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Livestock Industry Practices that Impact Sustainable Diets in the United States

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Abstract.
Corporate attempts to shape government policies so they are favorable to the firm is a widespread occurrence in the tobacco, alcohol, and food industries. Analysis of such corporate political activity has identified various strategies, practices, and mechanisms used by these industries. In this paper, we adapt an established framework to demonstrate the practices of the livestock industry in influencing sustainable diet policies in the U.S. We describe four case studies in which: (1) environmental sustainability was excluded from the Dietary Guidelines for Americans; (2) meat-friendly dietary recommendations were developed with no consideration of environmental impacts; (3) a professional nutrition society position paper was critiqued for recommending a reduction in ruminant animal consumption; and (4) a webinar was disseminated to nutrition professionals recommending beef as a part of a sustainable diet. In the first two cases the livestock industry rejected the importance of environmental considerations for dietary recommendations and in the second two it argued that livestock is an integral part of a sustainable diet, coopting the definition of sustainable diets. An information and messaging strategy was key to all of these cases. This included stressing the economic importance of the livestock industry, framing the debate, and shaping the evidence base on diet and the environment. The livestock industry also used financial incentives and policy substitution to accomplish their goals. Understanding and documenting such behaviors is a key first step in developing an approach to limit corporate influence on sustainable diet policies.

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Introduction

Although humanity's attention has been focused on the novel coronavirus pandemic, our planet faces grave environmental threats. The Intergovernmental Panel on Climate Change (IPCC), a collection of the top climate scientists in the world, has issued several recent reports highlighting the urgency of the global warming problem, which has been borne out in everyday extreme weather events, such as the massive fires in Australia, floods in the mid-western United States and an emerging megadrought in the western United States (IPCC, 2018, IPCC, 2019). Largely due to human activity, millions of species have suffered extinction, more than at any other time since the last mass extinction in the time of the dinosaurs (Ceballos et al., 2015). Water pollution and scarcity also threaten our very existence (Vorosmarty et al., 2010).

It is in this context that sustainability has become a vital concept in our everyday affairs. It is important in the design of our cities, the development of our energy infrastructure, our transportation sector, and in our agriculture. The agricultural sector accounts for about a quarter of greenhouse gas emissions (IPCC, 2014), 80-90% of global freshwater consumption (Foley et al., 2011) and occupies 38% of earth's ice-free land (Foley et al., 2011). The United Nation’s Food and Agriculture Organization (FAO) regularly focuses on the importance of sustainable diets, which it defines as "protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (Burlingame et al., 2012).This definition is widely used and is helpful for understanding all the important dimensions of a sustainable diet. It is a general aspirational statement with little details or emphasis, which, in part, might be why it is so well accepted by nutritionists, environmentalists, as well as some sectors of the food industry.

Optimizing natural and human resources is a key aspect of the definition because our planet has finite resources and increases in greenhouse gases are reaching a tipping point. Most analysts agree that optimizing human diets while minimizing environmental impacts requires the reduction of meat intake, particularly from ruminant animals. Worldwide, livestock accounts for about 14% of man-made greenhouse gas emissions (Gerber et al., 2013). The livestock industry, like all stakeholders in the food system, advocates for policies, programs, laws, and regulations that improve its position. But the outsized impact of livestock on our diet's environmental footprint and the insidious and ever-present nature in which the industry promotes its interests deserves more attention. This article reviews four examples that illustrate the actions of the industry to limit efforts to reduce our dietary carbon footprint. The actions include: (1) influencing government officials to drop sustainability from official US dietary guidance; (2) developing new diet guidelines that support meat consumption and are devoid of environmental sustainability; (3) critiquing a professional nutrition society position paper for recommending a decrease in ruminant animal consumption for environmental sustainability; and (4) disseminating a webinar for nutrition professionals on the sustainability of beef. We consider these actions and two additional examples using a framework that has been developed previously to identify food industry influence on public health policies.

Conceptual Framework

The impact of corporate political activity on public health has been well documented, particularly in the tobacco sector. As a result of the 1990's lawsuits in the U.S. against the tobacco industry for deceptive marketing practices (National Association of Attorneys General, 1998), millions of documents on internal corporate policies were released (UCSF, n.d.). This gave researchers an in-depth look at corporate behavior and how it affected public health (Bero, 2003). More recently,

attention has turned towards interference from other sectors in the design of health policies (Stuckler et al., 2012).

Researchers have developed various taxonomies or categories of actions to describe corporate political activity (CPA), which can be defined as 'corporate attempts to shape government policy in ways favorable to the firm' (Mialon et al., 2015). For example, McKee & Stuckler (2018) identify four ways in which corporations influence health, including: defining the dominant narrative; setting the rules by which society operates; commodifying knowledge; and undermining rights, whether political, social, or economic. Tangcharoensathien and colleagues (2019) describe market promotion and industry interference in emerging country policies also using four categories of tactics: interference with the legislative process; use of front groups; questioning the scientific evidence; and appearing responsible in the eyes of the public.

A particularly appealing approach, and one that we use in this paper, focuses on the food industry and its influence on public health policies, particularly around diet (Mialon et al., 2015). The framework proposed by Mialon and colleagues identifies overall 'strategies,' various 'practices' to implement such strategies, and additional details on the practices, which they refer to as 'mechanisms.' For example, to accomplish an overall strategy of 'information and messaging,' one food industry practice is to 'shape the evidence base' on diet and health issues. This can be accomplished by funding research, paying scientists as advisers or spokespersons, cherry picking data that favors the industry, and through various other mechanisms.

We adapt this framework to consider livestock industry influence on sustainable diet policies, focusing on three broad strategies: (1) information and messaging; (2) financial incentives; and (3) policy substitution. Most of the activity that we document falls under the strategy of information and messaging, in which we consider various practices, including lobbying of policymakers, stressing the economic importance of the livestock industry, framing the debate on diet and sustainability, and shaping the evidence base. The funding of policymakers, as part of an overall strategy of using financial incentives, is a practice that we will document as well. Finally, the livestock industry develops policy alternatives to substitute for existing policies which could benefit their sales.

Exclusion of sustainability from the 2015-2020 Dietary Guidelines for Americans

In February of 2015, the Dietary Guidelines Advisory Committee (DGAC), composed of 15 nutrition scientists and physicians appointed by the Secretary of the U.S. Department of Health and Human Services and the Secretary of the U.S. Department of Agriculture, presented its Advisory Report to these U.S. government authorities (DGAC, 2015). Since 1988, when it was founded, the DGAC´s role has been to review the latest scientific evidence and provide input to the Dietary Guidelines for Americans (DGA), recommendations designed to help Americans make healthy food and beverage choices that are updated every five years (USDA, n.d.). The 2015 DGAC report dedicated a chapter to food sustainability and safety, and included a detailed review of environmental sustainability and how it relates to diet. The DGAC found consistent evidence that a diet lower in animal-based foods and higher in plant-based foods would improve the health and reduce the environmental impact of the average U.S. diet (DGAC, 2015). Although their review followed the methodology used throughout the report, using robust scientific evidence to support their position (Millen et al., 2016, Nelson et al., 2016), the debate that ensued regarding this point was intense (Teicholz, 2015, CSPI, 2015), as was the degree of involvement by the meat and dairy industry to achieve its exclusion (Friedberg, 2016).

