Wicked Nutrition: The Controversial Greening of Official Dietary Guidance

Abstract: In 2015, controversy over the Dietary Guidelines for Americans reached a new level when the government-appointed Dietary Guidance Advisory Committee (DGAC) recommended that those guidelines promote more sustainable diets, particularly those lower in animal-based foods. Although the committee found ample scientific evidence that such a shift would be a "win-win" for Americans' health as well as the environment, it met with fierce opposition on both counts, and not only from the livestock industry. This suggests how sustainable diet guidance poses a classic wicked problem, meaning one characterized by high levels of complexity, uncertainty, and epistemological conflict. While relationships between food, bodies, and environments are inevitably complex and uncertain, the controversy surrounding DGAC's recommendation offers an opportunity to explore how the scientific evidence on dietary sustainability is actually produced, and how it does or does not speak to other knowledge about eating for bodily and ecological health. To do this I look first at the research behind DGAC's endorsement of diets high in plant-based versus animal-based foods, and then at select responses in the public comments. The contrast not only highlights the incommensurability of modeled versus experiential evidence, but also suggests that efforts to promote more sustainable food consumption cannot credibly ignore questions (however unresolved) about what constitutes more sustainable production.

Keywords: dietary guidance, sustainability, wicked problems, critical nutrition, life cycle assessment

IN THE THIRTY-FIVE YEAR history of the Dietary Guidelines for Americans (DGA), rarely has the science behind the guidance provoked more controversy than in 2015. Jointly written by the United States Department of Agriculture (USDA) and Health and Human Services (HHS), the DGA are updated every five years to reflect new evidence and new dietary concerns. Each time the government appoints a Dietary Guidance Advisory Committee (DGAC), composed of nutritionists, physicians, and public health experts, to conduct the necessary research and report back on its recommendations. In 2015, much of the 600-plus page DGAC report revisited familiar topics, such as the latest findings on sodium and cholesterol. But one new recommendation proved especially divisive. In the interests of improved environmental sustainability—a concern past advisory committees had not explicitly addressed—the 2015 DGAC report advised that the new guidelines call for diets lower in "animal-based" foods (DGAC 2015a).

The committee emphasized that it was not suggesting that Americans give up these foods altogether, only that they eat less of them. It also repeatedly stressed that healthful and more sustainable eating went hand in hand, and that its advice regarding plant-based versus animal-based foods was both science-based and consistent with sustainable diet guidelines published in several other countries (Lang 2014; Health Council of the Netherlands 2011; Monteiro et al. 2015; Livsmedelsverket 2015). Nonetheless, this advice provoked strong reactions in the media, in the record 29,000 public comments, and most noticeably in the US Congress, where meat industry–backed Republicans took unprecedented measures to keep this recommendation, and indeed any mention of sustainability, out of the DGA (Charles 2014; CSPI 2015). Ultimately the lawmakers got their way. The new guidelines, finally released in early 2016, say nothing about the environment impacts of diet (Health and Human Services, 2016).

For supporters of the DGAC recommendations, this outcome marked yet another triumph of industry lobbying over science-based nutrition policymaking (Lappé 2016; Katz 2016; Merrigan et al. 2015). While perhaps an accurate description of events in Congress, this interpretation overlooks the wide range of views about dietary sustainability expressed in the public comments on the DGAC report. It also downplays the many unanswered questions in the scientific literature on the subject, and neglects the other questions—more political, normative, and ultimately epistemological—raised by the increasingly international movement to incorporate environmental concerns into official dietary guidance (Lang 2014). *Which* concerns, for example, should be prioritized? How should likely tradeoffs

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between nutritional and environmental priorities be navigated (Garnett 2014)? Not least, what are legitimate sources of dietetic knowledge, once it is assumed that diet must sustain both humans and their earthly habitats?

DGAC's federal charter offers limited guidance on this last question, saying only that the committee must base its recommendations on "the preponderance" of current scientific and medical knowledge (Secretary of Health and Human Services 2013). On sustainability, it drew mostly from a relatively new body of research that models the aggregate farm-to-fork environmental impacts of different foods, food categories, and dietary patterns. This type of modeling generates the kind of quantitative, population-scale evidence that must inform all DGAC recommendations, and indeed all US government dietary guidance (DGAC 2015b).

While DGAC described the dietary sustainability modeling research as "state of the art," it also acknowledged certain limitations, including the complexities and uncertainties inherent in the models themselves. I examine some of those limitations. Unlike DGAC's Congressional detractors, however, my point is not that "the science isn't settled" and therefore nothing can be done (Hamblin 2015). Instead I want to call attention to the problem of looking to "the science" to support claims about the sustainability of different dietary patterns when it is far from clear what (or whose) knowledge that science should include.

