also builds on an integrated approach to food safety *"from farm to table"*, that covers all sectors of the food chain, including feed production, primary production, food processing, storage, transport and retail sales [122].

Existing EU policy measures include legislation on food information to consumers [123]; depending on the label, information is provided on nutritional content, on the origins of foods, and on health claims. From December 2016, nutritional information has been compulsory on all packaged food products and a statement of origin of fresh meat is also now mandatory [123]. A regulation on nutrition and health claims [124], promulgated in the EU in 2007, aims to ensure that such claims are truthful and not misleading; it also aims to stimulate innovation in the food industry to produce healthier food products [124]. At the EU level, a law on organic production has been passed, which sets out rules and guidelines and which defines the appropriate labelling of organic foods.

The EU is not only active in providing information, but also in shaping common policies such as the Common Agricultural Policy (CAP). CAP, as in most post-war food policies in Europe, focused on food security and encouraged an increase in a secure food supply through research, education and farm support, in order to provide stability to agricultural markets and to increase efficiency. CAP-related actions, such as price support and guaranteed collection, led to overproduction. To eliminate the surplus in dairy production, quotas were introduced in the 1980s, and, as a result, production levels fell. De-regulation brought even further falls in production in various fields. Boulton et al. (2011) describe the regulation and deregulation effects on the dairy industry in the UK, linked to CAP, which included moves towards more sustainable intensification of production [125]. Another

outcome was that low prices for quality food products became a policy priority. This resulted in a dominant role for retailers, and a lesser one for individual farmers, who care for their own local environments [125].

Integrating environmental concerns into the CAP is currently a crucial priority, with the aim of avoiding the risks of environmental degradation while enhancing the sustainability of agro-ecosystems. The CAP has identified three priority areas for action to protect and enhance the EU's rural heritage:

- Biodiversity and the preservation and development of 'natural' farming and forestry systems, and traditional agricultural landscapes;
- Water management and use;
- Dealing with climate change.

The integration of environmental concerns into the CAP is based on a two pronged approach: ensuring a sustainable way of farming by avoiding environmentally harmful agricultural activity, while also providing incentives for production and marketing of environmentally beneficial public goods and services [126].

It should be noted that climate change at the EU level is addressed mainly through the EU Emissions Trading Scheme (ETS), which relates to CO_2 emissions from power plants and large industrial facilities, representing approximately 45% of Europe's GHGEs. CO_2 emissions from sectors like agriculture, transport, and housing are not included within the ETS. Similarly, non-CO_2 emissions (such as methane, which contributes an important share of agricultural emissions) are also not included in the ETS; yet, according to FAO, agriculture emissions contribute to 10-15% of global warming gases [127]. Moreover, supporting healthy nutrition is not yet given much priority in current EU agricultural policies, and addressing this conceptual gap remains highly challenging [128].

The Commission has recently launched a proposal for Effort Sharing among Member States to tackle the GHGEs not covered by the ETS [129]. While energy efficiency in agriculture is one of the possible areas for improvement, there are fears that EU member states will

address other domains, such as sustainable mobility, rather than the more significant domain of agriculture.

5.2. The food supply chain: agriculture, food industry and retailers, and the role of governments

The food supply chain connects three main sectors: the agricultural sector, the food processing industry, and the distribution sector (wholesale and retail) (see Figure 4 and Figure 7). The food supply chain is complex. It is composed of a wide variety of companies, selling a diversity of products; these companies operate in different markets and sell a variety of food products to various types of purchasers. The regulatory framework affects the food supply chain at all levels, from the agricultural sector to retail shops. The degree of market power held by firms along this chain varies by product category and is influenced by the relevant markets in which these firms operate. Market power has a considerable impact on the contractual relationships between the main players along the chain, and it can influence the degree of translation of increases in agricultural commodity prices into consumer prices [130].

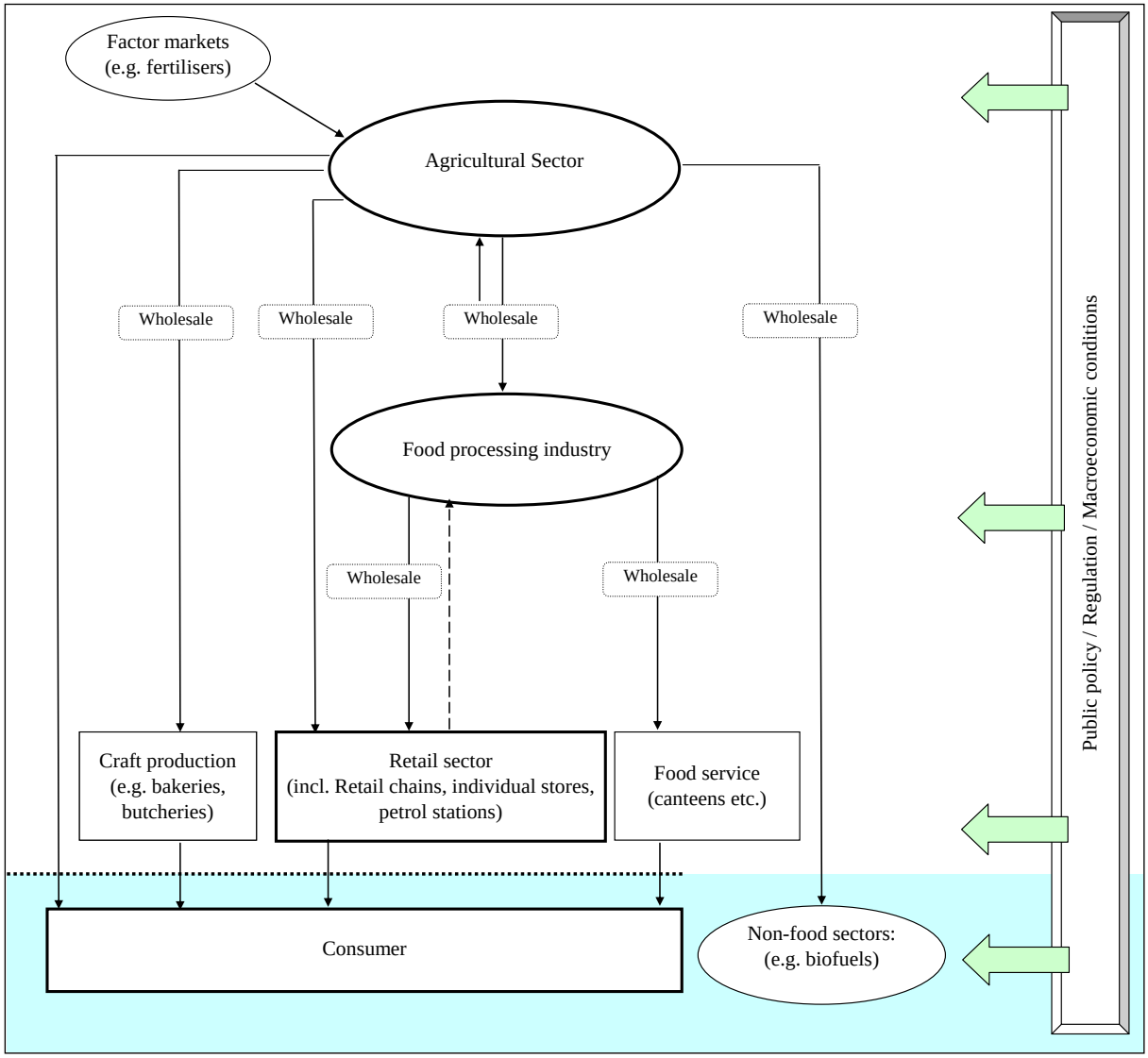


Figure 4. Schematic representation of the food supply chain [131]

Food supply chains involve various participants. Beske et al. (2014) described a critical literature review of food industry sustainable supply chain managements: all actors need to be oriented equally towards sustainability as well as to profitability, in close collaboration with other stakeholders, such as NGOs, and consumers themselves [132]. Accountability frameworks relevant to partnership working between governments and food industry stakeholders are needed as part of a process to promote healthy and sustainable food environments. Kraak et al. (2014) proposed a conceptual model and an accountability system for organisations that might promote healthy nutrition [133].

Meadows (1999) describes how best to intervene in systems by means of small changes at critical points, with a view to "pushing" any food chain towards healthy nutrition and sustainability [134]. Ingram et al. (2013) describe how 86 UK stakeholders, drawn from every part of food supply chains, identified their top priorities for future research into the effectiveness of supply chains [135]. These ranged from primary production (environment and resources, innovation, etc.), through processing, logistics, retailing and trade, and nutrition, to "*whole system – environmental context*", "*whole system – policy context*", and to waste reduction.

Buttriss (2013) looked at reformulation of certain foods, and future possibilities for developing appropriate incentives for the food industry [136]. She considers that this may be useful to reduce salt content of food, to remove trans fats, and to reduce saturated fat and sugar content in foods. However, she does not regard reformulation by itself as a main route to healthier nutrition [136] .

As most food items are produced by multi-national enterprises, joint action at a supra-national level is required. Thus, in 2005, the EU created the "EU platform for action on diet, physical activity and health", which is a "*forum for European-level organisations, ranging from the food industry to consumer protection NGOs, willing to commit to tackling current trends in diet and physical activity*" [137].

Sustainability appears to be improving at varying paces along the food supply chain**.** Food companies see sustainability as a means of increasing profitability and are willing to implement it often even without any financial support [138]. However, more economical concerns were raised in political discussion in Scotland [139–141]. Darkow et al. (2015) note that sustainability is a key issue in food service supply chains, but translating sustainability into the strategies of the firms involved may seem to them as potentially challenging the dominant logic of business [139]. Distribution is one part of food supply chains; however, Akkerman et al. (2010) conclude after a large review that while *"today's society is more and more concerned with sustainability, there is only very limited attention given to designing and operating sustainable food distribution networks"* [142].

The extent of the trend towards eating out of the home varies in different settings, being most common in urban areas, but is increasing everywhere. Often in commercial settings the nutritional quality of food offered is poor: too much fat, meat and salt [39]. Recent evidence indicates that more frequent eating at home is associated with a lower risk of diabetes [143]. However, in public sector catering, such as in schools and hospitals, it is possible to improve nutrition at a population level. School meal policies differ across Europe [144], but the importance of school meals is growing everywhere [145]. For example, in Finland eating out in public sector settings contributes 44% of all meals eaten out of people's homes; private sector lunch hour meals contribute a further 28%. In many countries eating out is not so common as in Finland [146]. Some catering stakeholders have seen sustainability in the context of a holistic approach, but this concept needs translation into practical reality [147]. Wahlen et al. (2012) have analysed what happens in practice when sustainable food consumption is promoted by mandatory weekly vegetarian days [148]. Public sector food service providers can promote sustainability, but no single solution is available, because school food systems (for example) are very different across Europe [149].

Life cycle assessment shows that responsible purchasing of food and other supplies, energy and water management, and waste management, are the main challenges to address in improving sustainability in restaurants [150]. The impact of single lunch portions in Finnish lunch plates varied from 0.35 kg to 3.80 kg C02 [151]. Beer and Lemmer (2011) have shown how "green" procurement effects portion prices [152]. Local food and short supply chains are often considered the more sustainable, but Galli et al. (2015) showed that local versus industrial food chains provide differing sustainability dimensions and challenges [153].

Food waste is also a waste of the resources used to produce food. In total, 24% of all food calories are wasted between farm and fork [154]. In an Italian study, unserved food was 15-16% of delivered food; the reasons were menu composition, rigid procurement practices, lack of attention to dietary habits and (poor) meal presentation [155]. In Finland waste varies by category of eating out: kitchen waste contributes 2-6%; the major component is food served in buffet serving systems but unselected by clients and therefore disposed of (2-16%); and leftovers contributes 3-10% [156].

5.3. Consumer organisations and public health bodies: crucial stakeholders in advocating for healthy and sustainable diets

Umbrella organisations, both national and international, influence policy processes through dialogue with the European Commission. Organisations such as EUPHA are instrumental in identifying public health issues, and they provide input to players in the relevant sectors, who can eventually influence the formulation of public health policy [157]. The European Consumer Organisation (BEUC) is increasingly involved in consumer protection policy development. The European Public Health Alliance (EPHA) is recognised as a leading advocacy NGO for most public health issues, including nutrition, healthy economic policy, and health inequalities. EuroHealthNet is also involved in reducing health inequalities, between and within EU countries, in order to build healthier communities. Advertisers and the media are additional stakeholders, being highly active in the food market generally, and particularly in the marketing of foods with high contents of saturated fat, salt, and added sugars to children [158].

6. Political processes, actions and experiences in the field of sustainable and healthy eating

Several studies provide an overview of the policy instruments, approaches and actions necessary to foster healthy and sustainable food consumption [81,159,160]. They describe tools for communication or information provision, for economic or fiscal activity, and for regulatory methods and behavioural changes [159–161].

Commitments to implement policies on sustainable food production and consumption have been made. Barling (2011) provides an overview of policy initiatives by national governments or at EU level [162]. Countries such as Germany [163], Netherlands [164], or Sweden [165], as examples, have started explicitly to address healthy and sustainable food consumption and production. However, political processes that consider potential difficulties and possibilities in incorporating sustainability and health into strategic action plans on food and nutrition, have not been well documented. In addition, data are lacking on evidence-informed food and nutrition policies that may result in health and sustainability gains; the absence of indicators to measure efficacy, or to track progress and to monitor success, should also be noted.

Box 3. Example: Scotland

Gill and Johnston (2010) assessed why governments develop food policies and described the role of evidence on the process [166]. The principal rationale for food policies has been to correct market failures and to drive towards national food security, while considering international commitments. Although natural scientists are increasingly involved, research evidence typically comes from economists. However, scientists do not have a monopoly on evidence, and policy-making is a complex process, with issues such as public acceptability and short-term benefits also being important [167]. Before developing the first Scottish food policy incorporating both nutrition and sustainability, public hearings were arranged involving more than 500 contributors. Evidence used in the process and logic models were used to identify actions required [168].