Ultimately, the Department of Agriculture (USDA) and the Department of Health and Human Services (DHHS) opted to remove this recommendation from the 2015-2020 DGAs. In a joint declaration made by then Secretary of Agriculture Tom Vilsack and then Secretary of Health and Human Services Sylvia Burwell, they concluded that the DGAC´s recommendations regarding 'sustainability', that is, the environmental impact of a food source, were outside the scope of the authorizing legislation for the DGA (Vilsack, T., Burwell, S., 2015). They stated that with 'a better understanding of food and nutrition, people can make educated decisions that will help keep their weight under control, prevent chronic conditions, ... and stave off health problems' (Vilsack, T., Burwell, S., 2015) without taking into consideration the impact of nutritional choices on the environment or the impact of the environment on health.

Consistent with the framework we describe above, we identify three practices used by representatives of the US meat and dairy industry to influence the US government´s decision to exclude environmental sustainability from the 2015-2020 DGA (see Table 1). For one, the livestock industry tried to frame the debate on this topic by stressing the good traits of the industry, in this case by claiming that livestock are an integral part of sustainable diets. In the past, several points have usually been made to support this. First, cows eat agricultural refuse that humans cannot, which would otherwise go to landfills or be burned, creating more greenhouse gas emissions. Thus, in this perverse description, livestock actually reduce potential emissions. Second, livestock feed on grasslands, which cannot support other crops, so they are expanding the land we can use for agriculture. Third, if properly managed, the manure from livestock on such lands serves as fertilizer, improving soil health. These points all represent partial truths. Yes, ruminants are able to digest fibrous foods that humans cannot, but the net effect of this on emissions is minor compared to the overall gases emitted in their production. Some range management practices are clearly more sustainable than others, and their adoption should be encouraged. But in the end, such practices could support enough livestock to meet less than half the current consumption of beef in the U.S. (Eshel et al., 2018). In other words, beef cannot be part of a sustainable diet in the U.S. without a drastic reduction in current consumption.

In the case of the DGA, the livestock industry used the federal commenting process to stress the good traits of the industry. As is typical, authorities requested written comments from the public on the DGAC report. The number of comments was the highest ever received, at around 29,000, as compared to 1,000 comments made to the 2010 DGACs recommendations (Friedberg, 2016). A number of these comments highlighted that growing livestock is sustainable or that strategies exist to make ranching practices more efficient and sustainable. These comments, however, did not recommend a reduction in consumption, which would be required to make beef sustainable (Eshel et al., 2018).

The livestock industry used two mechanisms to shape the evidence base on sustainable diets. The first mechanism, one not specifically outlined in Mialon's framework, was to criticize the authority of scientists that had a position unfavorable to the industry. The North American Meat Institute (NAMI) held the position that nutritionists were not experts in environmental issues and should refrain from addressing these types of issues (Charles, 2014). This is evidenced in a written comment submitted on the advisory report, in which NAMI likened the DGACs inclusion of environmental sustainability to a 'person designing a better light bulb [telling] Americans how to make a better sandwich' (NAMI, 2015). This ridiculing of the arguments of the DGAC is tied closely to a second mechanism used by the industry to shape the evidence base, suppressing or influencing the dissemination of research. NAMI took the position that environmental sustainability is 'outside the scope of the Committee´s Charge,' (NAMI, 2015)

Table 1 – Livestock industry practices that impact progress on sustainable diets

Practices	Mechanisms	Case Studies			
		Keep sustainability out of U.S. diet guidance	Develop meat-friendly diet guidance	Critique SNEB position on environmental sustainability and dietary guidance	Webinar for health professionals on sustainability of beef
Stress its economic importance	Stress number of jobs supported			Used job loss as rationale for criticizing recommendation to reduce ruminant animals	Included producer economic viability, contributions to rural economy as key part of sustainable food systems
Frame the debate	Stress good traits of the food industry	DGA Comments: Ranching can be sustainable (rather than change diets)	Excluded sustainability from their diet guidelines (since meat would fare poorly)	Ruminants can convert waste products, so actually improve the environment	Focused on cattle's 'upcycling' of plant proteins, reducing landfill waste; minimized impact of emissions
	Exaggerate opponents' arguments to the extreme			Created extremes of points made in SNEB paper: elimination of all animal foods and guidance based only on carbon footprints.	
Shape the evidence base	Criticize authority of scientists	DGAC Comments: Nutritionists not qualified to comment on environment			
	Suppress dissemination of research	DGA Comments: Environment is outside scope			
	Fund research of academics		AgriLife, in part supported by Texas beef, helped fund the work and employ lead author		
	Pay scientists as advisors or spokespersons			Letter to editor criticizing SNEB position paper written by 3 dairy industry scientists	Webinar run by industry scientist and consultant
	Cherry pick data		Studied long-term outcomes using GRADE's focus on RCT studies, a small % of the relevant ones.	Cited exclusive importance of dairy for nutrition omitting fortified soy milk with similar density of calcium, vitamin D	Present only some studies on beef's health and environmental impacts
	Provide industry-sponsored educational materials				Webinar offered as continuing education credits to dietitians
	Criticize evidence		Used GRADE criteria to downplay observational studies		
Fund policymakers	Donations or other financial inducements	Gave money to Senators and Representatives signing letter critical of DGAC report			
Develop alternatives to policies	Develop non-regulatory initiatives		Developed dietary recommendations as an alternative to DGAs		

to that which would be later used in the joint statement made by the Secretaries of Agriculture and of Health and Human Services (Vilsack, T., Burwell, S., 2015). Similar comments and in many cases duplicate comments were received from various national and local meat and dairy representatives like the National Cattlemen's Beef Association (DHHS, 2015), all arguing that sustainability was outside the scope of the Committee, despite evidence to the contrary.

Influencing policymakers to favor industry interests can take many forms including financial incentives like donations or gifts (Mialon et al., 2015). An analysis carried out by the Center for Science in the Public Interest (CSPI) found multiple pathways through which the meat and dairy industry funded policymakers to favor their position (CSPI, 2015). Based on publicly available information, CSPI detected more than $1 million USD were received from the industry by Senators who signed a letter critical of the DGAC report, with half of this amount coming solely from the beef and cattle industry (CSPI, 2015). Likewise, more than $2 million USD were received by House Representatives who signed a letter critical of the DGAC report from food and agriculture interests (CSPI, 2015). This letter emphasized that "'the DGA be based on sound nutrition science and not stray into other areas outside of this specific discipline.' (Hartzler et al., 2015). The Representatives expressed that the DGAC had greatly exceeded their scope, claiming that 'it is the responsibility of the Secretaries to ensure that this advisory committee stay focused on nutritional recommendations and not the wider policy realm of sustainability and tax policy, in which members of this committee had neither expertise, evidence, nor charter.'

None of these points are true. Various analyses of the DGAC´s recommendations, published in peer-reviewed journals, have concluded that the evidence presented by the DGAC was robust and justified the inclusion of the environmental sustainability as a factor to consider in the DGAs (Rose et al., 2019, Nelson et al., 2016, Millen et al., 2016). Additionally, the Third National Climate Assessment developed by the U.S. Global Change Research Program, with the participation of hundreds of the top climate scientists in the country, had already identified the reduction in greenhouse gas emissions that would accompany reductions in red meat consumption (Melillo, 2014, p. 233). Finally, substantial evidence has been presented indicating that inclusion of environmental sustainability in dietary guidance is well within the scope of the authorizing legislation (Rose et al., 2019).

