sustainability

MDPI

Review

Demand-Side Food Policies for Public and Planetary Health

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Abstract: Background: The current food system has major consequences for the environment and for human health. Alignment of the food policy areas of mitigating climate change and public health will ensure coherent and effective policy interventions for sustaining human health and the environment. This paper explores literature on demand-side policies that aim to reduce consumption of animal-based foods, increase plant-based foods, and reduce overconsumption. Methods: We searched for publications, published between January 2000 and December 2019, considering the above policy domains. Articles were distinguished for type of policy instrument, for topic via keywords and examples were given. Results: The majority of demand-side policies focus on preventing overweight and obesity, using all types of policy instruments including more forceful market-based policies. Hardly any examples of public policies explicitly aiming to lower animal-based foods consumption were found. Policies combining health and sustainability objectives are few and mainly of the information type. Discussion: Moving towards environmentally sustainable and healthy diets is challenging as the implemented demand-side policies focus largely on human health, and not yet on environmental outcomes, or on win-wins. Policies targeting foods from the health perspective can contribute to lower environmental impacts, by indicating suitable animal-based food replacers, and aiming at avoiding overconsumption of energy dense-nutrient poor foods. Preferred policies include a variety of instruments, including strong measures. Conclusions: Working solutions are available to ensure coherent and effective demand side food policies aligning public health and environmental aims. Implementation of aligned and effective policy packages is urgent and needed.

Keywords: sustainable; healthy; diet; food systems; policy instrument; review

1. Introduction

1.1. Environmental and Health Impacts of the Global Food System

The current food system has major consequences for the environment and for human health [1]. Food production including land use change is responsible for about 20% of total global anthropogenic greenhouse gas emissions (GHGE) [2–4], with the additional emissions from other parts of the food system adding another 10–20% of GHGE [5]. Agriculture is further responsible for 92% of the global water footprint [6] and is the largest driver of biodiversity loss [7]. Moreover, the large-scale application of fertilizer has major implications for global biochemical nitrogen and phosphorus flows [8]. Of the total nitrogen and phosphorus inputs via fertilizers, only 15–20% is actually present in the food that reaches the consumers' plates, implying large nutrient losses to the environment [9,10]. At the same time, the current food system also has major implications for disparities in food distribution and human health [11]. The current Western dietary pattern (high in animal-based and low in plant-based foods) and overconsumption has resulted in arise in overweight and obesity, and the associated rise in non-communicable diseases (NCDs), also known as chronic diseases, such as type II diabetes, coronary heart diseases, and some cancers [12–14].

Dietary choices link human health and environmental sustainability. Policies that target dietary choices may have benefits for both health and the environment. However, trade-offs are identified as well: Public health policies that exclusively aim to increase the consumption of certain foods may cause additional environmental pressure when not combined with lowering the consumption of other foods. For instance, if policies aim to increase fish consumption [15], but are not combined with advices to lower consumption of red (processed) meat, this may lead to increased pressure on the environment. Compared to traditional, Western dietary patterns, dietary patterns such as Mediterranean, vegetarian, or vegan diets generally have lower environmental impacts and are considered more healthy, as these diets contain lower amounts of animal products (especially red and processed meat [16]) and larger amounts of plant-based foods (vegetables and fruits) [17]. Livestock causes the largest environmental impacts in terms of GHGE [18] and have a high share in nitrogen losses [10,19]. Nitrogen use efficiency (edible protein produced per unit of nitrogen) in animal products is around 6–37%, while this is 45–76% for vegetable products, with beef, pork, and dairy having a particularly low efficiency [10].

1.2. The Need for Policies Addressing Health and Environmental Sustainability

A major type of policies focus on the prevention of NCDs via the prevention of overconsumption of energy-dense foods. Effective interventions lead to a lower prevalence of overweight and obesity, with associated improvements in the rate of NCDs [20], and are expected to reduce the demand for food. Unhealthy diets and overweight are, after smoking, the most important lifestyle factors that determine morbidity as well as the socioeconomic health inequalities in the EU [12,21]. Unhealthy diets have a high share of energy-dense, (micro) nutrient-poor foods and beverages (also called discretionary foods, ultra-processed, or non-core foods) [22]. Moreover, current Western diets contain too many foods with high-saturated fatty acids, sugar, salt, and low fiber contents [22,23]. Policies in this area focus on food choice as well as on food reformulation. Overconsumption of foods and beverages inflates dietary GHGE as well [24]. Some of the foods, such as sugar-sweetened beverages, may have a low environmental pressure per kg, but combined with a high consumption it contributes significantly to daily GHGE [25] and adverse effects on public health [14]. Figure 1 depicts major food and beverage sources for intakes of saturated fatty acids (meat, dairy, snacks), sodium (bread, mixed dishes, meat), added sugar (beverages and sweets and snacks) (adapted from [26,27]), and for GHGE (meat, dairy, beverages) (adapted from [28]). As there is potential common ground, further steps must be taken to identify types of policy instruments and potential policies itself that enable targeting improvements for both human and planetary health, on the demand side. Moreover, it is important and novel to identify how demand side policies from health and environmental perspective can complement and reinforce each other.