Box 4. Example: Australia

Carey et al. (2016) analysed processes of consultation and stakeholder involvement in the development of Australia's National Food Plan. Already in 1992, as part of food and nutrition policy, statements about the importance of ecological sustainable development so that resources are managed to ensure good health for future generations were made. However, implementation of this received little support as state food policy initiatives were dominated by agricultural and food policy interests. In 2010, a new commitment to develop a new integrated National Food Plan was made but during the process of consultation and stakeholder involvement nutrition and sustainability were effectively side-lined. Using existing documentation like government papers, stakeholder submissions and position papers as well as media releases, the authors show how powerful industry groups managed to shift focus on global food production, so as to position Australia as food superpower. The paper underlines that public health nutrition needs to adopt new methods to influence public policy beyond traditional lobbying and evidence submission [169].

There were 555 written submissions to two consultation papers during development of Australia's National food plan. Traditional production efficiency perspectives were dominant with less attention to consumption or equity. Despite about 65% stakeholders supporting the inclusion of environmental sustainability considerations, the final plan positioned sustainability in the context of maximising food production for economic sustainability only. The authors propose reforms in consultation process and call for greater transparency in policy making [170].

Carey et al. (2010) also describe economic and other pressures such as competition for land, reducing quality of soils and natural disasters facing production of vegetables and fruits in the peri-urban area of Melbourne [171]. The authors propose integrated approaches such as: integrated food policy and regional planning, funding research initiatives to investigate the health, social and economic benefits of regional supply, creating mandatory health and sustainability standards for food procurement, legislation that recognises health benefits (not just economic ones), feasibility studies on food provision, logos on sustainable production, and studies on land quality. The importance of integrated policies is emphasised.

Overall, sustainability is a difficult concept for policymakers and relies on inter-sectoral responses and thinking. The political reaction has so far been inadequate. There is a need for various approaches, from improving efficiency of production to creating a more equitable balance of power, with a view to changing eating patterns and reducing food waste along the whole supply chain. There are many potential interventions to change the way we eat, including regulation and legislation, fiscal measures, changing the environment of (and possibilities in) choice, enabling and supporting, education, information and awareness raising [172].

Various policy options are available to policy-makers directly involved in promoting healthy and sustainable diets [173]. However, fiscal instruments, particularly those in the form of taxes, are controversial, as they might widen inequalities if inappropriately applied [108].

Provision of information is also considered likely to increase health inequalities [108]. Figure 5 shows the various potential policies for healthy and sustainable eating.

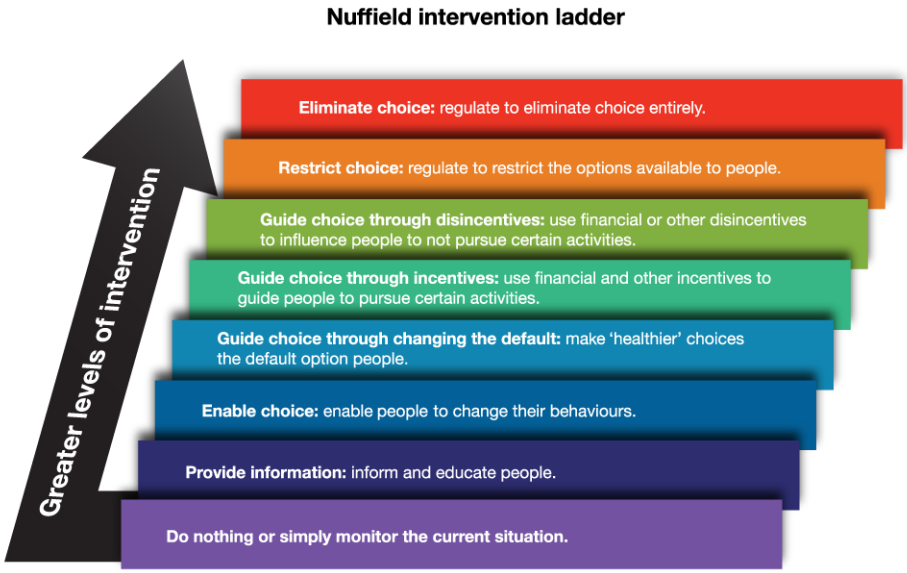


Figure 5. Nuffield intervention ladder, which presents various type of policies that could be applied to the field of healthy and sustainable eating[174]

6.1. Experiences towards sustainable and healthy eating

6.1.1.Integrating sustainability in Food Based Dietary Guidelines (FBDG)

Healthy food can have negative and often hidden consequences for the environment if not monitored properly [6,110,111]. For example, meat-free diets appear to be significantly lower in GHGEs as compared to meat-based diets [8,9,111]. However, it is important to find appropriate other protein sources to avoid micronutrient deficiencies [8,9,54,111] and to orientate consumption towards alternatives with low environmental impacts [111]. Indeed, in some cases, the quantity of legumes and pulses eaten to replace animal proteins can contribute similar levels of environmental impact to those of meat production [9,93,175].

Also, the way in which recommendations provided in nutritional guidelines may be implemented (e.g. through the increase of consumption of those types of fruits and vegetables associated with higher levels of GHGEs) could have negative consequences for

the environment [110]. It is thus crucial to include both health and environment considerations when developing dietary guidelines [111].

Food Based Dietary Guidelines provide important benchmarks to promote and plan diets. To date, only four countries have included sustainability in their Food Based Dietary Guidelines: Brazil, Sweden, Qatar and Germany [176]. Quasi-official guidelines are to be found in the UK, France, Netherlands and Estonia, and the Nordic countries. As this review considered only Food Based Dietary Guidelines in English, some significant examples (like those in Finland) were not included. The Nordic Council of Ministers has provided an estimate of the nutritional changes that are required to achieve more sustainable dietary patterns, and the Health Council of the Netherlands has provided its government with recommendation on the health and environmental impacts of different types of foods [54].

The Food Pagoda of China and the UK Eatwell Plate guide the consumption of nutritious foods through visual representations [7]. The Ibero-American Nutrition Foundation healthy lifestyles guide is a three dimensional pyramid (an alternative model to the classic food pyramids), which integrates healthy and sustainable lifestyles to nutritional recommendations within a defined social and cultural context. This model revised the Mediterranean diet pyramid, adding to this some advice on physical activity, cooking at home, personal and food hygiene, education, human rights, etc. Two of the three faces focus on achieving daily food intake (face 1) and daily activities (face 2), while the third face is an adaptation of the traditional food pyramid, with the addition of children's energy, nutritional, and hydration needs. The fourth face includes both daily and life-long habits [177]. The Double Pyramid Model**,** developed by the Barilla Centre for Food and Nutrition Foundation, and presented in Figure 6, is based on the principle that the foods recommended to be consumed most frequently (such as vegetables, grains, pulses, and fruit) are also those which have less environmental impact, and conversely, the foods that should be consumed less frequently (meat and highly processed foods) have a higher environmental impact [10]. Its main presumption is that the Mediterranean diet is a sustainable model and generates fewer GHGEs compared as to GHGEs generated by meat-oriented diets. It consists of an upside-down pyramid, with the most environmentally

damaging foods depicted at the top and healthier and less environmentally damaging foods at the bottom [54].

Sustainability issues in Food Based Dietary Guidelines are often incorporated but not explicit. For instance, from a nutritional and public health perspective, the promotion of fruit and vegetable intake is a well-established strategy to improve diets around the world [178,179]. Moreover, some authors argue that modifications of guidelines, such as the Eatwell Plate [180] are needed to promote some aspects of sustainability [86].

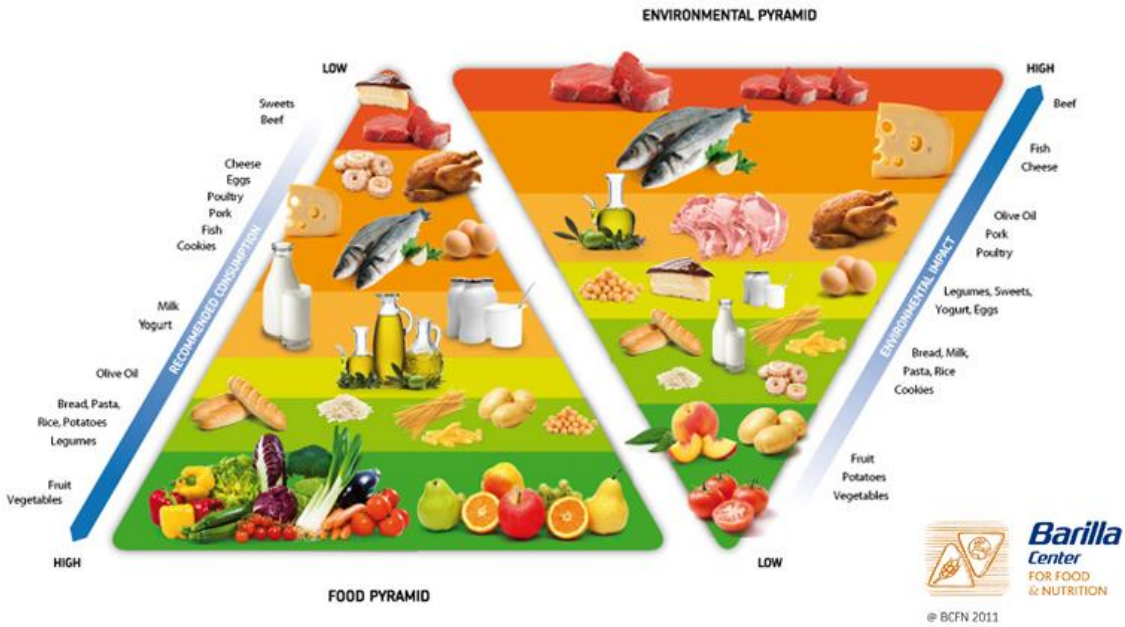


Figure 6. Double Pyramid Model, developed by the Barilla Centre for Food and Nutrition Foundation[10]

6.1.2.Labelling of sustainable food choices

Consumers wishing to adhere to Sustainable Food Based Dietary Guidelines face some considerable challenges [9]. Success in implementing sustainable diets at the population level ultimately depends on consumers' willingness and ability to change behaviour. Within the array of measures to create sustainable food systems, behaviour change is arguably the most difficult to achieve [181].

Information-oriented measures are important instruments for promoting dietary choices and for creating awareness among consumers in the European Union [161]. Currently,

various labels indicate sustainability of foods according to specific dimensions, e.g. social (animal welfare, free range, Fair Trade), environmental (organic/biological, carbon footprint, Rainforest Alliance, sustainable fisheries and aquaculture), and economic (price). Grunert et al. (2014) proposed a framework to explain the determinants of behaviour in terms of the use of sustainability labels [182].

Research indicates that sustainability labels appeal primarily to consumers who are already concerned about environmental issues [183]. A study carried out in the context of the French Nutrinet–Santé cohort highlighted that consumers of organic products were less overweight and obese, had higher levels of physical activity, more plant-based diets, and demonstrated overall better compliance with the concept of sustainable diet [73].

In addition, most consumers perceive sustainable foods as environmental foods associated with health, and as being plant- based foods [184]. The social/occupational dimension of sustainability in this regard is less apparent, but a stronger alliance to bring together those with environmental, occupational, and nutritional health concerns, and analogous NGO advocates, is needed, to promote greater public understanding of sustainable healthy nutrition, and its co-benefits [185].

6.1.3. Fiscal measures: towards promotion of sustainable and healthy dietary behaviours?

An emission-based tax scheme on food has been proposed as a possible way of reducing food sector greenhouse gas emissions [186–188]. The rationale for such a food tax is that the selling price to the consumer does not reflect the environmental cost of certain food products, driving their over-consumption in disregard of environmental impact. To balance these "social costs of carbon", a market based policy instrument such as a tax could be introduced, reflecting in the retail selling price the level of GHGEs in the entire supply chain associated with a product, from primary production, through processing, packaging, marketing, and distribution to purchase and consumption.

The primary goal of such a tax would be the mitigation (that is, the reduction) of the food sector greenhouse gas burden. Greenhouse gas-intensive food types, particularly red

meat and dairy products, and possibly air-freighted foods, would be more heavily taxed and sold at higher prices, thereby stimulating a shift in primary production practices and in consumption behaviours [188,189].

Although the potential for higher greenhouse gas efficiency in European agriculture is considerable, some authors have tried to quantify the improved-efficiency share of GHGEs, and found that improved-efficiency alone will not be enough to achieve the EU 2050 reduction targets [186]. This consideration also emphasises the significance of price-based policy instruments, such as consumption taxes differentiated by emission levels, environmental footprint, or other indicators of environmental impact [186–188]. However, meat production (particularly cattle) accounts for a large share of methane emissions; this implies that a greenhouse gas emission tax would appear to be more logical than a straight carbon tax [187].

Moreover, in order to achieve both environmental and health benefits, the focus of taxation should be not only on unsustainable environmental food products, but also on unhealthy ones. Yet, some difficulties may arise. For instance, a tax on fish consumption, in the light of the high energy needs for its production (smaller than the needs for production of beef, pork and lamb, but bigger than those for vegetable proteins), could have detrimental health consequences on omega three fatty acid intake [9,188,189]. Therefore, a major priority must be to integrate environmental and nutritional food tax policies, as part of a comprehensive approach, addressing environmental, agricultural and food policies, together aligned within the public health agenda [188].

Lastly, while food taxes are believed to influence consumers' behaviours more than education strategies (such as green labelling), they are nevertheless controversial because of their effects on health inequalities. People from low socioeconomic status communities are already more likely to purchase foods of poorer nutritional value, whose prices may be lower than those of more nutritious foods (which may not always be considered palatable or culturally acceptable) [190].