Development of meat-friendly dietary guidance

In 2019, six papers published in the Annals of Internal Medicine reported there was no compelling evidence that reducing unprocessed red or processed meat intake was associated with beneficial health outcomes (Zeraatkar et al., 2019a, Han et al., 2019, Zeraatar et al., 2019b, Vernooij et al., 2019, Valli et al., 2019, Johnston et al., 2019). These articles, written by a self-appointed team named the NutriRECS Consortium, challenged the Dietary Guidelines for Americans (DGA). Currently, the DGA recommends decreasing the intake of meats (and poultry and eggs) for teen boys and adult men (DHHS and USDA, 2015) In the opinion of the authors of these articles, the DGAs were based on low quality research designs and negligible findings on the associations between meat intake and adverse health outcomes, and therefore, Americans should continue current levels of red meat consumption.

This case illustrates two different broad strategies used by the livestock industry to influence outcomes. The first strategy, policy substitution, is quite straight forward – the development and promotion of an alternative to current policy, in this case federal dietary guidance policy encapsulated in the Dietary Guidelines for Americans. The second strategy, referred to as

'information and messaging' by Mialon and colleagues (Mialon et al., 2015), involved the practices of 'shaping the evidence base' and 'framing the debate' (Table 1).

The NutriRECS study authors shaped the evidence base with the criteria they chose to evaluate previous studies. Specifically, the authors used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology to rate evidence on the effects of meat consumption. GRADE was developed as an approach for assessing the quality of evidence for clinical guidelines and recommendations. It is particularly effective for evaluating pharmaceuticals or other treatments that can be evaluated in the short-term using randomized controlled trials (RCT). Long-term observational studies, which are needed to assess the impacts of diet on cancer and cardiovascular disease outcomes, are considered 'low certainty' of evidence by the GRADE approach. Moreover, RCTs require placebos, blinding, and other study aspects that cannot be met with diet studies, since participants know what they are eating. The study authors rated a number of trials as having a 'high risk of bias', partly due to a lack of blinding, even though they acknowledge this was not possible for the participants. The NutriGRADE system was specifically designed to address the limitations of the GRADE approach for evaluating long-term nutritional studies (Schwingshackl et al., 2016), but study authors chose not to incorporate this approach.

Study authors also shaped the evidence base by only considering long-term outcomes for their recommendations. There is a strong body of evidence, based on short-term studies, including RCTs, on the effects of dietary changes on biomarkers for cardiovascular disease, such as blood lipids (Jacobson et al., 2015), but these endpoints were excluded for consideration by the NutriRECS Consortium.

The funding of research by academics is another of the mechanisms the food industry uses to shape the evidence base (Mialon et al., 2015). In the case of the meat-friendly dietary guidelines, the lead author, Bradley Johnston, was funded by AgriLife Research, the extension research arm of Texas A&M University, which, in turn, is partially funded by the beef industry (Korte, 2020, Lutz, 2020). This was not initially disclosed to the journal, though today, all six articles have a disclosure statement at the conclusion of the article, stating that the authors of the work failed to share a key financial conflict of interest (Dyer, 2020). Patrick Stover, the Director of AgriLife and a co-author of these articles, conducted $4.5 million in beef research in 2019 (Korte, 2020), though this was never disclosed by him initially, nor in the article's disclosure amendment.

To frame the debate, authors of the meat-friendly guidance, excluded all considerations of environmental sustainability. Beef and other ruminant animals would obviously fare poorly in this regard, so its exclusion allowed the authors to focus only on health considerations. Moreover, the authors considered consumption preferences of current meat eaters in the development of their guidelines. They relied on a systematic review of the literature that they conducted, which found low-certainty evidence suggesting 'that omnivores are attached to meat and are unwilling to change this behavior when faced with potentially undesirable health effects.' (Valli et al., 2019). It is remarkable that dietary guidance would be shaped by current preferences rather than by health effects.

Since release of these guidelines, a number of nutrition professionals have critiqued the study's methodology and questioned the integrity of the research. Dr. Frank Sacks, the previous chair of the American Heart Association, called the research 'fatally flawed' (Kolata, 2019). Qian and coauthors (2020) claim the recommendations 'suffer from important methodological limitations and involve misinterpretations of nutritional evidence.' Dr. Jennifer Wilkins, President of the Society for Nutrition Education and Behavior, argued that an individual's willingness to

change consumption habits should not be taken into account when drafting dietary guidance and that the omission of environmental concerns was 'reckless' (Wilkins, 2020).

As to their integrity, a key question is: did the livestock industry shape their development? It is clear that the lead author received funds from AgriLife, where the largest producer of Black Angus cattle in Texas has established an endowment. The beef industry provides somewhere between 1.5% and 5% of AgriLife's funding (Korte, 2020, Rubin, 2020). Some might argue that these professional and financial opportunities might be independent of the study's findings and do not provide substantial evidence of industry interference. However, it is clear from previous research that publications sponsored by an industry are 4-8 times more likely to report favorable outcomes for that industry's food compared to other sources of funding (Katan, 2007, Bes-Rastrollo et al., 2013). Johnston and Stover are well-respected scientists, but all scientists, as Marion Nestle points out, have biases (Nestle, 2018). These biases tend to show up in the framing of the problem, the questions that are asked, and, for review articles, in the methods that are used. Ultimately, this group of scientists decided to develop dietary guidance around one food – red meat. They downplayed long-term observational and short-term RCTs documenting health problems with its consumption. They included consumer preference for this food and ignored the negative environmental impacts of it when developing their guidance. This framing of the approach is obviously biased and led to the recommendation that current beef consumption should be continued.

Critique of Society for Nutrition Education and Behavior position paper on environmental sustainability and dietary guidance

The previous two case studies described instances in which the livestock industry sought to exclude sustainability as a consideration in dietary guidance. Given the growing popular concern for sustainability, the industry has also sought to embrace the concept, and, in fact, coopt it for its own benefit, that is, to increase sales of its products. In this section, we describe the first of two examples of this in which the dairy industry argues that use of a more holistic definition of sustainable diets would favor the inclusion of ruminant animals.

To begin, we revisit FAO's definition of sustainable diets as 'those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations.' (Burlingame et al., 2012). This places low environmental impacts as the foundation of these diets. The longer description of such diets elaborates this basic definition with four specific dimensions, including: (1) 'protective and respectful of biodiversity and ecosystems'; (2) 'culturally acceptable'; (3) 'accessible, economically fair and affordable'; and (4) 'nutritionally adequate, safe, and healthy'. Drewnowski succinctly refers to these domains as environment, society, economics, and health (2017).

Because of the overriding concern with environmental degradation caused by our current food system, and the exclusion of this one dimension from previous national dietary guidance in the U.S., the Society for Nutrition Education and Behavior (SNEB) developed a detailed position paper recommending the inclusion of environmental sustainability in future guidance (Rose et al., 2019). The livestock industry, led by National Dairy Council scientists, criticized this position in a letter to the editor, arguing that a 'singular focus on the environment is in direct contradiction to the concept of sustainable diets.' (Miller et al., 2020). They went on to argue why ruminant animals were an important part of sustainable diets for economic reasons, as well as for health, social, and even environmental reasons.

This case study of the dairy industry response to a position paper from a professional nutritional association demonstrates a co-opting of sustainable diet terminology. The industry criticizes advice to reduce ruminant animal consumption to improve sustainability by arguing that such consumption is, rather, a vital part of sustainable diets. In this instance, they employed a number of the practices outlined by Mialon and colleagues (Mialon et al., 2015), including stressing the economic importance of the industry, framing the debate, and shaping the evidence base.