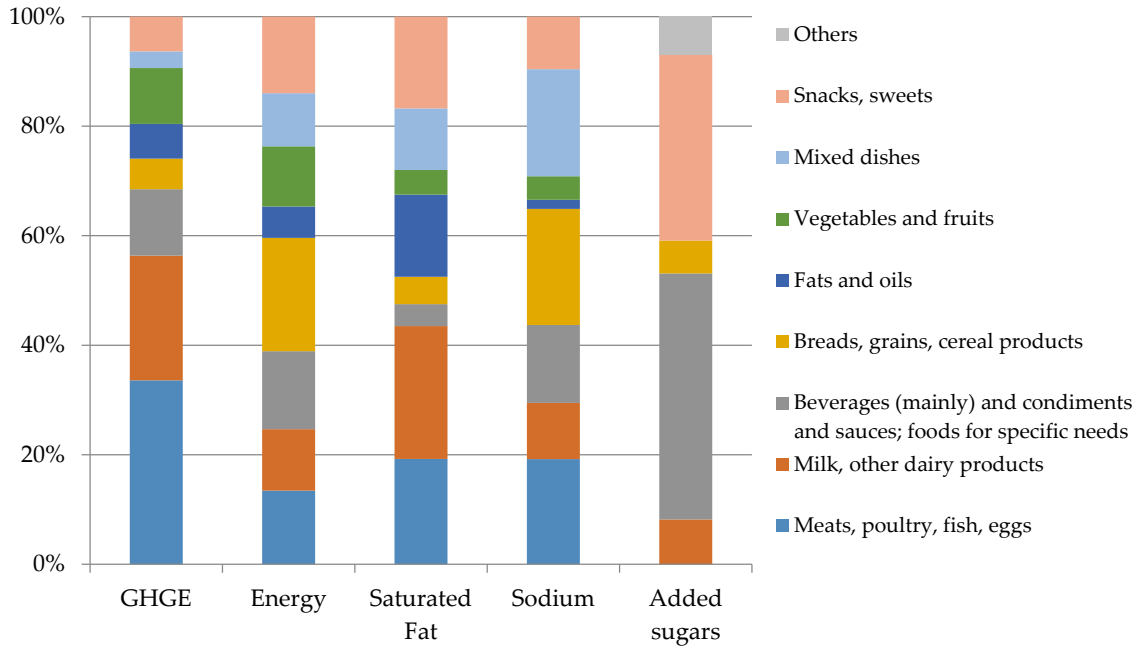

Figure 1. Major food and beverage sources for intakes of saturated fatty acids (meat, dairy, snacks), sodium (bread, mixed dishes, meat), added sugar (beverages and sweets and snacks) (adapted from [26,27], and for greenhouse gas emissions (GHGE) (meat, dairy, beverages) (adapted from [28]). Energy, saturated fat, and sodium were based on food consumption survey data (2003–2012) of Australia, France, Denmark, The Netherlands, and the United States. Added sugars were based on two surveys from the United States (What We Eat in America, National Health and Nutrition Examination Survey) of 2003–2006. GHGE was based on Dutch food consumption survey data of 2007–2010.

1.3. Study Objectives

In this article, we explore literature on currently available policies that aim to reduce consumption of animal-based foods, increase plant-based foods consumption, and reduce overconsumption or prevent overweight and obesity. The effects of the policies are described according to the type of instrument (administrative, market-based, informative, and behavioral approaches) and for examples it is explored how the interventions might affect environmental impact. To explore how the interventions might affect environmental impact, we focused on GHGE as one of the main environmental challenges [29]. GHGE are strongly associated with other environmental indicators such as land use, eutrophication [30], and losses of reactive nitrogen [10]. In particular, most environmental impacts are relatively low for plant-based foods as compared to animal-source food [10,19,30], with the exception of blue water use [25]; we therefore consider GHGE as a proxy for wider environmental pressures.

2. Materials and Methods

A systematic mapping review was made selecting papers published from January 2000 to December 2019 and included in the Scopus, PubMed, and Embase databases.

The search strategy consisted of a combination of two sets of search terms. In the first set, literature (PubMed and Scopus) was searched via search terms for policy or interventions of scale (e.g., national, large region) aiming at lowering consumption of animal-based foods or meat as well as higher plant-based foods or vegetables and fruits, lowering overconsumption (or shift towards healthier diets) to prevent overweight and obesity. In the second set (Embase), more general search terms were used and combinations of these terms. See the search strategies in Supplementary Table S1.

Review papers and individual studies with a preference for actually implemented policies and interventions, and research into their efficacy, were included, as well as exploratory policies and interventions not yet implemented, e.g., modeling studies. The collection of literature was

complemented by literature added via the authors (n = 55). Literature was included when it was aimed at lowering consumption of animal-based foods or meat, increasing consumption of plant-based foods or vegetables and fruits, or lowering of overconsumption (or shift towards healthier diet) to prevent overweight and obesity. The primary focus was on Europe, but relevant examples from outside Europe were also included. Studies on both children and adults were included. Only reviews in English were considered. Grey literature from international organizations (including information on national FBDG) such as the Food and Agricultural Organization (FAO), World Health Organization (WHO), Food and Climate Research Network (FCRN), and United Nations System Standing Committee on Nutrition (UNSCN) was included.

Figure 2 presents the search results. Records found were screened for relevance through title and/or abstract. Papers were selected to be read full-text. Papers selected from Scopus and PubMed were full-text screened by all authors, and papers selected from Embase by two experts of the Institute for Public health and the Environment (RIVM). Based on full-text reading, papers were included and stored in a database. Double references were excluded. This resulted in 176 papers.