A food tax, especially if inappropriately applied, risks affecting disproportionately the poorer parts of populations, who already spend a greater proportion of their incomes on

food purchases as compared to the expenditure patterns of people of higher socio-economic status. The former are already more vulnerable to the consequences of unhealthy diets [191]: for example, the prevalence of obesity in the EU increases dramatically as educational level decreases, especially in women [108].

There is therefore a risk that taxes might worsen an already uneven distribution of health. Strategies such as the combination of taxes (on unhealthy and unsustainable foods) with subsidies (for healthy and sustainable foods) could provide a fairer approach, by not widening health inequalities [192,193]. Similarly, reformulation (without changes in price to consumers) and marketing restrictions are believed to reduce health inequalities in nutrition [191].

Therefore, emission-based taxes on foods have the potential to benefit the environment, but greater benefits will be achieved if:

- food items are evaluated not only from an environmental perspective, but also from a public health viewpoint, and
- the effects on health inequalities are openly discussed and counteracted by appropriate measures.

6.1.4.Sustainable public procurement

Sustainable Public Procurement (SPP) is defined by the European Parliament as: "a process by which public authorities seek to achieve the appropriate balance between the three pillars of sustainable development - economic, social and environmental - when procuring goods, services or works at all stages of the project" [194]. Even more demanding is Green Public Procurement (GPP) [195], which aims to reduce environmental impact instead of only balancing these: "GPP means that public authorities seek to purchase goods, services and works with a reduced environmental impact throughout their life-cycle compared to goods, services and works with the same primary function which would otherwise be procured." The procurement directive [194] provides guidance towards sustainability in all public procurement.

Scientific research about sustainable public procurement evaluates processes, principles and policies. Morgan (2008) emphasises that public food catering services (e.g. school meals, and those in universities, hospitals, etc.) influence a significant part of the food sector and its economy in every country. These services are stable and predictable, but they may need more regulation and facilitation to bring them fully into line with sustainable public procurement strategies. Procurement policies can become powerfully effective in promoting sustainability when they are reformed appropriately so as to do this [196]. Purchasers need appropriate corporate policy and are guided by price, quality and service [197]. Good leadership has been found to be an important factor in achieving sustainable procurement, while financial concerns were identified as the biggest barrier [198]. Major contract caterers have still accepted only some of the principles of sustainable food procurement [199]. Organisations operating in local communities have achieved sustainable procurement by working only with small or medium-sized enterprises (SMEs) [200]; however, e-procurement still seems to cause problems for some SMEs [201]. More research is needed to explore the carbon footprints (CF) of school meals: however, Cerutti et al. (2015) found that 61-70% of CF comes from agricultural production, 6-11% from intermediate processes, and 24-28% from urban delivery [202].

Local government authorities use public procurement to foster sustainable development [203], yet according to Morgan (2008) local municipalities need more regulation and knowledge to enable them properly to procure fully sustainable school food, through which a more sustainable society can be promoted [204]. Smith et al. (2016) show a need for redefining GPP and SPP; “greening” has caused negative effects through the incurring of higher costs and lower quality. Sometimes attempts to comply with local policy demands have led to import of eco-labelled foods instead of more sustainable local produce [205]. However, a case study shows that “green” caterers offer more healthier food than do other caterers [206].

Public procurement refers to the act of professional purchasing and relates to obtaining or buying goods and services in the context of government and the public sector. It contrasts with private procurement in the daily shopping routines of the private consumer.

Public procurement practices however, are contractually bound to, and rely on, agreements, and they must comply with national or EU legislation.

Over the past few decades, the power of public procurement to influence the future development of food systems has become very clear. Public procurement has received increasing interest owing to its potential for creating desired social and economic outcomes [207,208]. In addition to its immediate impact on contracts, the "modelling" role of public procurement initiatives is believed to be an important factor in promotion of behaviour change. By changing the routines and practices of public food catering services in a way that is more supportive of sustainable diets, the public sector is sending a strong signal to citizens (and to the food industry) about official ambitions regarding the future direction of food systems.

One of the most prominent examples of a public procurement policy-driven change relates to organic food. Such procurement policies are an important means towards stable consumption of organic products [196,209,210]. Governments at local, regional and national levels realise that environmentally-friendly production, transport and consumption of food help to maintain soil quality and biodiversity. They also promote the recycling of animal and vegetable by-products and residues. Especially in countries where agriculture occupies an important position within the overall economy, it has been realised that the development of new public sector procurement policy-driven agricultural practices (such as public sector organic food and farming policies) has the potential to contribute positively to the development of local food economies. For example, in Denmark, over recent decades, public organic procurement policies regarding organic food and farming policies have become established, according to the Organic 2020 government policy, as an important tool to achieve the targets for the percentage of arable land on which production is organic [211]. It is also considered to be a prominent contribution to the fulfilment of the Danish target of 60% usage of organic products in public canteens by 2020 [212].

6.1.5. Other measures developed at the EU level

Some stakeholders, participating in the above mentioned "EU platform for action on diet, physical activity and health", committed themselves to sustainable development. Over 300 total pledges have been made since 2005, when the platform was created [137]. While not exhaustive, commitments towards sustainable development are rather few and include:

- The Fruit Vegetable and Horticultural European Regions Assembly (A.R.E.F.L.H.) dissemination initiatives, to build "*strong links between the area, its value, the local and typical produce, the traceability of the product, the positive impact on the environment and on consumers*" (an on-going action).
- The Unilever "Sustainable Living Plan", which is, according to Unilever itself, the blueprint to grow businesses, whilst decoupling any environmental footprint from growth, and increasing positive social impact (an on-going action).
- The UK Food Standards Agency "Food Vision website", created "*to help local groups develop food projects that will improve community health and well-being*" (a completed action).
- The Food Service Europe General Nutrition Recommendations include the "*increasing offer of fish, if possible from sustainable sources*" (a completed action).
- The Food and Drink Europe "Strategic Research Agenda and Implementation Plan - The European Technology Platform Food for Life" aims to derive its products from sustainable productions (a completed action).

6.2. Tracking impact and successes

Metrics and measurement mechanisms should be developed to track impacts of a sustainable diet on health and on the environment [7]. Dora et al. (2015) propose a set of key indicators to track impact:

1. percentage of calories from saturated and unsaturated fats;
2. consumption of red meat (kg/per capita per day);

3. percentage of adult population (≥ 18 years) who eat less than five servings of fruits and vegetables, on average, per day; and
4. household dietary diversity score [213].

Several systems are available that generate data which can be used to monitor and inform policy actions:

- Through the "European Database on Nutrition, Obesity and Physical Activity" (NOPA) [214], created in close collaboration with health ministries and with the support of the European Commission, WHO Europe collects details on more than 300 national and subnational policies related to nutrition and obesity in the European Region.
- Through the "Global database on the Implementation of Nutrition Action" "GINA"[215], from 2012 WHO provides an overview of the state of implementation of commitments and actions aimed to improve nutrition globally.
- Policy options are also summarised by the NOURISHING framework from the World Cancer Research Forum International [216], which monitors outcomes of a package of policies options to promote healthy eating and to tackle obesity and diet-related chronic diseases (the outcomes being food environment, food systems, and behaviour change).
- Similar work is conducted by an international consortium created in 2012, called the International Network for Food and Obesity/Non-communicable Diseases Research, Monitoring and Action Support (INFORMAS) [98]. INFORMAS proposes Government Healthy Food Environment Policy indices, to monitor and benchmark government policies and actions to promote the healthiness of food environments [217].
- The Global Nutrition Report provides a state of the art report of progress relating to commitments made, using available data on nutrition.
- The FAO/WHO Global Individual Food Consumption Data Tool, launched in 2016, will provide quantitative food intake data for key food groups, thus giving

precise information not only on food availability, but also on food consumption, for individuals of different sex, age and physiological conditions.

Integration of these initiatives with other data systems should greatly facilitate the development of powerful decision support systems. Within the agricultural community, several calls have been made to link agricultural data [218] to nutritional data [219]. It should be noted, however, that there appears to be gathering commitment to the Global Open Data for Agriculture and Nutrition (GODAN) initiative, which was created to unlock and to share agricultural and nutrition data. However, essential data to assess sustainability of diets is lacking, in particular in relation to more social aspects and outcomes, such as equity and human rights for vulnerable groups.

7. Discussion

7.1. Key findings

Sustainable healthy diets have low environmental impact, contribute to food and nutrition security and to healthy life, reducing the risk of all forms of malnutrition – both under- and over-nutrition, for present and future generations. Useful and positive experiences to draw upon regarding the promotion of sustainable diets in various European countries exist, although they are somewhat limited.

To consume a sustainable healthy diet, plant-based diets should be promoted. Individuals and societies should produce and consume both increased quantities and more varieties of fruit, vegetables, pulses, and whole-grain cereals. Attention should be paid to the place and type of production (e.g. was there excessive irrigation during production?), and seasonal foods should be preferred. Meat production and consumption should be minimised (for example, by decreasing frequency and portion size). In particular, red meat and processed meat products should be avoided. In addition, only limited quantities of other animal-origin foods should be consumed; plant-based proteins should be preferred. When consuming fish, informed decisions should be made in regard to the sources of fish: sustainable sources of fish should always be preferred. In addition, preserved fish and fish sauces high in salt content should be avoided, as should foods containing added sugar and salt (i.e. juices containing added sugars, cereals with added sugar and salt). Foods containing trans fats, or with high content of saturated fats, should also be avoided. These policies are all designed so as to improve quality of diets while reducing damaging environmental impacts .

Promoting healthy and sustainable diets, of a nature such as those described above, is itself a key lever towards achievement of change in food systems. The progress on sustainable development of food systems has been generally limited and fragmented, despite some important commitments. Food and nutrition policies must centre on the promotion of healthy and sustainable diets, and can be powerful instruments for the promotion of population health in an equitable manner. However, sustainability has yet to

be well integrated into policies designed, in any equitable manner, to promote healthy nutrition. Finally, strong accountability frameworks are needed, as they are essential prerequisites for effective monitoring of compliance with commitments made.

It is noteworthy that, with so many stakeholders involved, all with their own perspectives, public health professionals are well-positioned to provide an overview of the issues, and therefore they are in a position to provide a source of relatively independent advice. This could provide the basis for the achievement of political and public support for appropriate prioritisation of future actions. Moreover, effective accountability frameworks will be an essential prerequisite for effective monitoring of compliance with commitments made, and these must be properly established and funded; in addition, further monitoring and evaluation of the impacts on population and planetary health will be needed. These are all essentially public health functions.

7.2. Recommendations and future steps

7.2.1.Promoting a sustainable healthy diet at individual level

Small changes and informed choice by each individual could make a significant impact on sustainability and healthier diets. The use of easily understood figures and recommendations could help to inform decisions; for example by providing answers to common questions, such as "what kind of fish should we eat?" [181,220]. Awareness of the environmental importance of diets[184,220] among European consumers must be increased, followed by social marketing interventions aimed at changing consumers' behaviours. Consumers should see sustainability as an important and relevant issue for themselves and for future generations, and accordingly should want to be engaged [221,222]. Interventions based on policy decisions also need to be implemented properly.

Consumers should be encouraged to reduce their intake of meat-based proteins and encouraged to substitute those with plant-based proteins: e.g. 1/3 less, 1/3 replaced with plant protein, and the remaining 1/3 from a selected range of animals, avoiding eating red or processed meat. Meat consumption can be reduced by eating smaller portions of meat,

eating meat less often, or having meatless days; for some, these are the most acceptable ways to cut meat consumption [14,38].

Nutritionists and health professionals need to cooperate in increasing the public's awareness of nutrition, and in triggering change in behaviour. A first step could be to ensure that dietary guidelines integrate nutritional benefits, animal welfare, and the environmental components of sustainable diets. In addition, sufficient nutritionist staff should be trained to educate children in schools (from kindergarten onwards) about how to lead healthy, sustainable lifestyles, including good nutrition (such as the Mediterranean pattern of diet), cooking skills, eating behaviour, sustainability, the growing of vegetables, use of fruits and herbs, and regular physical activity.

7.2.2.A Policy Action Plan for Europe

Significant changes in European food systems are required [113]. Food systems should take account of and include both healthy nutrition and sustainability, by linking both population health and climate stabilisation agendas, through smart interventions that can improve both food security and human health, and planetary health as well [35,223]. Assuring food security for all is an essential component of sustainable food systems [35,109]. All components of food systems need to identify themselves as parts of a whole, rather than separate entities.

Food policies need to be developed and implemented in a holistic manner. They will only be effective if they are formulated with input from everyone involved in all aspects of food security and sustainability, including in the agricultural and health sectors, thereby enabling construction of coherent policy frameworks that will be beneficial to sustainability, agriculture and human health [37]. Thus, redevelopment of agriculture and fisheries in ways that conserve the natural resources upon which production depends needs to be addressed. It is essential that agriculture's dependence on fossil fuels, and the carbon footprint of all food systems, are reduced, and that control of pests and biosecurity are improved[224]. In addition, inter-species diversity and the protection of neglected species and varieties, which can be essential to nutrition security, should be addressed (e.g. winter versus summer

apples, which have different storage requirements) [6]. Measures must be taken to counteract dietary westernisation and to preserve healthy diets, some of which are traditional (e.g. Mediterranean and Nordic diets), and their associated lifestyles. [36,55,59,225].

To this end, the European Commission and governments of non-member states of the EU should each establish a statutory Sustainable Nutrition Task Force, the responsibilities of which would be, in each jurisdiction:

- to identify essential key features of a healthy and sustainable food system;
- to formulate and to recommend a strategic plan for moving from current food systems towards healthy and sustainable alternatives, as identified, by adopting a multi-disciplinary approach to food and nutrition;
- to plan and recommend a programme for implementation of the strategy for sustainable and healthy food systems;
- to monitor progress towards implementation of such policies;
- to supervise the evaluation of outcomes in relation to both healthy nutrition and sustainability.