First, they stressed the economic importance of the livestock industry by describing the potential jobs lost, an approach similar to that used in tobacco industry arguments. While it is true that improved consumption habits (i.e. reduced tobacco use) resulted in job losses, it has been shown that jobs lost in that sector were offset by jobs in other sectors (Warner et al., 1996, Warner, 2000). Thus, there is no reason to assume that improving diets to sustain the planet will cost jobs in the long run.

Second, they stressed the good traits of the livestock industry without providing context, one of the mechanisms that Mialon and colleagues include as a way to frame the debate (Mialon et al., 2015). They argued in the letter to the editor that ruminants can convert agricultural by-products and actually improve the environment, since such human-inedible fiber products would not be burned or decompose in landfills (Miller et al., 2020). This may be true, but the context is missing from this argument. Solely feeding such by-products could support only about 10% of American beef consumption. In other words, moving this industry to sustainable practices would require dramatic reductions in consumption.

Another mechanism to frame the debate employed by these authors is to caricature opposing arguments in the extreme. For example, the dairy authors gave arguments opposed to the complete elimination of animal products from the diet, though the SNEB position paper only suggested reductions in animal consumption, not elimination. Similarly, the dairy authors argued against recommending foods based solely on their carbon footprints, which the SNEB position paper never recommended.

Finally, to shape the evidence base, the dairy authors cherry-picked the data to favor their industry, citing evidence that it is difficult to meet nutrient requirements without consuming animal-based foods, particularly ruminants. This is blatantly false. Since 2010, the DGA's have provided examples of recommended nutritious diet patterns that are vegan. They do this by including fortified soymilk as part of the ‘dairy’ group, since it contains similar amounts of protein, calcium, and vitamin D as does cow-based milk.

In sum, the dairy industry, through paid scientists, used a number of typical industry practices – such as stressing the economic importance of the industry, framing the debate, and shaping the evidence base – to coopt the sustainability definition, so that ruminant animals could be considered part of a sustainable diet.

Webinar for health professionals on sustainability of beef

Our final case study, and the second example of the livestock industry coopting the meaning of sustainability, is a webinar for dietitians and other health professionals on the sustainability of beef. It was conducted by the senior director of sustainable beef production research at the National Cattlemen’s Beef Association and by a food industry consultant. The webinar was sponsored by the Beef Checkoff program, a U.S. government program overseen jointly between the Cattlemen´s Beef Board and the USDA that aims to increase the demand for beef in the US and internationally through marketing and research (Cattlemen’s Beef Board and National Cattlemen’s Beef

Association, 2019). The webinar was advertised using the newsletter of the Academy of Nutrition and Dietetics, the largest professional association of American dietitians and nutritionists. To maximize dissemination among nutrition professionals, the webinar was offered for free and awarded continuing education credits for registered dietitians.

The webinar used many of the practices outlined previously. It framed the debate by stressing the good traits of beef, while minimizing its negative ones. For example, the webinar lauded beef cattle's 'upcycling superpower', that is, its ability to convert plants into higher quality proteins. While arguing that this upcycling is better than mere recycling, it failed to point out the inefficiency in food energy and protein conversion of ruminants. For example, Shepon and colleagues found that the caloric conversion efficiency of poultry is 4.5 times greater than that of beef and 8.4 times greater with respect to protein conversion efficiency (2016). Plant-based diets, appropriately chosen, would be even more efficient at meeting calorie and protein needs with far less environmental damage (Eshel et al., 2016, Shepon, 2016). As did the dairy industry scientists in the previous example, it discussed food waste and cattle's ability to reduce it by consuming fibrous products that are inedible for humans, while minimizing the impact of methane emissions from cattle as well as its overall carbon footprint, which is 10 times greater than poultry and about 20 times greater than nuts, seeds, or legumes (Heller et al., 2018, Poore and Nemecek, 2018).

The webinar is an example of the beef industry shaping the evidence base on sustainable diets. This industry-sponsored educational material was provided by an industry scientist and consultant. It presented only a few of the studies of beef's impact on the environment or on health, essentially cherry picking the most favorable studies and excluding those demonstrating beef's negative impacts on both (Poore and Nemecek, 2018, Godfray et al., 2018, GBD, 2019).

Finally, the webinar highlighted the economic dimension of sustainability, which allowed it to focus on the importance of beef for producer viability as well as beef's contributions to rural economies. This is an interesting sleight of hand – if the beef industry employs a lot of people, it becomes, by definition, part of a sustainable diet. Eating more beef makes it sustainable.

Further examples of livestock industry influence on sustainable diets

In addition to the case studies presented above, there are many other examples of corporate political activity in the U.S. food system which influence the sustainability of diets. Two recent cases deserve special attention as they influence aspects at both ends of the system: on the consumer side, the labeling or identification of meat products, and on the producer side, the slaughtering and packing of meats.

At the federal level, U.S. Cattlemen's Association has sought to place restrictions on what can be labeled 'meat' by petitioning the US Department of Agriculture to limit its definition 'to the tissue or flesh of animals that have been harvested in the traditional manner' (USCA, 2018). The intention was to exclude products from plants and other non-animal components from being labeled as such, including burgers, such as the 'Impossible Burger' or the 'Beyond Burger,' which are both plant-based and have much lower carbon and water footprints. Although the basis of the claim is for truth in labeling and to avoid consumer confusion, there have been no such requests or concerns from any consumer organizations. As of this writing, the USDA had not acted on this petition, other than to seek public comments.

Although federal agencies have not changed labeling laws, a number of states have. Missouri passed legislation that would 'prevent misrepresentation of products as meat that are not derived from livestock or poultry' (Missouri Department of Agriculture, 2018). Other states, such as Mississippi, Arkansas, and Louisiana, have also passed similar labeling laws (Selyukh, 2019).

The concern is that labels with ‘meat,’ ‘burger,’ or ‘hot dog’ could only be used on foods made of animal flesh, and meat substitutes like veggie burgers would need to find an alternative name (Selyukh, 2019). These labeling laws were passed supposedly to protect confused consumers, but it is much more likely that such efforts are about marketing. Terms like veggie discs are obviously less appealing (Boffey, 2019). The popularity of vegetarian and vegan diets has increased rapidly and the meat industry is likely trying to avoid a slide in sales that has been seen in the dairy industry, where efforts to limit the labeling of plant-based milks are ongoing (Bull, 2020, Herzog, 2019).

Livestock industry influence has also been seen recently on the production side of meat, where the spotlight has focused on meat packing plants that have become hot spots for transmission of COVID-19. Clusters of cases have been seen throughout the country, thousands of workers have been affected, and many have died. In response to the growing number of plant closures by state health officials, John Tyson, chairman of the board of Tyson Foods, one of the country´s largest meat processing companies, took out full-page ads in the New York Times and Washington Post to highlight the risk of losing millions of pounds of meat (Swanson and Yaffe-Bellany, 2020). This is a clear example of using media to frame the debate, stressing the reduction in meat supply to the nation, while seeming concerned about workers’ safety and health. Two days later, President Trump signed an Executive Order based on the Defense Production Act through which he declared meat plants ‘critical infrastructure’ citing the need to ensure this source of ‘protein for Americans’ (Swanson and Yaffe-Bellany, 2020). According to news reports, this action followed weeks of behind the scenes lobbying by meat companies to reverse shut-downs by state and local health officials (Corkery et al., 2020). The action allows companies to open back up, while protecting them from legal actions by employees who get sick.