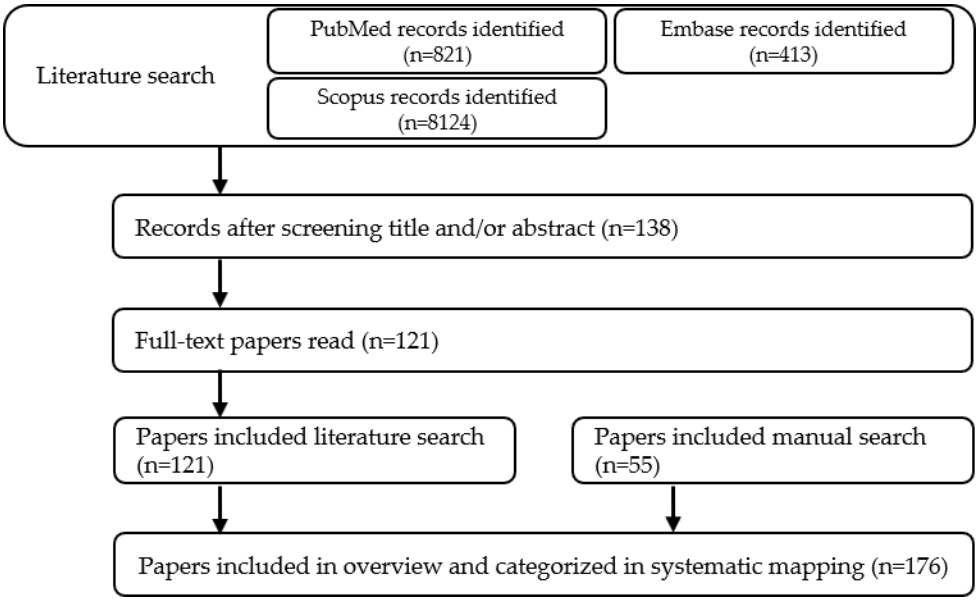

Figure 2. Selection process of papers derived from PubMed, Scopus, and Embase.

All references were classified in five different categories: (a) Administrative policies, (b) market-based instruments, (c) information-based instruments, (d) behavioral interventions, and (e) overarching description. References could be categorized in more than one category. The category "overarching description" of instruments included references that could not be specifically categorized into one or more types of instruments. Policies or interventions within categories were either voluntary or mandatory. A description of the classification and examples are given in Table 1. The classification is based on Hood and Margetts [31]. Governments have essentially four resources at their disposal—nodality, authority, treasure, and organizational (or 'NATO' in Hood's terminology)—which they use to monitor society and alter its behavior [31].

Table 1. Classification of public policies and initiatives.

Type of Policy	Description
Administrative policies	The state's authority to monitor, prohibit, or mandate behavior is perhaps one of the most characteristic expression of the authority of sovereign governments [32]. A distinction can be made between hard and soft regulations. Hard regulations have a mandatory nature and often target local/national authorities, producers or retailers. Regulatory instruments that aim to influence consumer behavior include laws, directives and regulations. Soft regulations include, for instance, co-regulations whereby the government delegates the achievement of policy objectives to other actors (such as industries or non-governmental organizations). Under this "semi" regulatory approach, the relevant policy initiators usually set out key deadlines and mechanisms for implementation, methods of monitoring and application of sanctions. Another example of soft regulation is voluntary agreements, where the industry supports and engages in voluntary pledges such as agreements on food reformulation towards lower salt and sugar contents of foods.
Market-based policies	To tax, spend and subsidize are among the powers that governments have at their disposal to incentivize behavioral change of individuals and businesses. Taxation might also be used to regulate risk behavior and to influence health-promoting choices, while providing the government with the financial resources for public health services. However, it should be noted that private businesses often have the final say over the final price of goods and services, depending on the tax prescriptions. E.g., a 100% passthrough of the tax to the final consumer could also be a requirement [33]. Subsidies and other financial incentives given by governments could serve as "carrots", and taxes as a "stick" to encourage consumers and households to eat more sustainably.
Information-based policies	There is a long tradition within the field of public health to rely on the provision of information on healthy lifestyles and risky behaviors to promote behavior change [32]. Health authorities can seek to influence behavior by using communication/information instruments at various levels of intervention. At the individual level, education is frequently used to counsel individuals at risk for diseases. At the community level, lifestyle information is provided and supportive environments for behavior change can be created (e.g., dietary guidelines or nutrition standards for foods offered in public settings). Typical examples at the population level include social marketing and education to promote healthy lifestyles (e.g., food-based dietary guidelines or health communication campaigns).
Behavioral policies	Governments increasingly use behavioral insights to supplement or replace more traditional policy instruments. A key feature of these insights is to nudge people towards the desired behavior. Nudging has been described as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" [34]. This original definition of nudging excludes legislation, regulation, and interventions that alter economic incentives, but it includes a wide variety of interventions to change social or physical environments to make certain types of behavior more likely [35]. Many nudges have a general form: they simplify processes to make benefits more readily available [36]). Behaviorally informed policies might be very cost effective and are therefore an attractive option for governments [36].

Second, references were categorized based on topic of the policy or intervention. Keywords and abstracts of scientific papers were used to categorize the references as: (a) Meat or animal, (b) vegetable or plant, (c) overconsumption (overweight, obesity), or (d) general. The category 'general' comprised references that were not specified to the abovementioned categories, but that were relevant to be included (e.g., interventions aiming at prevention of food waste). References could be categorized in more than one category. Grey literature was categorized manually on its overall content.

The list of 176 references is provided in Supplementary Table S2, including type of instrument and topic associated with each publication.