Each Sustainable Nutrition Task Force should include multidisciplinary representation of all relevant stakeholders, from government (health, nutrition, agriculture, environment, education, finance, and justice), and from local authorities (urban planning), agriculture (farmers), environment, health professions, industry, catering sector, academia, media, NGOs, civil society and consumer organisations. Each Strategy for Sustainable Healthy Nutrition should be supported by overarching legislation, an institutional infrastructure, educational structures with appropriate capacity building, and food security and nutrition for all should be guaranteed both now and in the future.

These strategies should guarantee that **food systems are sustainable** along the entire food chain, from production to consumption, protecting resources such as soil, air and water in the light of climate change challenges, and include actions designed to reduce food losses and waste. **Agriculture** should be reformed appropriately so as to conform to

necessary nutritional and sustainability standards, while also being strengthened so as to align it towards the best practices in sustainable agriculture, also recognising its vital importance in provision of local food. **Local products** should always be available, and produced in a manner which is at the same time resilient, environment- and culture-sensitive, health-oriented, economically fair and socially just, and provided in manner designed as far as possible to reduce inequalities.

By means of appropriate regulation, the **food industry** would be required to produce healthy, nutritious (minimally processed) foods in a sustainable manner, which contain low contents of sugars, salt and additives that could adversely affect health; **production and marketing** should be honest and transparent, with consumer-friendly food labelling, and with restrictions on the marketing of junk food and sweet beverages, especially to children. The private sector and all other actors in the food chain should be expected to produce, promote and distribute sustainable and healthy products, with accompanying reliable and user-friendly consumer information, and to deliver on commitments made regarding sustainable healthy nutrition.

Sustainable healthy food systems should be of high nutritional value, and, as a right, every **citizen** should have access to a wholesome, culturally appropriate and affordable food basket for a sustainable, heathy lifestyle. Furthermore, the public should be provided with ready access to healthy sustainable foods outside their home environment, that is in restaurants, work-place cafeterias, vending machines, medical facilities (including hospitals), sports arenas, public spaces, schools and day-care centres; junk food and fast food chains should not be allowed in hospitals, health clinics or in educational institutions.

Food and agriculture policies in Europe should be developed in a manner designed to avoid damage to the **economies** of developing countries. Finally, a **monitoring systems** should be put in place, to ensure that food is nutritious, safe, free of pathogens, and environmentally friendly, and that policies are implemented as planned.

7.2.3. Other policy recommendations for EU actors

In addition to the above mentioned recommendations for a Policy Action Plan for Europe, other recommendations for various European organisations are indicated:

- The **EU** must ensure that the Common Agricultural Policy (CAP) is fully reformed and properly integrated into the Strategy for Sustainable Healthy Nutrition and Sustainable Food Systems, so as to take seriously both nutritional and sustainability requirements, with subsidy redirected away from meat production towards vegetables (as indicated above).
- The **European Commission** should develop a European strategy for healthy and sustainable diets as part of a comprehensive and multi-sectoral food policy (as already recommended above).
- **WHO Europe** should take a lead in the development of:
    - dietary guidelines, appropriate for sustainable healthy nutrition, and geographically and culturally suited to different parts of Europe;
    - accountability mechanisms, suited to the tracking of the commitments made by stakeholders;
    - systems designed to facilitate the monitoring of down-stream socio-economic and health effects.

7.2.4. A Research Agenda for Europe for Healthy Sustainable Food Systems

There is considerable scope for much-needed research to evaluate the effects of adopting sustainable dietary patterns in everyday life. For instance, the determining factors and processes that contribute to healthy and sustainable diets need to be more closely analysed and understood. It is clear that there are inter-relationships between environmental sustainability and human health, differing behaviours (e.g. in the kitchen) attributable to various cultural attitudes and traditions, and affordability and availability of different foods, and that all of these variables affect the sustainability of specific diets;

however, more research is needed to enable us to understand more fully these inter-relationships [226,227].

Further investigation is also needed regarding aspects such as protein quality, water use and re-cycling, land use change, eutrophication (water pollution from excessive use of fertilizers leading to competing aquatic vegetation), and impacts on biodiversity [227]. How well the organic agro-food system compares to other food systems, with respect for organic consumers preference for more vegetables and less meat, remains to be investigated [69].

Methodologies for measuring the association between food, nutrition intake and GHGEs are still in development, and lack of suitable composite indices to measure sustainability hinders sound policymaking, which is a vital component of what is required to advance the concepts of sustainable diets [7,57]. As a first step, consensus on metrics relating to sustainable food systems needs to be developed and achieved [35,226].

The sustainability of alternative diets matched for energy and nutrient adequacy can only be made on the basis of energy and nutrient content and not by food weight [228,229]; therefore different ways of calculating GHGEs need to be developed so as to monitor weight-energy or, even better, portion-size. The point at which the higher carbon footprint of some nutrient-dense foods is offset by their higher nutritional value also deserves further research [228].

Consideration of wider aspects of food research, from field to fork, leads to the realisation that there are a number of separate relevant domains of relevant research (e.g. nutrition research, food science research, sustainability research, agricultural research, social science research as applied to farmers and farming communities, and to research into acceptability of food products to the public, etc.); however, researchers in these various domains rarely interact or talk to each other. Accordingly, what is needed is a new European research infrastructure devoted to all aspects of food research.

Within an agenda for research to be promoted by this new infrastructure, priority should be given to:

- development of new innovative methods designed to measure simultaneously both health and sustainability; at present, essential data to assess sustainability

of diets is lacking, in particular in relation to more social aspects and outcomes, such as equity and the human rights of vulnerable groups;

- research into how best to integrate data and information systems relating to food and nutrition, such as a link both to agricultural data [218] and to nutritional data [219]; it should be noted, however, that there appears to be gathering commitment to the Global Open Data for Agriculture and Nutrition (GODAN) initiative, which was created to unlock and to share agricultural and nutrition data;
- research designed to develop new metrics and measurement mechanisms, so as to track impacts of sustainable diets both on health and on the environment [7]. Dora et al. (2015) propose a set of key indicators to track impact [213]:
    - percentage of calories from saturated and unsaturated fats,
    - consumption of red meat (kg/per capita per day),
    - percentage of adult population (≥ 18 years) who eat less than five servings of fruits and vegetables, on average, per day, and
    - household dietary diversity score;
- research designed to assess and monitor the impact of different food items and diets in relation to health, environment, economy, and justice (e.g. in terms of effectiveness in reducing inequalities);
- research designed to monitor the effectiveness of the implementation of policies designed to promote sustainable healthy nutrition, and to evaluate the outcomes of these policies, using the new metrics developed as above.

7.2.5.Actions for EUPHA to address

EUPHA has the potential to provide advocacy input with the aim of influencing the formulation of public health policies. Accordingly, EUPHA will:

- advocate for the integration of sustainable diets into public health; and align itself with other public health agencies to achieve this aim;

- advocate for the integration of sustainable and healthy diets into public food services, and align itself with public food service health agencies to achieve this aim;
- continue to advocate for a WHO Convention on Sustainable Healthy Nutrition;
- facilitate and promote the engagement of the public health community in processes related to sustainable healthy nutrition;
- collaborate and advocate with its members, with the public health community generally, and with other non-governmental public health organisations, (such as European Public Health Alliance and BEUC, the European Consumer Organisation), to become more active in activities designed to promote sustainable healthy nutrition;
- share lessons learned concerning successful food and nutrition policies for the promotion of healthy and sustainable diets in Europe;
- promote and disseminate relevant research findings, so as to ensure that, when research results and findings are applied in practice, best possible public health outcomes for all are achieved;
- strengthen efforts in health and lifestyle promotion for the benefit of all consumers within Europe's general public.

In conclusion, sustainable and healthy diets are complex. To achieve them many different dimensions have to be considered and a wide variety of actions need to be taken. Recommendations have been made which require actions at various levels, and these are summarised in Figure 7.

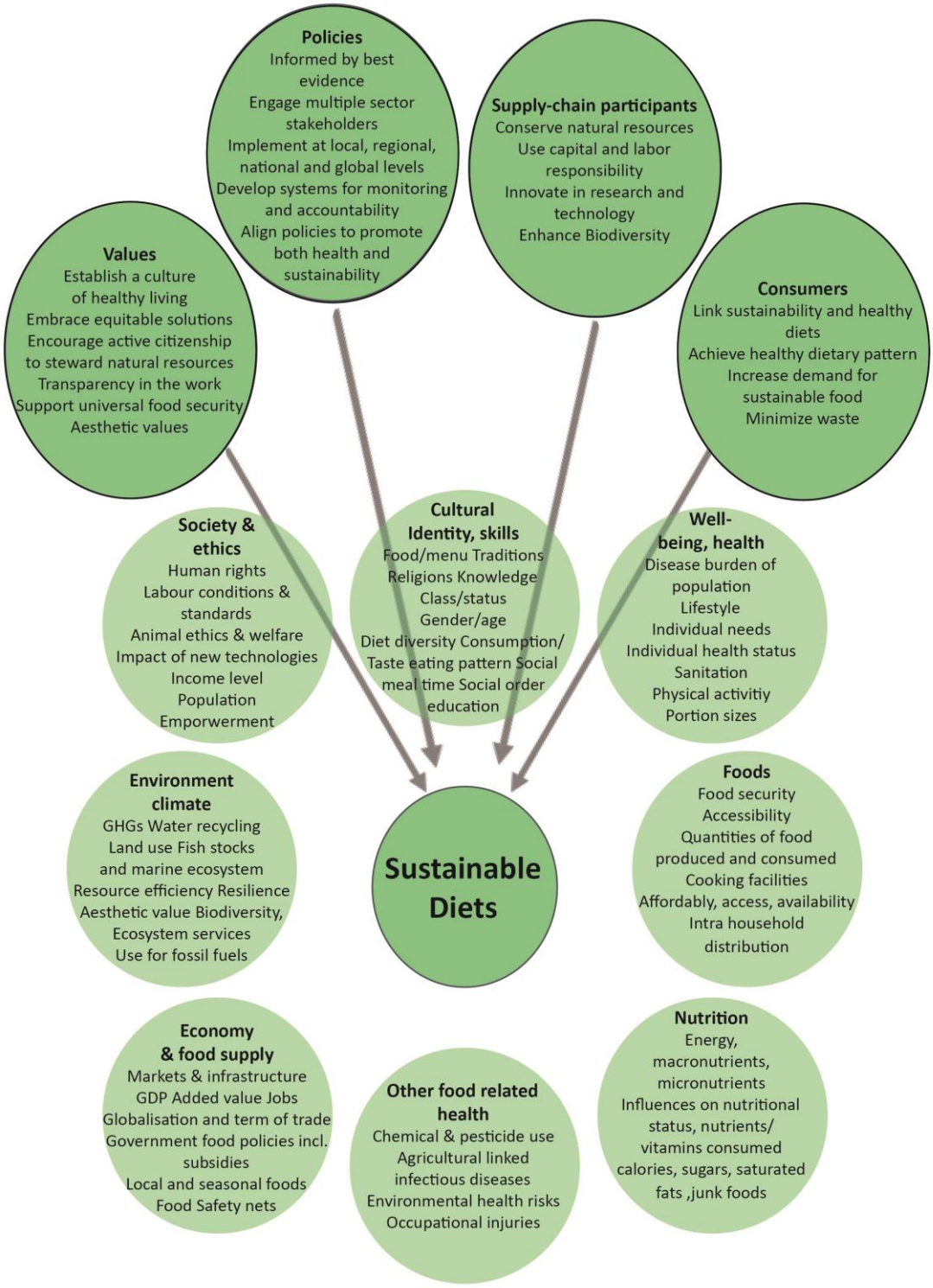


Figure 7. Domains and challenges to be considered (circles) and actions to be taken for sustainable diets (balloons) [7,172,230,230,231]

7.3. Limitations

This report has a few limitations. Firstly, from a methodological viewpoint, scoping reviews were performed. While systematic reviews are recognised as the most solid sources of evidence in the scientific field, given the aims of this report (i.e. summarising all existing evidence on sustainable diets in Europe), it was agreed by all members of the research team that to use parallel scoping reviews appeared to be the best way to proceed. Indeed, had the framework of systematic reviews been used, this would have excluded some important documents from grey literature which were used to develop this report.

Secondly, existing literature on healthy and sustainable diets is difficult to compare because of the lack of standardisation of research methods and of units of measurement (e.g. footprint per 100g or per 100 kcal). Indeed, in defining sustainability, different aspects were considered; for example, some studies look at the carbon or methane emissions, while others review water or ecological footprints. Moreover, certain study designs (and therefore results) are questionable: for example, one study compared milk to soft drinks [227]; another assessed 661 processed foods, the data for which were obtained from the food industry, but which did not include any fresh products in the assessment of GHGEs [228].

Thirdly, despite being broad in its content, the report does not include some important aspects related to sustainable and healthy diets, which should be included in future research.

These include:

- The impact of current and potential new food production systems on agricultural workers and on rural communities generally.
- The various challenges which need to be addressed if we are properly to ensure all basic human rights in relation to the employment of seasonal workers.
- Environmental, economic and social impacts of agriculture and the food trade in general, both at local and global levels.
- Food waste and the concept of a circular economy (i.e. zero waste economy), as applied to food.

7.4. Conclusions

This report was commissioned by the EUPHA Governing Board, to provide the scientific basis for a clear statement of policy relating to the need for sustainable food systems in Europe. It is based on the analysis of different aspects of sustainable and healthy diets, and their impacts on human and environmental health, as well as of the practical steps needed to achieve appropriate goals.