As recent critical nutrition scholarship has shown (see the *Gastronomica* Fall 2014 special issue), to a certain extent this problem afflicts all modern dietary guidance. While the authority of mainstream nutritional science has never been absolute, today it faces challenges not only from other biomedical fields—where new research in endocrinology and epigenetics, for instance, questions long-assumed relationships between dietary choices and bodily health (Landecker 2013; Guthman and Mansfield 2012)—but also from high-profile proponents of alternative diets (Moore and Hoffmann 2014; Gunnarsson 2012).

Growing awareness of the magnitude, range, and variation of food's environmental impacts adds to those challenges. On one hand, by some accounts the many activities involved in producing food add up to "the single largest human impact on our finite planet" (Clay 2011: 287). On the other hand, given the different combinations of ecosystems, species, technologies, and practices that go into producing food (not to mention getting it onto the table), those activities play out in nearly infinite variety across the planet, and not always harmfully. Knowledge about those food-environment interactions is also widely dispersed both across the sciences (agronomy, hydrology, animal physiology, etc.) and highly localized within different places and communities of food production.

In short, the case for sustainable diet guidance has become clearer even as it has become less clear where that guidance should come from. This is one dimension of a *wicked problem*. Rittel and Webber originally coined this term to describe problems characterized by high levels of urgency, complexity, and uncertainty, and by sharp disagreements about their basic definitions, causes, and therefore the type and amount of information needed to address them (Rittel and Webber 1973). Wicked problems demand attention but defy solutions, in part because there is no way to prove what the best solutions would be.

Writing in the 1970s, Rittel and Webber attributed the wickedness of many modern policy problems to a combination of increasing social pluralism and diminishing faith in institutionalized expertise. More recent writing on environmental controversies makes clear that their wickedness owes not just to how different social groups and scientific communities value "nature" and evaluate risk but also, often, *where* they are located relative to the nature or risks in question (Farrell 2011; Balint 2011). In the even more recent debate over DGAC's sustainable diet recommendations, geography mattered at yet another level: many of the public comments referenced not just scientific evidence in one form or another, but also their own and their families' health and, in the case of food producers, the health of their land and livestock. By contrast, the modeling research that DGAC consulted is largely aspatial.

By definition, the epistemological divides characterizing wicked problems are not easily bridgeable. But asking how the different sides arrive at their respective knowledge claims—rather than assuming, like some recent analyses, that they derive automatically from partisan ideologies (i.e., Shellenberger and Nordhaus 2013; Shellenberger 2015)—offers at least a start. It is a first step toward "working well with wickedness," as Law (2014) puts it. My own analysis of the contrasting claims about dietary sustainability, made in the 2015 DGAC report and subsequent public comments, begins with a brief history of why and how the committee decided to address this new concern. I then show how, in complying with the norms and rules of federal science-based dietary guidance, it arrived at advice that was indeed science-based, but could also be easily and legitimately criticized. This was partly because the committee portrayed a shift toward plant-based dietary patterns as a simple "win-win," downplaying uncertainties and tradeoffs, and partly because it drew on evidence incommensurable with popular dietary and environmental knowledge.

Ecological Influences

In their far-reaching influence on federal food policies, "one-size-fits-all" guidance, and traditional focus on the nutrient

intakes of individual eaters, the Dietary Guidelines for Americans arguably epitomize all that is both "hegemonic" and reductionist about modern nutritional science (Hayes-Conroy and Hayes-Conroy 2013). Critical nutrition scholars have shown how the DGA have been influenced by industrial societies' need for a productive, efficiently fed workforce, and how it has in turn influenced what people—perhaps Americans especially—are taught to care about in food (Mudry 2009; Biltekoff 2014; Guthman 2011; Scrinis 2013). But the DGA are just one of the more visible late twentieth-century products of a field that, at least at certain historical moments, has seen considerable cross-fertilization with the environmental and social sciences. In the 1920s, research on how the growing problem of soil erosion might affect plant, livestock, and ultimately human nourishment spurred both exchanges among diverse scientific disciplines (agronomy, animal physiology, botany, biochemistry) and the rise of a "proto-environmentalist critique" among participating researchers (Orr 1929; Renner 2012). In the 1970s, widespread concerns about how to feed a growing population on a finite planet—a wicked problem if there ever was one—informed Columbia University nutritionist Joan Gussow's course on "nutritional ecology," which she described as "an examination of the biological, technical, social, scientific, and commercial matrices in which the production, processing, and consumption of food are embedded" (Gussow 1978: xiii). More a food systems approach than an inquiry into trophic flows, Gussow's ecological perspective later became the basis for her and Kate Clancy's now oft-cited "Dietary Guidelines for Sustainability" (Gussow and Clancy 1986), which buttressed prevailing ideas about healthful eating (not too much salt, sugar, fat, or cholesterol; adequate starch and fiber) with resource-conserving rationales for cutting back on meat (beef especially; see Gussow 1994), choosing less processed and packaged foods, and supporting local farms. Like much of Gussow's other writing, the "Guidelines" article also criticized the narrowness of nutrition and other food sciences. As she wrote in a 1997 essay titled "Can an Organic Twinkie Be Certified?," what made such a product even thinkable was "the limitations reductionist science has put on our ability to take account of things that matter" (Gussow 1997: 6).