Meatpacking plants are problematic for the spread of infectious diseases because of the tight spaces, long hours, difficulty in getting sick leave, as well as lack of personal protective equipment and hand-washing stations. This is driven by economic incentives; a faster processing speed means greater revenues and profits for shareholders. A slower production line could help address this, since fewer workers would be needed at a time, so they could be spaced further apart. However, meatpacking companies have spent years lobbying to increase line speeds, and new actions by USDA have allowed line speeds to increase with fewer inspectors watching over production (Corkery et al., 2020). In the words of Tony Corbo, a senior lobbyist for the citizen watchdog group Food and Water Watch, ‘The industry has a lot of sway, and recent weeks have just shown what power they have’ (Corkery et al., 2020).

Diverse and dynamic industries

We have referred to the livestock industry in this paper as those involved in the production, processing, distribution, and sale of animal products. We have focused specifically on ruminant animal products, like beef and dairy, because of their outsized influence on the environment. There is, however, a tremendous diversity within this industry, not only by product, but also by entry point in the food system. Joshua Specht has described the evolution of the beef production system in the United States from a time when cattlemen and butchers were dominant players at the production and retail ends of the chain to the current formation in which those with the most power and influence are the meatpackers (Specht, 2019). These are the few large consolidated companies in the center of the chain that turn livestock into meat through slaughtering, processing, packaging, and distribution. This is relevant for our discussion because not all corporate political influence in the livestock industry lines up on the same side of an issue. For example, in the labeling issue

described above in which the US Cattlemen's Association requested a new definition of meat from USDA, there was support from the National Farmers Union (Johnson, 2018), while The North American Meat Institute, which represents meat processors, opposed it (NAMI, 2018). The definition sought by the cattlemen included the phrase 'harvested in the traditional manner,' because they are particularly concerned with the growth of the new lab-grown meat industry. As it turns out, both Tyson Foods and Cargill, large meat processors, have invested in cultured meat companies (Corbyn, 2020), so they opposed the new definition.

The other salient point is that such corporate political activity does not occur in a static environment. The beef and dairy industries have experienced significant declines in domestic consumption. In the 40 years since 1977, aggregate annual beef consumption has declined in the US from 86 to 54 pounds per capita, while dairy consumption (including fluid milks, creams, and yogurts), has dropped from 258 to 168 pounds per capita (USDA 2019). If the goal of corporate political activity is to shape government policy to favor the firm, we can assume that such activity will be even stronger when consumer demand is on the decline. And our global food system implies that domestic consumption is not the only avenue for success for these companies. Bovine meat consumption in China in 2013, for example, was 16 times greater than it was in 1973 (FAO, 2019). The nutrition transition implies that such upward trends will be seen in low- and middle-income countries throughout the world (Popkin, 2006). Thus, we can expect corporations to export political influence as well as their food products. We have already seen an example of this with the soda industry and obesity policy in China (Greenhalgh, 2019).

Conclusions

In sum, we have documented a number of instances in which the livestock industry's corporate political activities jeopardize progress on achieving sustainable diets. Whether by attempting to exclude discussion of sustainability from dietary guidance or coopting its meaning, we have seen the industry employ various practices outlined by Mialon and colleagues (2015) in which they shape the evidence base, frame the debate, stress the economic importance of the industry, fund policymakers, and develop alternative policies. Their efforts to influence corporate profits at the expense of public health are analogous to what we have seen by the tobacco, alcohol, and other food industries (Stuckler et al., 2012).

Will it be possible to include environmental sustainability as a consideration in forming future dietary guidance? The DGAs are developed every 5 years, so the development of the 2020-2025 DGAs could have presented an opportunity for this, one that would have made sense, given the knowledge and scientific evidence that have been amassed on this topic in the last five years. Unfortunately, a new work methodology was implemented by the USDA and DHHS, which constrains the advisory committee to consider only those issues previously developed by the government, effectively preventing the topic of sustainability from being examined. This new work methodology was itself a reaction to the previous advisory committee's work on sustainability, one which began with Congress requesting the National Academies of Science, Engineering, and Medicine to evaluate the DGA development process (National Academies of Sciences, Engineering, and Medicine, 2017). Dietary guidance policy in the US will have to wait for a new opportunity to influence Americans' dietary patterns towards a more sustainable approach. Ultimately, policy is influenced by politics, so such an opportunity will require a change in the political winds.

The nutrition field is challenged by conflicts of interest. Conducting a research study is expensive and funding is limited. Thus, it is not surprising that many nutrition scientists accept

financial support from the food industry to conduct research. But there is strong evidence that studies funded by companies are more likely to find results favorable to those companies (Nestle, 2018, Bes-Rastrollo et al., 2013, Katan, 2007). How can we ensure that such funding does not affect the results? To protect the integrity of nutrition research, mechanisms are needed that put a barrier between the company and the scientist, so that results are not shared before publication. One suggestion is to pool funding from various companies to be allocated by a third party, so that the scientist would not know which company supported the work and the companies would not know which scientists it supported. However, to the extent that food companies see support of nutrition science as a marketing activity, as Nestle has claimed (Nestle, 2018), it may be unlikely that such an approach would find much support in the food industry. The Cochrane Reviews editorial process has one of the strongest conflict of interest policies of scientific journals (Cochrane, 2020), precluding commercial sponsorship, requiring conflict-of-interest disclosures when proposing a review, prohibiting the first author from having a conflict-of-interest, and requiring the same from a majority of authors on a paper. Unfortunately, BMJ, which published the meat-friendly dietary guidance described above, does not have such a strict policy. Moreover, authors of those articles did not disclose conflicts in a timely manner. This, in itself, might be a corporate strategy, since most of the press around the release of these guidelines occurred before conflicts were known, strengthening the public's trust in the results.

The relationships between eating patterns and environmental sustainability are complex, and generate a multiplicity of positions in the scientific, commercial, and policy-making realms. Ultimately, it is in the public interest that policy design and implementation to support sustainable diets be free from corporate political activity that prioritizes commercial interests over health and well-being. Certainly, there is a need to analyze and predict the potential impacts of policies on commercial interests, which are crucial to our economic systems. Health systems and policies are a part of those economic systems and benefit from their strength. But history has made clear that corporate political influence in health policies weakens those policies. It is for this reason that Canada intentionally developed their latest dietary guidance free from food industry influence (Crowe, 2019). The US has not yet followed the example of its northern neighbor in crafting such recommendations. In this paper, we have highlighted corporate political activity that seeks to influence sustainable diet policies with the intent of limiting such influence in the future.

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REFERENCES

BERO, L. 2003. Implications of the tobacco industry documents for public health and policy. *Annu Rev Public Health,* 24**,** 267-88.

BES-RASTROLLO, M., SCHULZE, M. B., RUIZ-CANELA, M. & MARTINEZ-GONZALEZ, M. A. 2013. Financial conflicts of interest and reporting bias regarding the association between sugar-sweetened beverages and weight gain: a systematic review of systematic reviews. *PLoS Med,* 10**,** e1001578; dicsussion e1001578.