The findings suggest that while there is evidence that food systems and human diets have an important impact on both the environment and public health, policies are lacking that include both sustainability and healthy nutrition aspects. Food policies should promote plant-based diets, encourage a reduction of animal-based food consumption, as well as a reduction in consumption of foods from non-sustainable sources and crops. At the same time, foods containing high contents of sugar, salt, trans fats and saturated fats should be discouraged and avoided. This report provides recommendations to decision-makers at various levels, with the general aim of implementing sustainable healthy nutrition policies and research.

Finally, food providers and consumers should remember that eating is not only about complying with a list of regulations, but should be a pleasurable and tasty experience; meal times are important opportunities for socialising and for building relationships; traditional and cultural preferences in food choices should also be respected.

8. References

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. The Lancet. 2012 Dec 15;380(9859):2224–60.

2. Yusuf S, Hawken S, Ôunpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. The Lancet. 2004;364(9438):937–52.

3. University of Washington. GBD Compare | IHME Viz Hub [Internet]. 2017 [cited 2017 Feb 8]. Available from: http://vizhub.healthdata.org/gbd-compare

4. World Health Organization (WHO). WHO | Healthy diet Fact sheet N°394 [Internet]. WHO. 2015 [cited 2017 Feb 8]. Available from: http://www.who.int/mediacentre/factsheets/fs394/en/

5. Sassi F, Cecchini M, Lauer J, Chisholm D. Improving Lifestyles, Tackling Obesity: The Health and Economic Impact of Prevention Strategies [Internet]. OECD Publishing; 2009 Nov [cited 2017 Feb 8]. Report No.: 48. Available from: http://econpapers.repec.org/paper/oecelsaad/48-en.htm

6. Allen T, Prosperi P, Cogill B, Flichman G. Agricultural biodiversity, social-ecological systems and sustainable diets. Proc Nutr Soc. 2014 Nov;73(4):498–508.

7. Johnston JL, Fanzo JC, Cogill B. Understanding Sustainable Diets: A Descriptive Analysis of the Determinants and Processes That Influence Diets and Their Impact on Health, Food Security, and Environmental Sustainability. Adv Nutr Int Rev J. 2014 Jul 1;5(4):418–29.

8. Joyce A, Dixon S, Comfort J, Hallett J, Joyce A, Dixon S, et al. Reducing the Environmental Impact of Dietary Choice: Perspectives from a Behavioural and Social Change Approach. J Environ Public Health J Environ Public Health. 2012 Jun 17;2012, 2012:e978672.

9. Reynolds CJ, Buckley JD, Weinstein P, Boland J. Are the Dietary Guidelines for Meat, Fat, Fruit and Vegetable Consumption Appropriate for Environmental Sustainability? A Review of the Literature. Nutrients. 2014 Jun 12;6(6):2251–65.

10. Barilla Center for Food & Nutrition Foundation. Doppia Piramide 2016 - Un futuro più sostenibile dipende da noi [Internet]. 2016 [cited 2017 Feb 8]. Available from: https://www.barillacfn.com/en/publications/double-pyramid-2016-a-more-sustainable-future-depends-on-us/

11. World Health Organization (WHO). European Food and Nutrition Action Plan 2015-2020 [Internet]. 2014 [cited 2015 May 15]. Available from: http://www.euro.who.int/en/about-us/governance/regional-committee-for-europe/64th-session/documentation/working-documents/eurrc6414-european-food-and-nutrition-action-plan-2015-2020

12. Fernández-Alvira JM, Bammann K, Pala V, Krogh V, Barba G, Eiben G, et al. Country-specific dietary patterns and associations with socioeconomic status in European children: the IDEFICS study. Eur J Clin Nutr. 2014 Jul;68(7):811–21.

13. Mullie P, Clarys P, Hulens M, Vansant G. Dietary patterns and socioeconomic position. Eur J Clin Nutr. 2010 Mar;64(3):231–8.

14. Aiking H. Future protein supply. Trends Food Sci Technol. 2011 Mar;22(2–3):112–20.

15. Elmadfa I. European Nutrition and Health Report 2009. Karger Medical and Scientific Publishers; 2009. 426 p.

16. López-Azpiazu I, Sánchez-Villegas A, Johansson L, Petkeviciene J, Prättälä R, Martínez-González MA, et al. Disparities in food habits in Europe: systematic review of educational and occupational differences in the intake of fat. J Hum Nutr Diet. 2003 Oct 1;16(5):349–64.

17. Sanchez-Villegas A, Martínez JA, Prättälä R, Toledo E, Roos G, Martínez-González MA. A systematic review of socioeconomic differences in food habits in Europe: consumption of cheese and milk. Eur J Clin Nutr. 2003;57(8):917–29.

18. Prättälä R, Paalanen L, Grinberga D, Helasoja V, Kasmel A, Petkeviciene J. Gender differences in the consumption of meat, fruit and vegetables are similar in Finland and the Baltic countries. Eur J Public Health. 2007 Oct 1;17(5):520–5.

19. Temme EHM, Toxopeus IB, Kramer GFH, Brosens MCC, Drijvers JMM, Tyszler M, et al. Greenhouse gas emission of diets in the Netherlands and associations with food, energy and macronutrient intakes. Public Health Nutr. 2015 Sep;18(13):2433–45.

20. Food and Agriculture Organization of the United Nations (FAO). FAOSTAT [Internet]. 2017 [cited 2017 Mar 27]. Available from: http://www.fao.org/faostat/en/#compare

21. United Nations General Assembly. Transforming our world: the 2030 Agenda for Sustainable Development: Sustainable Development Knowledge Platform [Internet]. 2015 [cited 2017 Jan 18]. Available from: https://sustainabledevelopment.un.org/post2015/transformingourworld

22. United Nations Framework Convention on Climate Change (UNFCCC). Adoption of the Paris Agreement [Internet]. 2015 [cited 2017 Feb 8]. Available from: http://unfccc.int/paris_agreement/items/9485.php

23. Brinsden H, Lang T. Reflecting on ICN2: was it a game changer? Arch Public Health. 2015;73:42.

24. United Nations General Assembly. United Nations Decade of Action on Nutrition (2016-2025). 2016.

25. World Health Organization (WHO). WHO | Global nutrition policy review [Internet]. WHO. 2013 [cited 2017 Feb 8]. Available from: http://www.who.int/nutrition/publications/policies/global_nut_policyreview/en/

26. World Health Organization (WHO). First Action Plan for food and nutrition policy in the WHO European Region 2000-2005 [Internet]. World Health Organization Europe; 2001 [cited 2017 Feb 8]. Available from: http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/publications/policy-framework-and-strategies/who-european-strategies/first-action-plan-for-food-and-nutrition-policy-in-the-who-european-region-2000-2005

27. World Health Organization (WHO). Proposed Second WHO European Action Plan for Food and Nutrition Policy 2007-2012 [Internet]. World Health Organization Europe; 2007 [cited 2017 Feb 8]. Available from: document EUR/01/5026013

28. Brundtland G, Khalid M, Agnelli S, Al-Athel S, Chidzero B, Fadika L, et al. Our Common Future ('Brundtland report') [Internet]. Oxford University Press, USA; 1987 [cited 2017 Feb 8]. Available from: http://www.bne-portal.de/fileadmin/unesco/de/Downloads/Hintergrundmaterial_international/Brundtlandbericht.File.pdf?linklisted=2812

29. United Nations, Department of Economic and Social Affairs, Division for Sustainable Development. Global Sustainable Development Report .:. Sustainable Development Knowledge Platform [Internet]. 2014 [cited 2017 Jan 18]. Available from: https://sustainabledevelopment.un.org/globalsdreport

30. Whitmee S, Haines A, Beyrer C, Boltz F, Capon AG, Dias BF de S, et al. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. The Lancet. 2015 Nov 14;386(10007):1973–2028.

31. Gussow JD, Clancy KL. Dietary guidelines for sustainability. J Nutr Educ. 1986 Feb 1;18(1):1–5.

32. Food and Agriculture Organization of the United Nations, Biodiversity International. Proceedings of the International Scientific Symposium: Biodiversity and Sustainable Diets United Against Hunger. In Rome, Italy; 2012 [cited 2016 Jun 17]. Available from: http://www.bioversityinternational.org/e-library/publications/detail/sustainable-diets-and-biodiversity/

33. Aiking H. Protein production: planet, profit, plus people? Am J Clin Nutr. 2014 Jul 1;100(Supplement 1):483S–489S.

34. Dernini S, Berry EM. Mediterranean Diet: From a Healthy Diet to a Sustainable Dietary Pattern. Front Nutr [Internet]. 2015 [cited 2016 Jun 17];2. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4518218/

35. Berry EM, Dernini S, Burlingame B, Meybeck A, Conforti P. Food security and sustainability: can one exist without the other? Public Health Nutr. 2015 Sep;18(13):2293–302.

36. da Silva R, Bach-Faig A, Raidó Quintana B, Buckland G, Vaz de Almeida MD, Serra-Majem L. Worldwide variation of adherence to the Mediterranean diet, in 1961-1965 and 2000-2003. Public Health Nutr. 2009 Sep;12(9A):1676–84.

37. Kearney J. Food consumption trends and drivers. Philos Trans R Soc Lond B Biol Sci. 2010 Sep 27;365(1554):2793–807.

38. Westhoek H, Lesschen JP, Rood T, Wagner S, De Marco A, Murphy-Bokern D, et al. Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. Glob Environ Change. 2014 May;26:196–205.

39. Lachat C, Nago E, Verstraeten R, Roberfroid D, Van Camp J, Kolsteren P. Eating out of home and its association with dietary intake: a systematic review of the evidence. Obes Rev Off J Int Assoc Study Obes. 2012 Apr;13(4):329–46.

40. Capacci S, Mazzocchi M, Shankar B, Brambila Macias J, Verbeke W, Pérez-Cueto FJ, et al. Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness. Nutr Rev. 2012 Mar 1;70(3):188–200.

41. Van Cauwenberghe E, Maes L, Spittaels H, van Lenthe FJ, Brug J, Oppert J-M, et al. Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. Br J Nutr. 2010 Mar;103(6):781–97.

42. van der Horst K, Oenema A, Ferreira I, Wendel-Vos W, Giskes K, van Lenthe F, et al. A systematic review of environmental correlates of obesity-related dietary behaviors in youth. Health Educ Res. 2007 Apr;22(2):203–226.

43. Dutko P, Ver Ploeg M, Farrigan TL. Characteristics and influential factors of food deserts [Internet]. U.S. Department of Agriculture; 2012 [cited 2017 Feb 10]. (Economic Research Report). Report No.: ERR-140. Available from: http://agris.fao.org/agris-search/search.do?recordID=US201300007494

44. Walker RE, Keane CR, Burke JG. Disparities and access to healthy food in the United States: A review of food deserts literature. Health Place. 2010 Sep;16(5):876–84.

45. Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating Healthy Food and Eating Environments: Policy and Environmental Approaches. Annu Rev Public Health. 2008;29(1):253–72.

46. Rodrigues SSP, Caraher M, Trichopoulou A, de Almeida MDV. Portuguese households' diet quality (adherence to Mediterranean food pattern and compliance with WHO population dietary goals): trends, regional disparities and socioeconomic determinants. Eur J Clin Nutr. 2008;62(11):1263–72.

47. WHO European Ministerial Conference on Counteracting Obesity : Diet and Physical Activity for Health (2006 : Istanbul, Turkey), World Health Organization Regional Office for Europe. Comparative analysis of nutrition policies in the WHO European Region : a comparative analysis of nutrition policies and plans of action in WHO European Region, May 2006. 2006 [cited 2017 Feb 8]; Available from: http://www.who.int/iris/handle/10665/108042

48. Naska A, Fouskakis D, Oikonomou E, Almeida MDV, Berg MA, Gedrich K, et al. Dietary patterns and their socio-demographic determinants in 10 European countries: data from the DAFNE databank. Eur J Clin Nutr. 2005 Nov 9;60(2):181–90.

49. OECD. Health at a Glance: Europe 2016 [Internet]. 2016 [cited 2017 Feb 24]. Available from: http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-europe-2016_9789264265592-en

50. World Health Organization Regional Office for Europe. Growing up unequal. HBSC 2016 study (2013/2014 survey) [Internet]. 2016 [cited 2017 Feb 24]. Available from: http://www.euro.who.int/en/publications/abstracts/growing-up-unequal.-hbsc-2016-study-20132014-survey

51. Mithril C, Dragsted LO, Meyer C, Blauert E, Holt MK, Astrup A. Guidelines for the New Nordic Diet. Public Health Nutr. 2012 Oct;15(10):1941–7.

52. Burlingame B, Dernini S. Sustainable diets: the Mediterranean diet as an example. Public Health Nutr. 2011 Dec;14(Special Issue 12A):2285–2287.

53. Dernini S, Berry EM. Mediterranean Diet: From a Healthy Diet to a Sustainable Dietary Pattern. Front Nutr [Internet]. 2015 May 7 [cited 2016 Jun 17];2. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4518218/

54. Ruini LF, Ciati R, Pratesi CA, Marino M, Principato L, Vannuzzi E. Working toward healthy and sustainable diets: the 'Double Pyramid Model' developed by the Barilla Center for Food and Nutrition to raise awareness about the environmental and nutritional impact of foods. Nutr Environ Sustain. 2015;2:9.

55. Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S, et al. Mediterranean diet pyramid today. Science and cultural updates. Public Health Nutr. 2011;14(Special Issue 12A):2274–2284.

56. Mithril C, Dragsted LO, Meyer C, Tetens I, Biltoft-Jensen A, Astrup A. Dietary composition and nutrient content of the New Nordic Diet. Public Health Nutr. 2013 May;16(5):777–85.

57. Dernini S, Berry EM, Serra-Majem L, La Vecchia C, Capone R, Medina FX, et al. Med Diet 4.0: the Mediterranean diet with four sustainable benefits. Public Health Nutr. 2016 Dec 22;1–9.