3. Results

Figure 3 shows the categorization of the 176 identified references into type of instrument and topic.

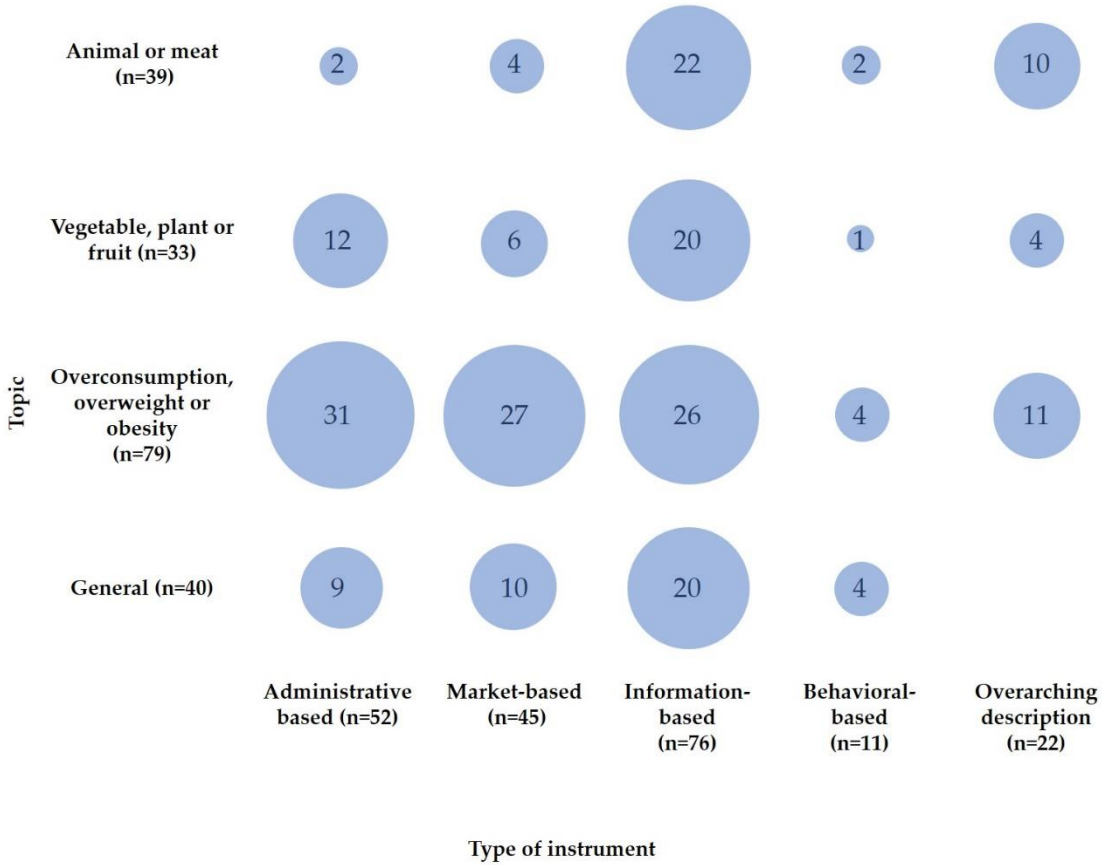

Figure 3. Categorization of references in terms of policy instrument and topic.

Descriptions of information-based instruments were the ones most frequently found (in 37% of the references), followed by administrative (25%), and market based (22%). Only a few references with behavioral instruments were identified (5%). Within the references found, "overconsumption, overweight and obesity" was the main topic (41% of references). Twenty percent of the references include meat or animal as a keyword. In these references, however, policies with explicit aims for lowering animal-based foods consumption were not found, although some food based dietary guidelines (e.g., UK [37] and The Netherlands [38]) propose that red (processed) meat should not be eaten every day (Ireland [39]) or not more than 70 g/day (UK [37]). Information-type policy instruments were the most frequent within the references with keywords focusing on animal or meat. Seventeen percent of the instruments focused on vegetable, plant, or fruit. Recommendations for policies and interventions aiming at improving the ratio of plant-based to animal-based foods consumption have started to appear e.g., in healthy dietary guidelines [40,41] and in climate mitigation policies e.g., in public procurement [42]. Information-type polices were the most common among studies mentioning vegetable or plant. The largest amount of references were found with keywords for overconsumption or healthier diets in general. Here the instruments described were evenly divided between administrative, market-based, and information-based.

For each type of instrument, examples are described below.

3.1. Administrative Instruments

3.1.1. Food Reformulation by Legislation (Mandatory) or by Voluntary Agreements

In order to efficiently reduce the health risk related to trans fatty acids (TFA), Denmark imposed legislation for a maximum level of 2 g/100 g fat on industrially produced TFA in 2003. Monitoring showed that TFA has been reduced or removed from products with high TFA content, like French fries, microwave oven popcorn, and various bakery products [43,44] (R98, R71). The European Commission adopted a new regulation to set a maximum limit on the use of industrially produced TFA in foods in the EU applying similar rules: 2 g of industrially produced trans fats per 100 g of fat in the food intended for the final consumer and food intended for the supply to retail. This Regulation will apply as from April 2, 2021 [45] (R42). For other food components such as salt, sugar, and fat, or environmental characteristics such as GHGE and fossil fuel or water use, food reformulation might be an option as well. Mandatory food reformulation could consistently achieve larger salt reductions in foods and diets than voluntary reformulation and might also achieve higher reductions in disability-adjusted life years (DALYs) and quality-adjusted life years (QALYs) compared to voluntary reformulation [46] (R72).