BURLINGAME, B. A., DERNINI, S. [eds.], Food and Agriculture Organization of the United Nations & Biodiversity International. 2012. *Sustainable diets and biodiversity : directions and solutions for policy, research and action.* Available at: http://www.fao.org/3/a-i3004e.pdf (Accessed: 18 August 2019)

BOFFEY, D. 2019. 'Veggie discs' to replace veggie burgers in EU crackdown on food labels, *The Guardian,* 4 April. Available at: https://www.theguardian.com/food/2019/apr/04/eu-to-ban-non-meat-product-labels-veggie-burgers-and-vegan-steaks (Accessed on: 10 May 2020)

BULL, M. 2020. The milk situation: Americans have been souring on dairy milk for decades, *The New York Times,* 14 March. Available at: https://www.nytimes.com/2020/03/14/style/milk-dairy-marketing.html (Accessed: 28 March 2020)

CATTLEMEN'S BEEF BOARD AND NATIONAL CATTLEMEN'S BEEF ASSOCIATION. 2019. How do we feed the future without eating the planet? Examining the human and environmental impacts of beef production, 19 March. Available at: https://www.beefitswhatsfordinner.com/nutrition/health-professional-resources/feeding-the-future (Accessed: 25 March 2019)

CEBALLOS, G., EHRLICH, P. R., BARNOSKY, A. D., GARCIA, A., PRINGLE, R. M. & PALMER, T. M. 2015. Accelerated modern human-induced species losses: Entering the sixth mass extinction. *Sci Adv,* 1**,** e1400253.

CHARLES, D. 2014. *Congress to Nutritionists: Don´t Talk about the Environment* [Podcast]. 15 December. Available at: https://www.npr.org/sections/thesalt/2014/12/15/370427441/congress-to-nutritionists-dont-talk-about-the-environment#:~:text=The%20American%20Meat%20Institute%2C%20which,down%20the%20fledgling%20effort%20completely (Accessed: 3 March 2020)

COCHRANE. 2020. Policy: conflicts of interest and Cochrane Reviews. Available at: https://documentation.cochrane.org/display/EPPR/Policy%3A+conflicts+of+interest+and+Cochrane+Reviews (Accessed on 27 May 2020)

CORBYN, Z. 2020. Out of the lab and into your frying pan: the advance of cultured meat, *The Guardian,* 19 January. Available at: https://www.theguardian.com/food/2020/jan/19/cultured-meat-on-its-way-to-a-table-near-you-cultivated-cells-farming-society-ethics (Accessed: 26 May 2020)

CORKERY, M., YAFFE-BELLANY, D. & SWANSON, A. 2020. Powerful Meat Industry Holds More Sway After Trump's Order, *The New York Times,* 29 April 2020. Available at: https://www.nytimes.com/2020/04/29/business/coronavirus-trump-meat-plants.html (Accessed: 13 May 2020)

CROWE, K. 2019. The long road to a new Canada's Food Guide, *CBC News*,9 JanuaryAvailable at: https://www.cbc.ca/news/health/canada-food-guide-healthy-eating-food-processors-industry-dairy-beef-lobbying-1.4970122 (Accessed: 29 May 2020)

CSPI. 2015. Congressional Catering: How Big Food and Agricultural Special Interests Wield Influence in Congress and Undermine Public Health. Available at: https://cspinet.org/sites/default/files/attachment/riders-dga-campaign-analysis-report.pdf (Accessed: 3 March 2020)

DGAC Dietary Guidelines Advisory Committee. 2015. Scientific report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture. Available at: https://health.gov/sites/default/files/2019-09/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf (Accessed 17 April 2020)

DHHS. 2015. Comments submitted to the federal government on the Scientific Report of the 2015 Dietary Guidelines Advisory Committee. Available at: https://health.gov/our-work/food-nutrition/2015-2020-dietary-guidelines/advisory-report/public-comments/read-comments (Accessed March 03, 2020)

DHHS and USDA. 2015. 2015–2020 Dietary Guidelines for Americans, 8th ed. Available at: http://health.gov/dietaryguidelines/2015/guidelines/ (Accessed: 3 March 2020)

DREWNOWSKI, A. & ECOSYSTEM INCEPTION, T. 2017. The Chicago Consensus on Sustainable Food Systems Science. *Front Nutr,* 4**,** 74.

DYER, O. 2020. Controversial red meat study adds correction over undisclosed industry funding. *BMJ,* 368**,** m111.

ESHEL, G., SHEPON, A., NOOR, E. & MILO, R. 2016. Environmentally Optimal, Nutritionally Aware Beef Replacement Plant-Based Diets. Environ Sci Technol, 50, 8164-8.

ESHEL, G., SHEPON, A., SHAKET, T., COTLER, B. D., GILUTZ, S., GIDDINGS, D., RAYMO, M. E. & MILO, R. 2018. A model for 'sustainable' US beef production. *Nat Ecol Evol,* 2**,** 81-85.

FAO. 2019. FAOSTAT, New Food Balances. Available at: http://www.fao.org/faostat/en/#data/FBS (Accessed: 26 May 2020)

FOLEY, J. A., RAMANKUTTY, N., BRAUMAN, K. A., CASSIDY, E. S., GERBER, J. S., JOHNSTON, M., MUELLER, N. D., O'CONNELL, C., RAY, D. K., WEST, P. C., BALZER, C., BENNETT, E. M., CARPENTER, S. R., HILL, J., MONFREDA, C., POLASKY, S., ROCKSTROM, J., SHEEHAN, J., SIEBERT, S., TILMAN, D. & ZAKS, D. P. 2011. Solutions for a cultivated planet. *Nature,* 478**,** 337-42.

FREIDBERG, S. 2016. Wicked Nutrition: The Controversial Greening of Official Dietary Guidance. *Gastronomica: The Journal of Critical Food Studies*, 16, 2, 69-80.

GBD 2017 Diet Collaborators. 2019. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet,* 393, 1958-1972.

GBD, D. C. 2019. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet,* 393**,** 1958-1972.

GERBER, P.J., STEINFELD, H., HENDERSON, B., ET AL. 2013. Tackling Climate Change Through Livestock—A Global Assessment of Emissions and Mitigation Opportunities. *Food and Agriculture Organization of the United Nations*.

GODFRAY, H. C. J., AVEYARD, P., GARNETT, T., HALL, J. W., KEY, T. J., LORIMER, J., PIERREHUMBERT, R. T., SCARBOROUGH, P., SPRINGMANN, M. & JEBB, S. A. 2018. Meat consumption, health, and the environment. *Science,* 361.

GREENHALGH, S. 2019. Soda industry influence on obesity science and policy in China. *J Public Health Policy,* 40**,** 5-16.

HAN, M. A., ZERAATKAR, D., GUYATT, G. H., VERNOOIJ, R. W. M., EL DIB, R., ZHANG, Y., ALGARNI, A., LEUNG, G., STORMAN, D., VALLI, C., RABASSA, M., REHMAN, N., PARVIZIAN, M. K., ZWORTH, M., BARTOSZKO, J. J., LOPES, L. C., SIT, D., BALA, M. M., ALONSO-COELLO, P. & JOHNSTON, B. C. 2019. Reduction of Red and Processed Meat Intake and Cancer Mortality and Incidence: A Systematic Review and Meta-analysis of Cohort Studies. *Ann Intern Med,* 171**,** 711-720.

HARTZLER, V., CONAWAY, M., WALORSKI, J. ET AL. 2015. Letter to Secretaries Vilsack and Burwell, 31 March. Available at: https://republicans-agriculture.house.gov/uploadedfiles/ag_dietaryguidelineslettertosecsvilsackburwell.pdf (Accessed: 24 April 24 2020)

HELLER, M. C., WILLITS-SMITH, A., MEYER, R., KEOLEIAN, G. A. & ROSE, D. 2018. Greenhouse gas emissions and energy use associated with production of individual self-selected US diets. *Environ Res Lett,* 13**,** 044004.