58. Sáez-Almendros S, Obrador B, Bach-Faig A, Serra-Majem L. Environmental footprints of Mediterranean versus Western dietary patterns: beyond the health benefits of the Mediterranean diet. Environ Health. 2013;12:118.

59. Vareiro, Bach-Faig, Quintana R, Bertomeu, Buckland, Vaz de Almeida, et al. Availability of Mediterranean and non-Mediterranean foods during the last four decades: comparison of several geographical areas. Public Health Nutr. 2009 Sep;12(9A):1667–75.

60. Sofi F, Macchi C, Abbate R, Gensini GF, Casini A. Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. Public Health Nutr. 2014 Dec;17(12):2769–82.

61. Amorim Cruz J. Dietary habits and nutritional status in adolescents over Europe--Southern Europe. Eur J Clin Nutr. 2000 Mar;54 Suppl 1:S29-35.

62. Germani A, Vitiello V, Giusti AM, Pinto A, Donini LM, del Balzo V. Environmental and economic sustainability of the Mediterranean Diet. Int J Food Sci Nutr. 2014 Dec;65(8):1008–12.

63. Bere E, Brug H, Klepp K-I. Why do boys eat less fruit and vegetables than girls? Public Health Nutr. 2008 Mar 1;11(3):321–5.

64. van Dooren C, Marinussen M, Blonk H, Aiking H, Vellinga P. Exploring dietary guidelines based on ecological and nutritional values: A comparison of six dietary patterns. Food Policy. 2014 Feb;44:36–46.

65. Adamsson V, Reumark A, Fredriksson I-B, Hammarström E, Vessby B, Johansson G, et al. Effects of a healthy Nordic diet on cardiovascular risk factors in hypercholesterolaemic subjects: a randomized controlled trial (NORDIET). J Intern Med. 2011 Feb 1;269(2):150–9.

66. Damsgaard CT, Dalskov S-M, Petersen RA, Sørensen LB, Mølgaard C, Biltoft-Jensen A, et al. Design of the OPUS School Meal Study: A randomised controlled trial assessing the impact of serving school meals based on the New Nordic Diet. Scand J Soc Med. 2012 Dec 1;40(8):693–703.

67. Ndanuko RN, Tapsell LC, Charlton KE, Neale EP, Batterham MJ. Associations between Dietary Patterns and Blood Pressure in a Clinical Sample of Overweight Adults. J Acad Nutr Diet. 2017 Feb;117(2):228–39.

68. Poulsen SK, Due A, Jordy AB, Kiens B, Stark KD, Stender S, et al. Health effect of the New Nordic Diet in adults with increased waist circumference: a 6-mo randomized controlled trial. Am J Clin Nutr. 2014 Jan 1;99(1):35–45.

69. European Parliament. Human health implications of organic food and organic agriculture (request of the Science and Technology Options Assessment Panel, and managed by the Scientific Foresight Unit (STOA) within the Directorate-General for Parliamentary Research Services (DG EPRS) of the European Parliament) (PDF Download Available). 2016 [cited 2017 Feb 24]; Available from: https://www.researchgate.net/publication/312032995_Human_health_implications_of_organic_food_and_organic_agriculture_request_of_the_Science_and_Technology_Options_Assessment_Panel_and_managed_by_the_Scientific_Foresight_Unit_STOA_within_the_Directorat

70. Edwards-Jones G. Does eating local food reduce the environmental impact of food production and enhance consumer health? Proc Nutr Soc. 2010 Nov;69(4):582–91.

71. Garnett T. 'Cooking up a storm.' Food, greenhouse gas emissions and our changing climate. UK: Food and Climate Research Network, University of Surrey; 2008.

72. Saikat SQ, Carter JE, Mehra A, Smith B, Stewart A. Goitre and environmental iodine deficiency in the UK — Derbyshire: A review. Environ Geochem Health. 2004 Dec 1;26(4):395–401.

73. Strassner C, Cavoski I, Di Cagno R, Kahl J, Kesse-Guyot E, Lairon D, et al. How the organic food system supports sustainable diets and translates these into practice. Nutr Environ Sustain. 2015;19.

74. Lindenthal T, Markut T, Hörtenhuber S, Rudolph G. Greenhouse Gas Emissions of Organic and Conventional Foodstuffs in Austria. In Lcafood; 2010 [cited 2017 Feb 8]. p. 319–24. Available from: http://orgprints.org/17996/

75. Seufert V, Ramankutty N, Foley JA. Comparing the yields of organic and conventional agriculture. Nature. 2012 May 10;485(7397):229–32.

76. Garcia JM, Teixeira P. Organic versus conventional food: A comparison regarding food safety. Food Rev Int. 2017 Jul 4;33(4):424–46.

77. Olson EL. The rationalization and persistence of organic food beliefs in the face of contrary evidence. J Clean Prod. 2017 Jan 1;140, Part 2:1007–13.

78. Garnett T. Fruit and vegetables & UK greenhouse gas emissions: exploring the relationship [Internet]. UK: Food and Climate Research Network, University of Surrey; 2006 [cited 2017 Feb 8]. Available from: http://scholar.googleusercontent.com/scholar?q=cache:gk42UVNmAQgJ:scholar.google.com/&hl=en&as_sdt=0,5

79. Macdiarmid JI. Is a healthy diet an environmentally sustainable diet? Proc Nutr Soc. 2013 Feb;72(01):13–20.

80. Lake, Hooper, Abdelhamid, Bentham, Boxall, Draper, et al. Climate change and food security: health impacts in developed countries. Environ Health Perspect. 2012 Nov;120(11):1520–6.

81. European Commission. Survey on Members States: Implementation of the EU Salt Reduction Framework - Publication - EU2016.nl [Internet]. 2012 [cited 2017 Feb 24]. Available from: https://english.eu2016.nl/documents/publications/2016/02/22/survey-on-members-states-implementation-of-the-eu-salt-reduction-framework

82. Food and Agriculture Organization of the United Nations. Food balance sheets [Internet]. 2017 [cited 2017 Feb 10]. Available from: http://www.fao.org/economic/ess/fbs/en/

83. Lacirignola C, Capone R, Debs P, El Bilali H, Bottalico F. Natural Resources – Food Nexus: Food-Related Environmental Footprints in the Mediterranean Countries. Front Nutr [Internet]. 2014 Dec 12 [cited 2017 Feb 8];1. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4428351/

84. Garnett T, Appleby MC, Balmford A, Bateman IJ, Benton TG, Bloomer P, et al. What is a sustainable healthy diet? A discussion paper [Internet]. Food Climate Research Network; 2014 Apr [cited 2017 Feb 8]. Available from: https://cgspace.cgiar.org/handle/10568/35584

85. Becker W, Lyhne N, Pedersen AN, Aro A, Fogelholm M, Phorsdottir I, et al. Nordic Nutrition Recommendations 2004 - integrating nutrition and physical activity. Scand J Nutr. 2004 Jan 1;48(4):178–87.

86. Harland JI, Buttriss J, Gibson S. Achieving eatwell plate recommendations: is this a route to improving both sustainability and healthy eating? Nutr Bull. 2012 Dec 1;37(4):324–43.

87. Pérez-Cueto FJ, Aschemann-Witzel J, Shankar B, Brambila-Macias J, Bech-Larsen T, Mazzocchi M, et al. Assessment of evaluations made to healthy eating policies in Europe: a review within the EATWELL Project. Public Health Nutr. 2012 Aug;15(8):1489–96.

88. Saxe H. The New Nordic Diet is an effective tool in environmental protection: it reduces the associated socioeconomic cost of diets. Am J Clin Nutr. 2014 May 1;99(5):1117–25.

89. Saxe H, Larsen TM, Mogensen L. The global warming potential of two healthy Nordic diets compared with the average Danish diet. Clim Change. 2013 Jan 1;116(2):249–62.

90. Vanham D, Mekonnen MM, Hoekstra AY. The water footprint of the EU for different diets. Ecol Indic. 2013 Sep;32:1–8.

91. Hoolohan C, Berners-Lee M, McKinstry-West J, Hewitt CN. Mitigating the greenhouse gas emissions embodied in food through realistic consumer choices. Energy Policy. 2013 Dec;63:1065–74.

92. Hallström E, Carlsson-Kanyama A, Börjesson P. Effect of dietary change on greenhouse gas emissions and land use demand - the state of knowledge in 2014. In: Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector (LCA Food 2014), San Francisco, California, USA, 8-10 October, 2014. San Francisco, California, USA,: American Center for Life Cycle Assessment; 2014.

93. Vieux F, Darmon N, Touazi D, Soler L-G. Greenhouse gas emissions of self-selected individual diets in France: Changing the diet structure or consuming less? Ecol Econ. 2012 Mar;75:91–101.

94. Horgan GW, Perrin A, Whybrow S, Macdiarmid JI. Achieving dietary recommendations and reducing greenhouse gas emissions: modelling diets to minimise the change from current intakes. Int J Behav Nutr Phys Act. 2016;13:46.

95. Perignon M, Vieux F, Soler L-G, Masset G, Darmon N. Improving diet sustainability through evolution of food choices: review of epidemiological studies on the environmental impact of diets. Nutr Rev. 2017 Jan 1;75(1):2–17.

96. Aleksandrowicz L, Green R, Joy EJM, Smith P, Haines A. The Impacts of Dietary Change on Greenhouse Gas Emissions, Land Use, Water Use, and Health: A Systematic Review. PLOS ONE. 2016 Nov 3;11(11):e0165797.

97. Fazeni K, Steinmüller H. Impact of changes in diet on the availability of land, energy demand, and greenhouse gas emissions of agriculture. Energy Sustain Soc. 2011;1(1):6.

98. Lee A, Mhurchu CN, Sacks G, Swinburn B, Snowdon W, Vandevijvere S, et al. Monitoring the price and affordability of foods and diets globally. Obes Rev. 2013 Oct 1;14:82–95.

99. Horning ML, Fulkerson JA. A Systematic Review on the Affordability of a Healthful Diet for Families in the United States. Public Health Nurs. 2015 Jan 1;32(1):68–80.

100. Jones NRV, Conklin AI, Suhrcke M, Monsivais P. The Growing Price Gap between More and Less Healthy Foods: Analysis of a Novel Longitudinal UK Dataset. PLOS ONE. 2014 Oct 8;9(10):e109343.

101. Ajzen I. The Theory of Planned Behavior. In: Organisational Behavior and Human Decision Processes. 1991. p. 179–211.

102. Higgs S. Social norms and their influence on eating behaviours. Appetite. 2015 Mar;86:38–44.

103. Lloyd-Williams F, O'Flaherty M, Mwatsama M, Birt C, Ireland R, Capewell S. Estimating the cardiovascular mortality burden attributable to the European Common Agricultural Policy on dietary saturated fats. Bull World Health Organ. 2008 Jul;86(7):535–41.

104. O'Flaherty M, Bandosz P, Critchley J, Capewell S, Guzman-Castillo M, Aspelund T, et al. Exploring potential mortality reductions in 9 European countries by improving diet and lifestyle: A modelling approach. Int J Cardiol. 2016 Mar 15;207:286–91.

105. GBD 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Lond Engl. 2016 Oct 8;388(10053):1659–724.

106. World Health Organization (WHO). WHO | Unhealthy diet [Internet]. WHO. 2017 [cited 2017 Feb 8]. Available from: http://www.who.int/gho/ncd/risk_factors/unhealthy_diet_text/en/

107. World Health Organization (WHO). Global Health Risks - Mortality and burden of disease attributable to selected major risks. 2009.

108. World Health Organization (WHO). Review of social determinants and the health divide in the WHO European Region. Final report [Internet]. 2014 [cited 2017 Feb 8]. Available from: http://www.euro.who.int/en/publications/abstracts/review-of-social-determinants-and-the-health-divide-in-the-who-european-region.-final-report

109. Buttriss. Feeding the planet: an unprecedented confluence of pressures anticipated. Nutr Bull. 2011 Jun 1;36(2):235–41.

110. Auestad N, Fulgoni VL. What Current Literature Tells Us about Sustainable Diets: Emerging Research Linking Dietary Patterns, Environmental Sustainability, and Economics. Adv Nutr Int Rev J. 2015;6(1):19–36.

111. Macdiarmid JI, Kyle J, Horgan GW, Loe J, Fyfe C, Johnstone A, et al. Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? Am J Clin Nutr. 2012 Sep 1;96(3):632–9.

112. Government Office for Science. Foresight projects. Future of food and farming: final project report [Internet]. 2011 [cited 2017 Feb 8]. Available from: https://www.gov.uk/government/publications/future-of-food-and-farming

113. Springmann M, Godfray HCJ, Rayner M, Scarborough P. Analysis and valuation of the health and climate change cobenefits of dietary change. Proc Natl Acad Sci. 2016 Apr 12;113(15):4146–51.

114. Kremen C, Miles A. Ecosystem Services in Biologically Diversified versus Conventional Farming Systems: Benefits, Externalities, and Trade-Offs. Ecol Soc [Internet]. 2012 Dec 18 [cited 2017 Feb 8];17(4). Available from: http://www.ecologyandsociety.org/vol17/iss4/art40/

115. Tilman D, Clark M. Global diets link environmental sustainability and human health. Nature. 2014 Nov 27;515(7528):518–22.

116. Richardson C, Courvisanos J, Crawford JW. Toward a synthetic economic systems modeling tool for sustainable exploitation of ecosystems. Ann N Y Acad Sci. 2011 Feb 1;1219(1):171–84.

117. Jennings S, Smith ADM, Fulton EA, Smith DC. The ecosystem approach to fisheries: management at the dynamic interface between biodiversity conservation and sustainable use. Ann N Y Acad Sci. 2014 Aug 1;1322(1):48–60.