3.1.2. Regulations for Marketing of Foods

Many governments have implemented advertising bans to reduce the exposure of the population, especially children, to advertisements of unhealthy foods. Such unhealthy foods include alcoholic drinks, foods high in saturated fat, salt, and free sugars [47] (R165). Implementation of comprehensive marketing restrictions is not yet widely adopted in Europe and deserves further attention [21], especially since voluntary marketing restrictions by the food industry are less effective than government regulation [48] (R95). Governments are needed for standardization of science-based criteria, monitoring of effects and implementation of sanctions when there is non-compliance. There is some evidence that a lower exposure to marketing results in lower purchases of unhealthy foods [49] (R49). It is important to consider the media to be covered by the regulation: Focusing just on television advertisements will not suffice anymore, as children spend more and more time online [47] (R165).

3.1.3. Public Procurement Rules or Standards

Another policy option to improve diets is to set food procurement rules or standards for public areas, such as schools and governmental offices for healthy food availability. Niebylski et al. (2014) [50] (R121) evaluated the impact of implemented policies on food purchases, food consumption, and behaviors towards healthy foods. Thirty-four studies [50] (R121) were found to be effective at increasing the availability and purchases of healthy food and decreasing purchases of unhealthy food. Most policies also had other components such as education, price reductions, and health interventions.

Research on national school food programs were identified in Norway and the UK [11] (R1). Afshin et al. (2015) (R1) summarized that changes in school procurement policies appear to be effective for either increasing healthy or reducing unhealthy choices, while setting nutrition standards (such as for fat or salt) have less consistent benefits because focusing on single nutrient targets may have little impact [11] (R1). A healthy school lunch program ran from 2006–2008 in England [51] (R156). All stakeholders were actively involved in the design and implementation of the program. As a result, school meal take up increased and consumption of healthy foods also increased, while consumption of unhealthy foods was reduced, resulting in lower intakes of energy, saturated fat, sugar, and salt [51] (R157). A systematic review [52] (R109) concluded that school food environment interventions, including food standards, improved dietary behavior, but changes in adiposity measures were generally not significant. Furthermore, data from Wales (UK) show that the number of actions schools undertake to promote healthy eating is significantly associated with healthy food choices made, and actions at multiple levels act synergistically [53] (R114). A link between healthier school meals

and the effect on GHGE has been assessed by Wickramasinghe et al. (2016) showing low GHGE of healthy diets combined with low salt, saturated fatty acids, and added sugar contents [54] (R166).

3.2. Market-Based Instruments

Price is an important predictor of purchase behavior. In Europe, it has been observed that energy-rich, nutrient-poor foods are generally cheaper than nutrient-rich foods [20], and that price promotions are often biased towards less healthy options [55] (R61).

Taxes and Subsidies

Most research on the effect of taxes and subsidies of food choices are based on modelling studies with a lack of empirical evidence. Fiscal measures may have different effects in different countries, depending on, for example, the baseline tax rate, population obesity rate, and consumption behaviors [49] (R49). The main challenges to the successful implementation of taxes are a tax system's administrative capacity, substitution effects, tax evasion, and opposition from the food industry [20] (R145). Nevertheless, several countries have implemented food taxes for alcoholic and sugar sweetened beverages.

The evidence of the impact of pricing policies is the strongest for alcoholic beverages [56] (R148). Higher taxes for alcoholic beverages are found to lower consumption, and increase population health [56,57] (R148, R29). Pricing policies are considered to be highly cost-effective intervention methods [57] (R29). A tax on sugar-sweetened beverages appears to reduce consumption by approximately the same percentage as the tax rate [58] (R157). In the four months following the introduction of a 5% tax on soft drinks in France in 2013, supermarket sales declined by 3.3% [59] (R94). In 2014, a 10% tax on sugar sweetened beverages in Mexico led to a 12% reduction in sales after the first year (and an increase in non-taxed drinks of about 4%, mainly bottled water) [60] (R34). At the same time, a tax of around 8% on energy-dense food was associated with a 5% reduction in sales [61] (R12). The effects were largest for people of low socio-economic status.

Taxation of animal-based foods could be a tool to reduce consumption of these foods and thus environmental impact [49] (R49). A Swedish modelling study found that a tax ranging from 8.9% to 33.3% on seven meat and dairy foods, could reduce greenhouse gas and nitrogen emissions associated with the consumption of these animal-based foods by up to 12% [62] (R139).

Based on actual studies and modelling studies, the evidence of the impact of subsidies is strongest for fruit and vegetables. Consumption of fruit and vegetables seems to increase by about half the size of the subsidy (in percentage points), but the effects on total energy intake remain unclear, with some studies showing slight decreases in energy intake and others showing increases [58] (R157).

A common objection against food taxes is that these may be regressive and affect low-income households disproportionally [63] (R82). However, a combination of taxes and subsidies could reduce regressive effects and may enable consumers to change to a more healthy and sustainable diet without additional cost [64–66] (R48, R149, R20). At the same time, health gains may also be largest for low-income households and could result in savings in health care expenditures [67] (R140). Implementing taxes for public health reasons as opposed to generating revenue, may increase public acceptability of the policy, especially when revenues will be used to fund public health [49] (R49).