HERZOG, A. 2019. FDA Considers Changing Labeling Requirements For Nondairy 'Milk' Products, *Heartland Institute*, 3 June 2019. Available at: https://www.heartland.org/news-opinion/news/fda-considers-changing-labeling-requirements-for-nondairy-milk-products (Accessed: 22 April 2020)

IPCC. 2014. Climate Change 2014: synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change.

IPCC. 2018. Special report: Global warming of 1.5°C. Available at: https://www.ipcc.ch/sr15/ (Accessed: 16 November 2019)

IPCC. 2019. Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecoystems. Available at: https://www.ipcc.ch/report/srccl/ (Accessed: 16 November 2019)

JACOBSON, T. A., MAKI, K. C., ORRINGER, C. E., JONES, P. H., KRIS-ETHERTON, P., SIKAND, G., LA FORGE, R., DANIELS, S. R., WILSON, D. P., MORRIS, P. B., WILD, R. A., GRUNDY, S. M., DAVIGLUS, M., FERDINAND, K. C., VIJAYARAGHAVAN, K., DEEDWANIA, P. C., ABERG, J. A., LIAO, K. P., MCKENNEY, J. M., ROSS, J. L., BRAUN, L. T., ITO, M. K., BAYS, H. E., BROWN, W. V., UNDERBERG, J. A. & PANEL, N. L. A. E. 2015. National Lipid Association Recommendations for Patient-Centered Management of Dyslipidemia: Part 2. *J Clin Lipidol,* 9**,** S1-122 e1.

JOHNSON, R. 2018. Docket No. FDA-2018-N-2155 for "Foods Produced Using Animal Cell Culture Technology; Public Meeting; Request for Comments", 24 September. National Farmer´s Union letter to Food and Drug Administration. Available at: https://1yd7z7koz052nb8r33cfxyw5-wpengine.netdna-ssl.com/wp-content/uploads/2018/09/09-24-18-Animal-Cell-Culture-Technology-Comments_National-Farmers-Union.pdf (Accessed: 10 May 2020)

JOHNSTON, B. C., ZERAATKAR, D., HAN, M. A., VERNOOIJ, R. W. M., VALLI, C., EL DIB, R., MARSHALL, C., STOVER, P. J., FAIRWEATHER-TAITT, S., WOJCIK, G., BHATIA, F., DE SOUZA, R., BROTONS, C., MEERPOHL, J. J., PATEL, C. J., DJULBEGOVIC, B., ALONSO-COELLO, P., BALA, M. M. & GUYATT, G. H. 2019. Unprocessed Red Meat and Processed Meat Consumption: Dietary Guideline Recommendations From the Nutritional Recommendations (NutriRECS) Consortium. *Ann Intern Med,* 171**,** 756-764.

KATAN, M. B. 2007. Does industry sponsorship undermine the integrity of nutrition research? *PLoS Med,* 4**,** e6.

KOLATA G., 2019. Eat Less Red Meat, Scientists Said. Now Some Believe That Was Bad Advice, *The New York Times*, 30 September 2019. Available at: https://www.nytimes.com/2019/09/30/health/red-meat-heart-cancer.html (Accessed: 1 October 2019)

KORTE L. 2020. Did Texas A&M influence controversial study on red meat?, *Statesman*, 10 January. Available at https://www.statesman.com/news/20200110/did-texas-am-influence-controversial-study-on-red-meat (Accessed: 28 April 2020)

LUTZ, J. 2019. Steak Holder Interests: Industry Funding and Nutrition Reporting, *True Health Initiative*, 11 October 2019. Available at: https://www.truehealthinitiative.org/news2019/steak-holder-interests-industry-funding-and-nutrition-reporting/ (Accessed: 28 April 2020)

MCKEE, M. & STUCKLER, D. 2018. Revisiting the Corporate and Commercial Determinants of Health. *Am J Public Health,* 108**,** 1167-1170.

MELILLO, J. M., RICHMOND, T., YOHE, G., EDS. 2014: Climate Change Impacts in the United States: The Third National Climate Assessment, pp. 233. Available at: https://www.globalchange.gov/browse/reports/climate-change-impacts-united-states-third-national-climate-assessment-0 (Accessed: 3 March 2020)

MIALON, M., SWINBURN, B. & SACKS, G. 2015. A proposed approach to systematically identify and monitor the corporate political activity of the food industry with respect to public health using publicly available information. *Obes Rev,* 16**,** 519-30.

MILLEN, B. E., ABRAMS, S., ADAMS-CAMPBELL, L., ANDERSON, C. A., BRENNA, J. T., CAMPBELL, W. W., CLINTON, S., HU, F., NELSON, M., NEUHOUSER, M. L., PEREZ-ESCAMILLA, R., SIEGA-RIZ, A. M., STORY, M. & LICHTENSTEIN, A. H. 2016. The 2015 Dietary Guidelines Advisory Committee Scientific Report: Development and Major Conclusions. *Adv Nutr,* 7**,** 438-44.

MILLER, G. D., COMERFORD, K. B., BROWN, K. & MITLOEHNER, F. M. 2020. The Importance of a Holistic Approach to Sustainability in Dietary Guidance. *J Nutr Educ Behav,* 52**,** 203-205.

MISSOURI DEPARTMENT OF AGRICULTURE. 2018. *Public Statement - Meat Labeling,* 18 August. Available at: https://agriculture.mo.gov/animals/meat.php (Accessed on: 10 May 2020)

NAMI North American Meat Institute. 2015. Announcement of the Availability of the Scientific Report of the 2015 Dietary Guidelines Advisory Committee, Solicitation of Written Comments on the Advisory Report, 18 May. Available at: https://www.meatinstitute.org/index.php?ht=a/GetDocumentAction/i/112594 (Accessed: 3 March 2020)

NAMI North American Meat Institute. 2018. North American Meat Institute Comments on United States Cattlemen's Association Petition 18-01 for the Imposition of Beef and Meat Labeling Requirements, 16 May. Available at: https://www.meatinstitute.org/index.php?ht=a/GetDocumentAction/i/146088 (Accessed: 22 May 2020)

NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE. 2017. *Redesigning the process for establishing the Dietary Guidelines for Americans*. Washington, DC: The National Academies Press.

NATIONAL ASSOCIATION OF ATTORNEYS GENERAL. 1998. Master Settlement Agreement. Available at: https://web.archive.org/web/20080625084126/http://www.naag.org/backpages/naag/tobacco/msa/msa-pdf/1109185724_1032468605_cigmsa.pdf (Accessed 17 April 2020)

NELSON, M. E., HAMM, M. W., HU, F. B., ABRAMS, S. A. & GRIFFIN, T. S. 2016. Alignment of Healthy Dietary Patterns and Environmental Sustainability: A Systematic Review. *Adv Nutr,* 7**,** 1005-1025.

NESTLE, M. 2018. *Unsavory truth : how food companies skew the science of what we eat,* New York, Basic Books.

POORE, J. & NEMECEK, T. 2018. Reducing food's environmental impacts through producers and consumers. *Science,* 360**,** 987-992.

QIAN, F., RIDDLE, M. C., WYLIE-ROSETT, J. & HU, F. B. 2020. Red and Processed Meats and Health Risks: How Strong Is the Evidence? *Diabetes Care,* 43**,** 265-271.

POPKIN, B. M. 2006. Global Nutrition Dynamics: The World Is Shifting Rapidly Toward a Diet Linked with Noncommunicable Diseases. *Am J Clin Nutr,* 84, 289-298.