118. Kawarazuka N, Béné C. The potential role of small fish species in improving micronutrient deficiencies in developing countries: building evidence. Public Health Nutr. 2011 Nov;14(11):1927–38.

119. Risks C on NR in SS to BB and, Board F and N, Medicine I of. Seafood Choices: Balancing Benefits and Risks. National Academies Press; 2007. 737 p.

120. Mozaffarian D. Dietary and Policy Priorities for Cardiovascular Disease, Diabetes, and Obesity. Circulation. 2016 Jan 12;133(2):187–225.

121. Afshin A, Micha R, Khatibzadeh S, Schmidt LA, Mozaffarian D. Dietary Policies to Reduce Non-Communicable Diseases. In: Brown GW, Yamey G, Wamala S, editors. The Handbook of Global Health Policy [Internet]. John Wiley & Sons, Ltd; 2014 [cited 2017 Mar 15]. p. 175–93. Available from: http://onlinelibrary.wiley.com/doi/10.1002/9781118509623.ch9/summary

122. European Parliament. General Food Law REgulation (EC) No 178/2002 [Internet]. 2002 [cited 2017 Feb 8]. Available from: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32002R0178

123. European Parliament. Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers [Internet]. 2011 [cited 2017 Feb 8]. Available from: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32011R1169

124. European Parliament. Regulation (EC) No 1924/2006 of the european parliament and of the council of 20 December 2006 on nutrition and health claims made on foods [Internet]. 2006 [cited 2017 Feb 8]. Available from: http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A02006R1924-20121129

125. Boulton AC, Rushton J, Wathes CM, Wathes DC. Past trends and future challenges for a sustainable UK dairy industry. J R Agric Soc Engl 172 [Internet]. 2011 [cited 2017 Feb 8]; Available from: https://www.researchgate.net/publication/286113914_Past_trends_and_future_challenges_for_a_sustainable_UK_dairy_industry

126. European Commission. Integrating environmental concerns into the CAP [Internet]. Agriculture and rural development - European Commission. 2012 [cited 2017 Mar 10]. Available from: http://ec.europa.eu/agriculture/envir/cap_en

127. Tubiello FN, Salvatore F, Cóndor Golec RD, Ferrara A, Rossi S, Biancalani R, et al. Agriculture, Forestry and Other Land Use Emissions by Sources and Removals by Sinks: 1990-2011 Analysis [Internet]. FAO Statistics Division; 2014 [cited 2017 Feb 10]. Available from: https://www.researchgate.net/publication/264583467_Agriculture_Forestry_and_Other_Land_Use_Emissions_by_Sources_and_Removals_by_Sinks_1990-2011_Analysis

128. Walls HL, Cornelsen L, Lock K, Smith RD. How much priority is given to nutrition and health in the EU Common Agricultural Policy? Food Policy. 2016 Feb;59:12–23.

129. European Commission. Energy Union and Climate Action: Driving Europe's transition to a low-carbon economy (Press Release). 2016 [cited 2017 Feb 10]; Available from: http://europa.eu/rapid/press-release_IP-16-2545_en.htm

130. Bukeviciute L, Dierx A, Ilzkovitz F. The functioning of the food supply chain and its effect on food prices in the European Union. Eur Econ [Internet]. 2009 [cited 2017 Feb 8];Occasional Papers 47. Available from: http://ec.europa.eu/economy_finance/publications/pages/publication_summary15232_en.htm

131. European Commission. Commission Staff Working Document, The functioning of the food supply chain and its effects on food prices SEC (2008) 2972. 2008.

132. Beske P, Land A, Seuring S. Sustainable supply chain management practices and dynamic capabilities in the food industry: A critical analysis of the literature. Int J Prod Econ. 2014 Jun;152:131–43.

133. Kraak VI, Swinburn B, Lawrence M, Harrison P. An accountability framework to promote healthy food environments. Public Health Nutr. 2014 Nov;17(11):2467–83.

134. Meadows D. Leverage Points: places to intervene in a system [Internet]. USA: The Sustainability Institute, Hartland, VT; 1999 [cited 2017 Feb 8]. Available from: http://www.developerdotstar.com/mag/articles/places_intervene_system.html

135. Ingram JSI, Wright HL, Foster L, Aldred T, Barling D, Benton TG, et al. Priority research questions for the UK food system. Food Secur. 2013 Oct 1;5(5):617–36.

136. Buttriss. Food reformulation: the challenges to the food industry. Proc Nutr Soc. 2013 Feb;72(1):61–9.

137. European Commission. EU platform for action on diet, physical activity and health [Internet]. Public Health. 2017 [cited 2017 Feb 8]. Available from: /health/nutrition_physical_activity/platform_en

138. Wagner B, Svensson G. A framework to navigate sustainability in business networks: The transformative business sustainability (TBS) model. Eur Bus Rev. 2014 Jun 3;26(4):340–67.

139. Darkow I-L, Foerster B, von der Gracht HA. Sustainability in food service supply chains: future expectations from European industry experts toward the environmental perspective. Supply Chain Manag Int J. 2015 Mar 6;20(2):163–78.

140. Leat P, Revoredo-Giha C, Lamprinopoulou C. Scotland's Food and Drink Policy Discussion: Sustainability Issues in the Food Supply Chain. Sustainability. 2011 Mar 31;3(4):605–31.

141. Ilbery B, Maye D. Food supply chains and sustainability: evidence from specialist food producers in the Scottish/English borders. Land Use Policy. 2005 Oct;22(4):331–44.

142. Akkerman R, Farahani P, Grunow M. Quality, safety and sustainability in food distribution: a review of quantitative operations management approaches and challenges. Spectr. 2010 Sep 1;32(4):863–904.

143. Zong G, Eisenberg DM, Hu FB, Sun Q. Consumption of Meals Prepared at Home and Risk of Type 2 Diabetes: An Analysis of Two Prospective Cohort Studies. PLOS Med. 2016 Jul 5;13(7):e1002052.

144. Storcksdieck genannt Bonsmann S. Comprehensive mapping of national school food policies across the European Union plus Norway and Switzerland. Nutr Bull. 2014 Dec 1;39(4):369–73.

145. United Nations World Food Programme (UNWFP). State of School Feeding Worldwide 2013 [Internet]. 2013 [cited 2017 Feb 24]. Available from: https://www.wfp.org/content/state-school-feeding-worldwide-2013

146. Orfanos P, Naska A, Trichopoulou A, Grioni S, Boer JMA, van Bakel MME, et al. Eating out of home: energy, macro- and micronutrient intakes in 10 European countries. The European Prospective Investigation into Cancer and Nutrition. Eur J Clin Nutr. 2009;63(S4):S239–62.

147. Post A, Mikkola M. Nordic stakeholders in catering for sustainability: Chasm between ideology and practice? Br Food J. 2012 May 11;114(5):743–61.

148. Wahlen S, Heiskanen E, Aalto K. Endorsing Sustainable Food Consumption: Prospects from Public Catering. J Consum Policy. 2012 Mar 1;35(1):7–21.

149. Løes A-K, Nölting B. Increasing organic consumption through school meals—lessons learned in the iPOPY project. Org Agric. 2011 May 1;1(2):91–110.

150. Baldwin C, Wilberforce N, Kapur A. Restaurant and food service life cycle assessment and development of a sustainability standard. Int J Life Cycle Assess. 2011 Jan 1;16(1):40–9.

151. Virtanen Y, Kurppa S, Saarinen M, Katajajuuri J-M, Usva K, Mäenpää I, et al. Carbon footprint of food – approaches from national input–output statistics and a LCA of a food portion. J Clean Prod. 2011 Nov;19(16):1849–56.

152. Beer S, Lemmer C. A critical review of 'green' procurement: Life cycle analysis of food products within the supply chain. Worldw Hosp Tour Themes. 2011 Jun 14;3(3):229–44.

153. Galli F, Bartolini F, Brunori G, Colombo L, Gava O, Grando S, et al. Sustainability assessment of food supply chains: an application to local and global bread in Italy. Agric Food Econ. 2015 Dec 1;3(1):21.

154. Lipinski B, Hanson C, Lomax J, Kitinoja L, Waite R, Searchinger T. Reducing food loss and waste. 2013 [cited 2017 Mar 1]; Available from: http://staging.unep.org/wed/2013/docs/WRI-UNEP-Reducing-Food-Loss-and-Waste.pdf

155. Falasconi L, Vittuari M, Politano A, Segrè A. Food Waste in School Catering: An Italian Case Study. Sustainability. 2015 Nov 4;7(11):14745–60.

156. Silvennoinen K, Katajajuuri J-M, Hartikainen H, Jalkanen L, Koivupuro H-K, Reinikainen A, et al. Food waste volume and composition in the Finnish supply chain: special focus on food service sector. 2012 [cited 2017 Mar 1]; Available from: https://portal.mtt.fi/portal/page/portal/mtt/hankkeet/foodspill/Food%20Waste%20Volume%20and%20Composition%20Focus%20on%20Food%20Service%20Sector.pdf

157. Syed Ghulam Rahman. Public Health in Europe: the role of Non Governmental Public Health associations in public helath policy development [Internet]. Karolinska Institutet; [cited 2017 Feb 8]. Available from: https://www.google.ch/search?q=18.%09https%3A%2F%2Feupha.org%2Frepository%2Fpublications%2FPublic_health_in_Europe_-_%2520the_role_of_EUPHA_members.pdf&ie=utf-8&oe=utf-8&client=firefox-b-ab&gfe_rd=cr&ei=hUybWMvTNqzC8gf-v7XwBA

158. World Health Organization (WHO). Tackling food marketing to children in a digital world: trans-disciplinary perspectives. Children's rights, evidence of impact, methodological challenges, regulatory options and policy implications for the WHO European Region (2016) [Internet]. 2016 [cited 2017 Feb 10]. Available from: http://www.euro.who.int/en/publications/abstracts/tackling-food-marketing-to-children-in-a-digital-world-trans-disciplinary-perspectives.-childrens-rights,-evidence-of-impact,-methodological-challenges,-regulatory-options-and-policy-implications-for-the-who-european-region-2016

159. Garnett T, Mathewson S, Angelides P, Borthwich F. Policies and actions to shift eating patterns: What works? A review of the evidence of the effectiveness of interventions aimed at shifting diets in more sustainable and healthy directions [Internet]. Oxford, UK: Food Climate Research Network (FCRN), University of Oxford.; 2015 [cited 2016 Jun 29]. Available from: http://www.fcrn.org.uk/fcrn-publications/reports/policies-and-actions-shift-eating-patterns-what-works

160. Reisch L, Eberle U, Lorek S. Sustainable Food Consumption: An Overview of Contemporary Issues and Policies. Sustain Sci Pract Policy [Internet]. 2013 Jul 1 [cited 2016 Jun 29];9(2). Available from: https://www.questia.com/library/journal/1P3-3132520411/sustainable-food-consumption-an-overview-of-contemporary

161. European Commission. Policies to encourage sustainable consumption. Technical report-2012-061 [Internet]. 2012 [cited 2017 Jan 18]. Available from: http://ec.europa.eu/environment/eussd/pdf/report_22082012.pdf

162. Barling D. The challenges facing contemporary food systems: European policy and governance pathways to sustainable food consumption and production. Agron Environ Sociétés. 2011;1(2):15–25.

163. German Council for Sustainable Development. The Sustainable Shopping Basket. A guide to better shopping [Internet]. 2013 [cited 2017 Feb 8]. Available from: http://www.nachhaltigkeitsrat.de/en/projects/projects-of-the-council/the-sustainable-shopping-basket/

164. Health Council of the Netherlands (HCN). Guidelines for a healthy diet: the ecological perspective. Vol. 2011/08E. The Hague; 2011. 84 p.

165. Swedish Food Agency (SFA). Find your way to eat greener, not too much and be active [Internet]. Sweden; 2015 [cited 2017 Feb 8]. Available from: http://www.livsmedelsverket.se/globalassets/english/food-habits-health-environment/dietary-guidelines/kostrad-eng.pdf?id=8140

166. Gill M, Johnston K. Informing food policy: balancing the evidence. Proc Nutr Soc. 2010;69(04):621–627.

167. Gillies P. Effectiveness of alliances and partnerships for health promotion. Health Promot Int. 1998;13(2):99–120.

168. Scottish Government SAH. National Food and Drink Policy for Scotland - Development of the Policy [Internet]. 2003 [cited 2017 Mar 10]. Available from: http://www.gov.scot/Topics/Business-Industry/Food-Industry/national-strategy/history

169. Carey R, Caraher M, Lawrence M, Friel S. Opportunities and challenges in developing a whole-of-government national food and nutrition policy: lessons from Australia's National Food Plan. Public Health Nutr. 2016 Jan;19(1):3–14.

170. Ridgway EM, Lawrence MA, Woods J. Integrating Environmental Sustainability Considerations into Food and Nutrition Policies: Insights from Australia's National Food Plan. Front Nutr [Internet]. 2015 Sep 17 [cited 2017 Jan 18];2. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4585016/

171. Caraher M, Carey D. Issues On Food Sustainability in Australia. Nutridate. 2010;21(4):2–6.

172. Garnett T. Changing what we eat [Internet]. Food Climate Research Network (FCRN), University of Oxford.; 2014 [cited 2017 Jan 18]. Available from: http://www.fcrn.org.uk/sites/default/files/fcrn_wellcome_gfs_changing_consumption_report_final.pdf

173. Local Government Association. Changing behaviors in public health - to nudge or to shove? [Internet]. Local government Association, UK; 2013 [cited 2017 Feb 8]. Available from: http://www.local.gov.uk/publications/-/journal_content/56/10180/5557157/PUBLICATION

174. Nuffield Council on Bioethics. Public health ethical issues. Nuffield Intervention Ladder. [Internet]. London: Nuffield Council on Bioethics.; 2007 [cited 2017 Mar 17]. Available from: http://blogs.biomedcentral.com/bmcseriesblog/wp-content/uploads/sites/9/2015/04/Ladder.jpg

175. Vieux F, Soler L-G, Touazi D, Darmon N. High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults. Am J Clin Nutr. 2013 Mar 1;ajcn.035105.