3.3. Information-Based Instruments

3.3.1. Food Labels and Logos

Many countries have adopted mandatory regulations to display nutrition information on labels of food products. In some cases, nutrition information is conveyed as a logo based on health ratings. Theoretically, consumers could use this information to make more healthy food choices, but the evidence to support the effectiveness of these labels is limited and mixed [55,68](R61, R82). Labels might be difficult to interpret for consumers and nutrition information may not influence

purchases. For instance, by introducing the Nutrition Labeling and Education Act (NLEA), the U.S. Food and Drug Administration (FDA) hoped consumers would better understand the nutritional value of products [69] (R115). In France, recently the health logo "Nutri-Score" was launched based on FSA nutritional profiling schemes [70] (R79). Although the potential effects on health are evaluated and promising, environmental aspects are not yet included in the design of the logo.

Carbon labelling has been used as a tool to encourage consumers to choose low-impact foods, but consumer's understanding of the labels is generally low [49,71] (R49, R69). The UK supermarket chain Tesco had carbon footprint labels on a selection of their private label products but they ended the project because consumers had difficulties interpreting these footprints and calculating carbon footprints proved very resource-intensive [49] (R49). Other footprint labels such as water footprint of nitrogen footprint labels have been proposed [72] (R96), and tools are available to calculate nitrogen footprints [73] (R47). A better understanding is needed on how consumers engage with different footprint labelling and/or whether it is possible to combine the messages for health and sustainability in one food label or logo. In addition, calculation methods need to be standardized in order to allow non-biased comparisons between different foods and brands.

Information-based policies and interventions have been found to be much less effective than those influencing food environments [49] (R49). Multiple surveys in developed countries show that what primarily influence people's consumption habits are price and taste, and thus information on the health and environmental impact of foods may not have a large effect on dietary choice [49,74,75] (R78, R49, R58). However, information-oriented interventions can help to increase awareness, which might result in increased acceptance of stronger types of policy interventions [49].

3.3.2. Food Based Dietary Guidelines

Another way to influence food consumption is through national dietary guidelines, which are developed from a health perspective and give advice for daily food consumption. A few countries (e.g., Brazil and Sweden) have explicitly included sustainability goals in their national food-based dietary guidelines [55,76] (R61, R44). Brazilian dietary guidelines emphasize the benefits of dietary patterns based on a variety of natural or minimally processed foods, mostly plants, and freshly prepared meals consumed together with others, for health and sustainability [77] (R113). Other countries, such as The Netherlands, explicitly define a maximum meat intake [78] (R155). It is not known if introducing these guidelines has changed food consumption patterns. Populations consume a range of food in differing quantities in a given dietary pattern, which are mostly not in line with food-based dietary guidelines [79,80] (R160, R159). Currently, the effect of including environmental sustainability in the guidelines is likely to be limited [81] (R133) and food based dietary guidelines can be improved [79] (R159). However, dietary guidelines have important additional roles and can for instance be used as input for public procurement criteria, as a basis for food and recipe (re)formulation by the food industry, and may thereby exert a significant effect on the food system.

3.3.3. Food and Nutrition Campaigns and Education

Various countries have introduced campaigns aimed at the general population to promote healthy diets. Well-known examples are campaigns that promote the consumption of fruit and vegetables [82] (R132). According to some studies, these campaigns, however, have had limited effect on the total fruit and vegetables consumption [82]. A well-known campaign to encourage people to limit their meat consumption is the Meatless Monday campaign. This bottom-up initiative was set up by a catering company and has been implemented in restaurants, canteens and schools in many countries. A 2012 US survey showed that 43% of respondents were familiar with Meatless Monday and of those, 36% said they were willing to eat less meat [49] (R49). Another study from Norway found that soldiers exposed to Meatless Monday measures became more positive to vegetarian food [83] (R110).

Evidence about the effectiveness to improve diets through nutrition education is inconclusive [84,85] (R2, R176). Some evidence shows that cooking classes in children or adults can

lead to the consumption of healthier diets [55] (R61). A review on school gardens for education found that 6 out of 11 studies observed increased vegetable intakes, while four showed no effect [86] (R37). However, only short-term effects were measured using low-quality methods and also generational effects of nutrition education must be taken into account.

A review of intervention studies to reduce consumption of sugar-sweetened beverages in children concludes that educational programs can lead to reduced consumption and small reductions in BMI, but again, long-term effects were difficult to attain [87] (R9). The combination of nutrition education with changes in the food environment seems to have the most effect [55,85,87] (R2, R9, R61).

3.4. Behavioral Instruments

There is increasing interest in nudge-type approaches, where the context of consumption is changed to direct people's behavior in a predictable way without forbidding any options and without aiming to influence consumers' conscious choices [34]. The evidence for these types of approaches is still limited, especially with regards to whether the effects observed can be sustained in the long term [49] (R49). In addition, most nudges have been tested in laboratory settings, and evidence from 'real-world' settings is limited [49,88] (R49, R101).

Many nudge-type interventions exist, and they might all have different effects at different times in different settings for different people. Several systematic reviews have investigated individual small-scale nudging interventions. One review suggests that nudges in general may increase healthy food choice by 15% on average, as measured by a change in frequency of consumption or overall intake [89] (R5). Nudging strategies such as positioning in the supermarket can increase healthier purchasers. In a review, Bucher et al. (2016) reported that out of 18 studies where food position or order was manipulated, 16 showed a positive effect on food choice, meaning that the participants were nudged towards a more healthy food choice [90] (R22). Another review provides evidence that nudging can be effective for influencing healthier food and beverage choices. Combining salience and priming nudges showed consistent positive influence on healthier food and beverage choices [91] (R167).