ROSE, D., HELLER, M. C. & ROBERTO, C. A. 2019. Position of the Society for Nutrition Education and Behavior: The Importance of Including Environmental Sustainability in Dietary Guidance. *J Nutr Educ Behav,* 51**,** 3-15.

RUBIN, R. 2020. Backlash Over Meat Dietary Recommendations Raises Questions About Corporate Ties to Nutrition Scientists. *JAMA.*, 323, 401-405.

SCHWINGSHACKL, L., KNUPPEL, S., SCHWEDHELM, C., HOFFMANN, G., MISSBACH, B., STELMACH-MARDAS, M., DIETRICH, S., EICHELMANN, F., KONTOPANTELIS, E., IQBAL, K., ALEKSANDROVA, K., LORKOWSKI, S., LEITZMANN, M. F., KROKE, A. & BOEING, H. 2016. Perspective: NutriGrade: A Scoring System to Assess and Judge the Meta-Evidence of Randomized Controlled Trials and Cohort Studies in Nutrition Research. *Adv Nutr,* 7**,** 994-1004.

SELYUKH, A. 2019. *What Gets To Be A 'Burger'? States Restrict Labels On Plant-Based Meat* [Podcast]. 23 July. Available at: https://www.npr.org/sections/thesalt/2019/07/23/744083270/what-gets-to-be-a-burger-states-restrict-labels-on-plant-based-meat (Accessed: 10 May 2020)

SHEPON, A., ESHEL, G., MILO, R. 2016. Energy and protein feed-to-food conversion efficiencies in the US and potential food security gains from dietary changes. *Environ. Res. Lett*, 11, 105002.

SPECHT, J. 2019. *Red meat republic : a hoof-to-table history of how beef changed america*, Princeton, NJ, Princeton University Press.

STUCKLER, D., MCKEE, M., EBRAHIM, S. & BASU, S. 2012. Manufacturing epidemics: the role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco. *PLoS Med,* 9**,** e1001235.

SWANSON, A. & YAFFE-BELLANY, D. 2020. Trump Declares Meat Supply 'Critical,' Aiming to Reopen Plants, *The New York Times*, 29 April 2020. Available at: https://www.nytimes.com/2020/04/28/business/economy/coronavirus-trump-meat-food-supply.html (Accessed: 13 May 2020)

TANGCHAROENSATHIEN, V., CHANDRASIRI, O., KUNPEUK, W., MARKCHANG, K. & PANGKARIYA, N. 2019. Addressing NCDs: Challenges From Industry Market Promotion and Interferences. Int J Health Policy Manag, 8, 256-260.

TEICHOLZ, N. 2015. The scientific report guiding the US dietary guidelines: is it scientific? *BMJ,* 351**,** h4962.

UCSF University of California, San Francisco. No date. *Truth Tobacco Industry Documents.* Available at: https://www.industrydocuments.ucsf.edu/tobacco (Accessed: 17 April 2020)

USCA. 2018. Petition for the Impositon of Beef and Meat Labeling Requirements: To Exclude Products not Derived Directly from Animals Raised and Slaughtered from the Definition of "Beef" and "Meat", 9 February. Petition to USDA. Available at: https://www.fsis.usda.gov/wps/wcm/connect/e4749f95-e79a-4ba5-883b-394c8bdc97a3/18-01-Petition-US-Cattlement-Association020918.pdf?MOD=AJPERES (Accessed: 10 May 2020)

USDA. No date. *Dietary Guidelines for Americans, Dietary Guidelines 1990*. Available at: https://www.fns.usda.gov/dietary-guidelines-1990 (Accessed 9 March 2020)

USDA. 2019. Economic Research Service, food availability data series from the Food Availability (Per Capita) Data System. Available at https://www.ers.usda.gov/data-products/food-availability-per-capita-data-system/interactive-charts-and-highlights/#selected (Accessed: 26 May 2020)

VALLI, C., RABASSA, M., JOHNSTON, B. C., KUIJPERS, R., PROKOP-DORNER, A., ZAJAC, J., STORMAN, D., STORMAN, M., BALA, M. M., SOLA, I., ZERAATKAR, D., HAN, M. A., VERNOOIJ, R. W. M., GUYATT, G. H., ALONSO-COELLO, P. & NUTRI, R. W. G. 2019. Health-Related Values and Preferences Regarding Meat Consumption: A Mixed-Methods Systematic Review. *Ann Intern Med,* 171**,** 742-755.

VERNOOIJ, R. W. M., ZERAATKAR, D., HAN, M. A., EL DIB, R., ZWORTH, M., MILIO, K., SIT, D., LEE, Y., GOMAA, H., VALLI, C., SWIERZ, M. J., CHANG, Y., HANNA, S. E., BRAUER, P. M., SIEVENPIPER, J., DE SOUZA, R., ALONSO-COELLO, P., BALA, M. M., GUYATT, G. H. & JOHNSTON, B. C. 2019. Patterns of Red and Processed Meat Consumption and Risk for Cardiometabolic and Cancer Outcomes: A Systematic Review and Meta-analysis of Cohort Studies. *Ann Intern Med,* 171**,** 732-741.

VILSACK, T., BURWELL, S. 2015. 2015 Dietary Guidelines: Giving You the Tools You Need to Make Healthy Choices. *USDA Media Blog*. Available at: https://www.usda.gov/media/blog/2015/10/06/2015-dietary-guidelines-giving-you-tools-you-need-make-healthy-choices (Accessed: 3 March 2020)

VOROSMARTY, C. J., MCINTYRE, P. B., GESSNER, M. O., DUDGEON, D., PRUSEVICH, A., GREEN, P., GLIDDEN, S., BUNN, S. E., SULLIVAN, C. A., LIERMANN, C. R. & DAVIES, P. M. 2010. Global threats to human water security and river biodiversity. *Nature,* 467**,** 555-61.

WARNER, K. E. 2000. The economics of tobacco: myths and realities. *Tob Control,* 9**,** 78-89.

WARNER, K. E., FULTON, G. A., NICOLAS, P. & GRIMES, D. R. 1996. Employment implications of declining tobacco product sales for the regional economies of the United States. *JAMA,* 275**,** 1241-6.

WILKINS, J. 2020. New Meat Guidelines: A Challenge for Nutrition Educators. *J Nutr Educ Behav,* 52**,** 1.

ZERAATKAR, D., HAN, M. A., GUYATT, G. H., VERNOOIJ, R. W. M., EL DIB, R., CHEUNG, K., MILIO, K., ZWORTH, M., BARTOSZKO, J. J., VALLI, C., RABASSA, M., LEE, Y., ZAJAC, J., PROKOP-DORNER, A., LO, C., BALA, M. M., ALONSO-COELLO, P., HANNA, S. E. & JOHNSTON, B. C. 2019a. Red and Processed Meat Consumption and Risk for All-Cause Mortality and Cardiometabolic Outcomes: A Systematic Review and Meta-analysis of Cohort Studies. Ann Intern Med, 171, 703-710.

ZERAATKAR, D., JOHNSTON, B. C., BARTOSZKO, J., CHEUNG, K., BALA, M. M., VALLI, C., RABASSA, M., SIT, D., MILIO, K., SADEGHIRAD, B., AGARWAL, A., ZEA, A. M., LEE, Y., HAN, M. A., VERNOOIJ, R. W. M., ALONSO-COELLO, P., GUYATT, G. H. & EL DIB, R. 2019b. Effect of Lower Versus Higher Red Meat Intake on Cardiometabolic and Cancer Outcomes: A Systematic Review of Randomized Trials. Ann Intern Med, 171, 721-731