176. Fischer CG, Garnett T. Plates, pyramids and planets - Developments in national healthy and sustainable dietary guidelines: a state of play assessment [Internet]. Food and Agriculture Organization of the United nations and Food Climate Research Network (FCRN), University of Oxford.; 2016 [cited 2017 Jan 18]. Available from: http://www.fao.org/sustainable-food-value-chains/library/details/en/c/415611/

177. Gil A, Ruiz-Lopez MD, Fernandez-Gonzalez M, Victoria EM de. The FINUT Healthy Lifestyles Guide: Beyond the Food Pyramid. Adv Nutr Int Rev J. 2014 May 1;5(3):358S–367S.

178. Lachat C, Otchere S, Roberfroid D, Abdulai A, Seret FMA, Milesevic J, et al. Diet and Physical Activity for the Prevention of Noncommunicable Diseases in Low- and Middle-Income Countries: A Systematic Policy Review. PLOS Med. 2013 Jun 11;10(6):e1001465.

179. World Health Organization (WHO). A review of nutrition policies: draft report WHO [Internet]. 2010 [cited 2017 Jan 18]. Available from: http://www.who.int/nutrition/EB128_18_Backgroundpaper1_A_review_of_nutritionpolicies.pdf

180. Public Health England, Welsh Government, Scottish, Scottish Government, Food Standards Agency in Northern Ireland. Your guide to the eatwell plate – helping you to eat a healthier diet. Public Health England; 2013.

181. Godfray HCJ, Crute IR, Haddad L, Lawrence D, Muir JF, Nisbett N, et al. The future of the global food system. Philos Trans R Soc Lond B Biol Sci. 2010 Sep 27;365(1554):2769–77.

182. Grunert KG, Hieke S, Wills J. Sustainability labels on food products: Consumer motivation, understanding and use. Food Policy. 2014 Feb;44:177–89.

183. Van Loo EJ, Hoefkens C, Verbeke W. Match or mismatch between sustainable, healthy and plant-based food choice: consumer insight and policy implications. under review;

184. Hartmann C, Siegrist M. Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. Trends Food Sci Technol. 2017 Mar;61:11–25.

185. Ashford NA, Hall RP, Ashford RH. The crisis in employment and consumer demand: Reconciliation with environmental sustainability. Environ Innov Soc Transit. 2012 Mar;2:1–22.

186. Bryngelsson D, Wirsenius S, Hedenus F, Sonesson U. How can the EU climate targets be met? A combined analysis of technological and demand-side changes in food and agriculture. Food Policy. 2016 Feb;59:152–64.

187. Feng K, Hubacek K, Guan D, Contestabile M, Minx J, Barrett J. Distributional Effects of Climate Change Taxation: The Case of the UK. Environ Sci Technol. 2010 May 15;44(10):3670–6.

188. Garnett T. Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? Food Policy. 2011 Jan;36, Supplement 1:S23–32.

189. Kehlbacher A, Tiffin R, Briggs A, Berners-Lee M, Scarborough P. The distributional and nutritional impacts and mitigation potential of emission-based food taxes in the UK. Clim Change. 2016 Jul 1;137(1–2):121–41.

190. Darmon N, Drewnowski A. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. Nutr Rev. 2015 Oct 1;73(10):643–60.

191. Loring B, Robertson A. Obesity and inequities. Guidance for addressing inequities in overweight and obesity. World Health Organization; 2014.

192. Food and Agriculture Organization of the United Nations (FAO). The State of Food and Agriculture 2013 [Internet]. 2013 [cited 2017 Feb 8]. (ISBN 978-92-5-107671-2). Available from: http://www.fao.org/docrep/018/i3300e/i3300e00.htm

193. World Health Organization (WHO). Using price policies to promote healthier diets (2015) [Internet]. 2015 [cited 2017 Feb 8]. Available from: http://www.euro.who.int/en/publications/abstracts/using-price-policies-to-promote-healthier-diets-2015

194. European Parliament. Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC Text with EEA

relevance [Internet]. 2014 [cited 2017 Mar 1]. Available from: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0024

195. Comission of the European Communities. COM (2008) 400 [Internet]. 2008 [cited 2017 Mar 1]. Available from: https://www.google.ch/search?q=COM+(2008)+400.+&ie=utf-8&oe=utf-8&client=firefox-b&gfe_rd=cr&ei=c9m2WMCcIMnDaMCljbgG

196. Sonnino R. Quality Food, Public Procurement, and Sustainable Development: The School Meal Revolution in Rome. Environ Plan A. 2009 Feb 1;41(2):425–40.

197. Bergström K, Solér C, Shanahan H. Professional food purchasers' practice in using environmental information. Br Food J. 2005 May 1;107(5):306–19.

198. Brammer S, Walker H. Sustainable procurement in the public sector: an international comparative study. Int J Oper Prod Manag. 2011 Mar 22;31(4):452–76.

199. Rimmington M, Carlton Smith J, Hawkins R. Corporate social responsibility and sustainable food procurement. Br Food J. 2006 Oct 1;108(10):824–37.

200. Walker H, Preuss L. Fostering sustainability through sourcing from small businesses: public sector perspectives. J Clean Prod. 2008 Oct;16(15):1600–9.

201. Walker H, Brammer S. The relationship between sustainable procurement and e-procurement in the public sector. Int J Prod Econ. 2012 Nov;140(1):256–68.

202. Cerutti AK, Contu S, Ardente F, Donno D, Beccaro GL. Carbon footprint in green public procurement: Policy evaluation from a case study in the food sector. Food Policy. 2016 Jan;58:82–93.

203. Preuss L. Addressing sustainable development through public procurement: the case of local government. Supply Chain Manag Int J. 2009 May 1;14(3):213–23.

204. Morgan K. Greening the Realm: Sustainable Food Chains and the Public Plate. Reg Stud. 2008 Nov 1;42(9):1237–50.

205. Smith J, Andersson G, Gourlay R, Karner S, Mikkelsen BE, Sonnino R, et al. Balancing competing policy demands: the case of sustainable public sector food procurement. J Clean Prod. 2016 Jan 20;112, Part 1:249–56.

206. Mikkelsen BE, Bruselius-Jensen M, Lassen A. Are green caterers more likely to serve healthy meals than non-green caterers? Results from a quantitative study in Danish worksite catering. Public Health Nutr. 2006;9(7):846–850.

207. McCrudden C. Using public procurement to achieve social outcomes. Nat Resour Forum. 2004 Nov 1;28(4):257–67.

208. Stefani G, Tiberti M, Lombardi GV. Public Food Procurement: A Systematic Literature Review [Internet]. Universita' degli Studi di Firenze, Dipartimento di Scienze per l'Economia e

l'Impresa; 2015 [cited 2017 Feb 8]. Report No.: wp2015_02.rdf. Available from: https://ideas.repec.org/p/frz/wpmmos/wp2015_02.rdf.html

209. Lehtinen U. Sustainability and local food procurement: a case study of Finnish public catering. Br Food J. 2012 Aug 3;114(8):1053–71.

210. Mikkelsen BE, Sylvest J. Organic Foods on the Public Plate: Technical Challenge or Organizational Change? J Foodserv Bus Res. 2012 Jan 1;15(1):64–83.

211. Mikkelsen BE. WG24 – Revaluing institutional food procurement Organic food on the public plate in Denmark – top down or bottom up? In Rome, Italy; 2015.

212. Danish Ministry of Food, Agriculture and Fisheries. Økologisk Handlingsplan 2020 (The Organic Action Plan 2020 Overview) [Internet]. Copenhagen, DK; 2012 [cited 2017 Feb 8]. Available from: http://mfvm.dk/landbrug/indsatsomraader/oekologi/oekologiplan-danmark-2015/oekologisk-handlingsplan-2020/

213. Dora C, Haines A, Balbus J, Fletcher E, Adair-Rohani H, Alabaster G, et al. Indicators linking health and sustainability in the post-2015 development agenda. The Lancet. 2015 Jan;385(9965):380–91.

214. World Health Organization (WHO). WHO European Database on Nutrition, Obesity and Physical Activity (NOPA) [Internet]. 2016 [cited 2017 Feb 10]. Available from: http://data.euro.who.int/nopa/

215. World Health Organization (WHO). WHO | Global database on the Implementation of Nutrition Action (GINA) [Internet]. WHO. 2017 [cited 2017 Feb 10]. Available from: http://www.who.int/nutrition/gina/en/

216. World Cancer Research Fund International. NOURISHING framework [Internet]. 2017 [cited 2017 Feb 10]. Available from: http://www.wcrf.org/int/policy/nourishing-framework

217. Swinburn B, Vandevijvere S, Kraak V, Sacks G, Snowdon W, Hawkes C, et al. Monitoring and benchmarking government policies and actions to improve the healthiness of food environments: a proposed Government Healthy Food Environment Policy Index. Obes Rev. 2013 Oct 1;14:24–37.

218. Sachs J, Remans R, Smukler S, etal. Monitoring the world's agriculture : Nature : Nature Research. Nature. 2010;466:558–60.

219. DeFries R, Fanzo J, Remans R, Palm C, Wood S, Anderman TL. Metrics for land-scarce agriculture. Science. 2015 Jul 17;349(6245):238–40.

220. Clonan A, Wilson P, Swift JA, Leibovici DG, Holdsworth M. Red and processed meat consumption and purchasing behaviours and attitudes: impacts for human health, animal welfare and environmental sustainability. Public Health Nutr. 2015 Sep;18(13):2446–56.

221. Mäkelä J, Niva M. Citizens and sustainable culinary cultures. In: Climate Change Adaptation and Food Supply Chain Management. Routledge; 2015.

222. Niva M, Mäkelä J, Kahma N, Kjærnes U. Eating Sustainably? Practices and Background Factors of Ecological Food Consumption in Four Nordic Countries. J Consum Policy. 2014 Dec 1;37(4):465–84.

223. Friel S. Climate change, food insecurity and chronic diseases: sustainable and healthy policy opportunities for Australia. New South Wales Public Health Bull. 2010 Aug 6;21(6):129–33.

224. Farmar-Bowers Q. Finding Ways to Improve Australia's Food Security Situation. Agriculture. 2015 May 27;5(2):286–312.

225. Trichopoulou A. Diversity v. globalization: traditional foods at the epicentre. Public Health Nutr. 2012 Jun;15(6):951–4.

226. Heller MC, Keoleian GA, Willett WC. Toward a Life Cycle-Based, Diet-level Framework for Food Environmental Impact and Nutritional Quality Assessment: A Critical Review. Environ Sci Technol. 2013 Nov 19;47(22):12632–47.

227. Werner LB, Flysjö A, Tholstrup T. Greenhouse gas emissions of realistic dietary choices in Denmark: the carbon footprint and nutritional value of dairy products. Food Nutr Res [Internet]. 2014 Jun 10 [cited 2017 Feb 8];58. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4053929/

228. Drewnowski A, Rehm CD, Martin A, Verger EO, Voinnesson M, Imbert P. Energy and nutrient density of foods in relation to their carbon footprint. Am J Clin Nutr. 2015 Jan;101(1):184–91.

229. Masset G, Soler L-G, Vieux F, Darmon N. Identifying Sustainable Foods: The Relationship between Environmental Impact, Nutritional Quality, and Prices of Foods Representative of the French Diet. J Acad Nutr Diet. 2014 Jun;114(6):862–9.

230. McGuire S. Scientific Report of the 2015 Dietary Guidelines Advisory Committee. Washington, DC: US Departments of Agriculture and Health and Human Services, 2015. Adv Nutr Int Rev J. 2016 Jan 1;7(1):202–4.

231. Vinnari M, Vinnari E. A Framework for Sustainability Transition: The Case of Plant-Based Diets. J Agric Environ Ethics. 2014 Jun 1;27(3):369–96.

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12. Appendix: Search Syntaxes Used for the First Reviews

1. Description of European Diets: (((Europe OR European OR England OR Scotland OR Scottish OR Finland OR Finnish OR Wales OR Welsh OR "Northern Ireland" OR Ireland OR Irish OR UK OR "United Kingdom" OR Britain OR British OR Spain OR Spanish OR Portugal OR Portuguese OR Greece OR Greek OR Italian OR Italy OR Norway OR Norwegian OR Denmark OR Danish OR Sweden OR Swedish OR Iceland OR German OR Germany OR French OR France OR Czech OR Poland OR polish OR Russia OR Russian OR Slovak* OR Slovene* OR Croatia*)) AND ((("dietary patterns" OR "dietary habits" OR "nutritional intakes" OR "diet" OR "dietary intakes" OR "food habits" OR "eating patterns" OR "food patterns" OR "nutrient intakes")) AND ("carbon footprint" OR "environmental impact" OR "carbon emissions" OR "ecological footprint" OR "greenhouse gases" OR "environmental degradation" OR "climate change")
2. Consideration of individual and societal costs and benefits of sustainable healthy eating: ("diet*" or "nutrition*" or food).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] AND ("environmental impact" or "sustainable" or "ecological").mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] AND (cost* or benefit* or econom*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier], limited to ("review articles" and yr="2009 -Current")
3. Sustainable dietary guidelines: ((((("environmental impact" OR "sustainable" OR "ecological"))) AND (("diet*" OR "nutrition*" OR food))) AND ((guideline* OR recommendation* OR guid*)) AND (Review[ptyp] AND ("2009/01/01"[PDat] : "2016/12/31"[PDat]))
4. Available conceptual models and tools to inform decision making on food, sustainability and health
5. Mapping out the range of food actors
6. Identifying evidence-informed food and nutrition policies