Less reviews or interventions on nudging towards a more sustainable diet were identified. A recent systematic review suggested that altering physical micro-environments nudges consumers to buy less meat. In particular, interventions that target portion size, provide meat alternatives, or change the sensory properties of meat and meat alternatives are most promising in reducing meat demand [92] (R16).

4. Discussion

This paper has reviewed different types of policies and interventions to improve the sustainability of diets, focusing in particular on those that aim to lower animal-based and/or increase plant-based foods consumption, and avoid overconsumption of foods and beverages. This overview shows that policies combining health and sustainability objectives are few and mainly of the information type such as food-based dietary guidelines. Very few policies explicitly aim to lower animal-based foods consumption, except for some countries' food based dietary guidelines and for some food campaigns such as Meatless Monday. Most policies focus on public health to steer consumers eating behavior towards lower consumption of energy-dense, (micro)nutrient-poor foods and drinks, and higher vegetable and fruit consumption. Combining both policy perspectives and using several types of demand type policies as applied in public health may contribute towards environmental sustainability, going beyond GHGE mitigation thus including (e.g.,) lower nitrogen impact, as well as population health, although trade-offs must be considered.

The EAT-Lancet report [1] and various healthy food guidelines [40,76] provide concrete guidelines on which foods should be consumed more (e.g., fish, fruit, vegetables, legumes, nuts) or less (e.g., red and processed meat). For some foods added to the diet from a health perspective (such as dairy, fish, nuts and fruits), a higher consumption may increase the environmental impact. The overarching principles such as to lower animal-based and increase plant-based foods have been put forward as

a proxy for healthy [40] and sustainable diets [93]. These principles may especially serve to lower the disruption of the nitrogen cycle as animal products have the largest nitrogen losses along the food chain. Yet, in the systematic mapping of reviews, hardly any policies were found that explicitly aim to lower animal-based foods consumption and few policies of the information type combining health and environmental sustainability. Governments seem to be reluctant to address meat and dairy consumption. Possible reasons mentioned for the lack of policies to reduce meat consumption and encourage sustainable diets have been economic interests [94], and the electoral weight of the agricultural sector [95]. In addition, willingness to change meat consumption among consumers is currently low, although more willingness might exist in the younger generation [96]. How people can be motivated to decrease meat consumption is still underexplored [75]. However, most stakeholders (from health, environment, policy, consumer organizations, and NGOs) emphasize that climate change targets do not leave the option of no-need [42]. Therefore, there is potential for common ground—and a strong role to be played by governments in initiating and supporting the envisioned transition towards high plant-based *combined with* low animal-based diets and in addressing identified barriers. The focus on increased consumption of plant-based foods only is not sufficient.

People consume a range of food in different quantities in a given dietary pattern. In Western countries, dietary patterns are mostly not in line with national dietary guidelines [79,80,97,98] and energy intakes exceed energy requirements resulting in a large percentage of the population with overweight and obesity [14]. Reducing overconsumption (via lower energy intakes) benefits the environment as well, as shown in a modelling study from France [99]. For The Netherlands, Van de Kamp et al. [100] showed that reducing the consumption of red and processed meat during dinner and of sugar sweetened and alcoholic beverages throughout the day leads to significantly lower dietary GHGE, while also having health benefits (reduced saturated fatty acid intake and/or sugar intake). For the UK, Green et al. [101] demonstrated that a dietary switch in the UK away from snacks and animal-based foods, and towards more fruit, vegetables, and cereals would result in a 40% reduction of GHGE. With current food consumption patterns, moving from high towards low environmental footprint diets (more plant-based and lower animal-based) combined with reduced discretionary foods (snacks and sugar sweetened and alcoholic beverages) will reduce energy, salt, saturated fatty acid, and sugar intake and probably decrease GHGE and other environmental indicators. Therefore, with some modifications, the recommendations and policies for the foods targeted from the health perspective (ultra-processed foods, sugary and alcoholic drinks) can also contribute to lower environmental impacts.

It is worthwhile to explore the effects of mixes or packages of policies (mandatory, pricing policies, information) instead of providing information alone. Market-based types of policies and interventions (e.g., taxes on sugar sweetened and alcoholic beverages) were found to be the most effective to reduce overconsumption [20], preferably in a mix with information and administrative types of policies [56,58–60] although evidence for effects on the rate of obesity are limited. According to current consensus, changing food consumption patterns is most effective through a policy mix or package [42,102–104], involving financial (dis)incentives, over the longer term, combined with information measures, nudges, and descriptive social norms [105]. Considering that delivering over-information to consumers usually does not help to incentivize significant changes in consumer behavior, labels and logos might be effective tools if not too complex, but usually reach effectively only a niche population that is already informed and concerned. Moreover, educational measures have limited direct effect, but could pave the way for future behavioral changes and/or policy interventions with a more mandatory character.

4.1. Policies Targeting the Individual are not Enough: A Food System Approach Is Needed

There is consensus that a single short-term intervention will, however, not be sufficient to address the multitude of connected factors that affect the food environment; instead, multiple interventions of various types and in various settings will be necessary to realize lasting change [106]. Policies targeting

the individual are not enough: Food environments should change as well [55,107]. For example, a high concentration of shops or restaurants selling unhealthy food can increase overconsumption [49], just as current marketing and advertising efforts by the food industry and product placements and pricing policies by retailers [55]. Even though individuals could, in theory, be held accountable for the individual dietary choices, the balance of power is currently in favor of multi-national corporations [55]. Strong support from politicians, public health authorities, and civil society is necessary for the implementation of effective food policies aiming at a healthier diet in a sustainable food environment. Still, public–private partnerships have a role to play, as these can be valuable to address complex food and nutrition issues from multiple perspectives [55]. Governments can stimulate the development of sustainable food policies, while involving consumers, producers, and civil society.

Food choice is driven by a complex set of physiological, economic, historical, cultural, political, and sociological factors. A more thorough understanding of what drives eating patterns could support the design and implementation of appropriate policies for the promotion of more sustainable eating patterns [108,109]. Collaboration across disciplines and beyond academic boundaries, from agriculture to trade policy and from nutrition to social sciences, will aid the progression in this field [110]. Various global initiatives create momentum for collaboration towards sustainable food systems. The Sustainable Development Goals and the UN Decade of Action on Nutrition provide crucial frameworks for joint action to work towards healthy food consumption patterns that remain within planetary boundaries. The development of a new Common Agricultural Policy also presents an opportunity to align agricultural policies with efforts to improve healthy and sustainable food consumption, and the vision of a Common Food Policy has recently be put forward [42]. This remains challenging, as the relation between agricultural policies and diets is complex and not yet completely understood [55]. Still, investments should be made to better align public policies that aim to promote health, nutrition, and sustainability and to improve collaboration between different policy fields to reach synergies. To make sustainable diets a priority in climate funding, research efforts should support the development of metrics and indicators of the co-benefits of sustainable diets for climate and health [103].

4.2. Monitoring and Revising of Policy Measures

The effect of implemented policies could be different in reality from what was expected. For example, a meat tax could lead to increased consumption of cheaper, fattier, energy-dense composite meat snacks or dishes and a policy recommending the consumption of only lean meat risks to produce food waste or distorting global markets (thus forcing developing countries people to eat cheaper, fattier, unhealthy meat). Hence, to assess the effects after policy implementation, it is important to include policy evaluation steps. The ultimate benefit of policy evaluation is to account for the policy outcomes and after a learning process revise and reformulate policy decisions.

One of the issues around the concept of sustainable diets is the discussion on metrics [111]. GHGE are by far the most commonly measured component in the scientific literature. Addressing GHGE and not addressing health-related indicators may lead to a narrow conceptualization of sustainable diets. Besides nutrition/health and environmental (climate, pollution, biodiversity, and scarce resources), economic, ethical, and equity aspects also need to be looked at to comprehensively assess sustainability [112,113]. Multiple indicators and diverse sets of methodologies to assess sustainability might help to address the inherent complexity of sustainability and may help guide policy-making [102,113]. However, their absence may not distract from implementing the policies to lower animal-based food consumption, increase plant-based foods, and avoid food overconsumption. Thus, while policy design encompasses a quality selection of an appropriate indicator set, simple messages can be communicated to the consumer who needs to gain trust that the food policies implemented will be beneficial for both environment and health, as well as ethically justifiable.

4.3. Strengths and Limitations

Even though we are confident that important literature and examples were found and covered in this paper, our review was limited to the English literature, thus might we have missed studies on implemented policies if only published in the country's native (non-English) language. Furthermore, to categorize topics of policies e.g., meat or animal, or plant or vegetable, we focused on keywords listed in scientific papers. This approach enabled us to objectively categorize policies according to the proposed topics. However, keywords may not necessarily reflect the policies discussed in the paper. To ensure appropriate categorization, we also read abstracts or full-text papers when it was not clear from the keywords which topic and type of policy was discussed. A strength of our study was the assessment of the type of demand side policy instrument. Categorizing instruments according to type (administrative, market-based, information-based, or behavioral) provided useful insights in the currently applied policies to steer towards more healthy and environmentally friendly diets.

4.4. Practical Implications

Our evaluation showed that in the current policy environment, it is challenging to move towards dietary changes to reduce environmental impact via reduced animal food consumption. More policies, using strong instruments, are needed aiming at the combination of reduced animal-based food consumption with higher plant-based food consumption. On the other hand, there is a wide range of public health related policies available to steer consumers eating behavior towards healthier diets. Combining both perspectives, starting from working examples, and combining several types of policy instruments is the most promising way forward towards integrated food policies. Public health policies showed that the most effective policies include a mix of policies involving market-based instruments, that suit aspects of public health and the environment, although more research may be needed [93].

Governments can play a strong role to initiate and support the transition towards more sustainable and healthy diets. Investment is needed from several areas to reach synergies with public health-related policies. Collaborations across different disciplines, ministries, and beyond academic boundaries is needed to improve, and to better align public policies aiming to promote human health and nutrition with sustainability outcomes. An appropriate and comprehensive set of indicators may help design future policies. A single short-term policy should make place for longer-term policy packages to realize lasting change.

5. Conclusions

To be able to capture concerns related to both public health and environmental sustainability, integrated food policy is needed and possible, as the current evaluation shows. Our review finds that working solution are available to ensure coherent and effective demand side food policies. The policies for the foods and drinks targeted from a health perspective can be aligned to lower environmental impacts as well by aiming at avoiding overconsumption and indicating suitable (plant based) replacers for animal-based food consumption. Preferred policies include a variety of instruments, including stronger measures such as market-based instruments. Implementation of aligned and effective policy packages is urgent and needed.

Supplementary Materials: The following are available online at http://www.mdpi.com/2071-1050/12/15/5924/s1, Table S1: Search strategy, Table S2: Categorization of references.

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