By the time the 2015 DGAC began its work, Gussow and Clancy's ecological perspective informed a growing movement among professional nutritionists (Klein 2013). Clancy herself spoke at the committee's second public meeting, responding to questions posed by DGAC member Miriam Nelson and other members of a new subcommittee on sustainability. Nelson, a Tufts University nutrition professor and second-time DGAC member, previously led the committee's work on "food environments" (i.e., where people buy, eat, and otherwise encounter food) and this time saw an opportunity to address food's environmental impacts as well. Unlike five years prior, she said, there now appeared to be "enough evidence" on these impacts for DGAC to make credible science-based recommendations. After all, the dietary guidelines had always been concerned with food security, and in her presentation Clancy showed the many ways it could be threatened by the current American diet's contributions to (among other things) soil erosion, water pollution, aquifer depletion, biodiversity loss, and climate change (DGAC 2014). A shift toward plant-based diets—the same diets associated with lower risks of heart disease—could help mitigate those impacts. "Plant-based" did not necessarily mean no animal products, she emphasized, just less of them (and especially less beef).

The DGAC public meeting notes indicate that other committee members agreed with Nelson that the environmental impacts of diet deserved investigation. But they also pointed out that the committee was expected to make "evidence-based" recommendations. Where exactly would evidence of the most sustainable dietary patterns come from? Certainly not from randomized clinical trials, the so-called "gold standard" of biomedical evidence, nor from prospective cohort studies, the basis of much conventional dietary guidance (DGAC 2013: 123; see also Maki et al. 2014). Nelson acknowledged that they would need to identify the "right experts" to help identify the best available evidence (the committee later recruited two, one from Tufts and the other from Michigan State University), but that she expected they would find it in modeling studies. She also expected to find "alignment" between the goals of human and environmental health, for "wholesome foods are probably best for the planet, as well" (DGAC 2013: 119).

Overall, the DGAC meeting records and other accounts of the committee's deliberations[1] show that its members were open to "thinking beyond just individual behavior change," as Nelson put it (ibid.: 116). Members of the sustainability subcommittee in particular were asking questions not just about plant- versus animal-based foods, but also about how those foods are produced, with what inputs, and where. They were also asking about how to make the strongest case that Americans' ongoing food security depended, as Clancy said, on "ecological health" (DGAC 2013). In at least a tentative and partial sense, in other words, the 2015 DGAC adopted an ecological nutrition approach.

But even putting aside the likely political opposition—merely the creation of a subcommittee on sustainability sparked charges that DGAC's "green radicals" intended to force veganism and higher food prices on the American public

(Stier 2014; Telford 2014)—the committee members knew that the federal rules and norms of science-based dietary guidance effectively limited what they could say. They had to hope that their research confirmed that healthful and sustainable eating patterns did in fact align, because the former was their mandated priority. They had to keep their report "in scope," which meant avoiding policy terrain typically covered by other government documents such as the Farm Bill. They also had to be "very cautious," as one member later put it, to only make claims "which we felt were defensible in the literature and generalizable across the population and the landscape of the United States."[2] And before they said anything, they had to identify literature that would yield "generalizable" evidence.

Model Evidence? Nutrition Meets Life Cycle Assessment

This is a much more complicated conversation than people realize.

—US SECRETARY OF AGRICULTURE TOM VILSACK, MARCH 26, 2015 (BOTTEMILLER EVICH 2015).

Like all the dietary topics it addressed, DGAC began its research on sustainable diets with a basic question: "What is the relationship between population-level dietary patterns and food sustainability and related food security?" It also started with a basic definition of a sustainable diet, adopted from the Food and Agriculture Organization, as "a pattern of eating that promotes health and well-being and provides food security for the present population while sustaining human and natural resources for future generations" (DGAC 2015a: 1). With guidance from committee members (including its two environmental consultants), staff at the USDA's Nutrition Evidence Library (NEL) then conducted a systematic review and compiled an "evidence portfolio" of studies meeting federal standards for scientific "quality, objectivity, utility and integrity" (Nutrition Evidence Library, n.d.).

Most of the studies chosen for this portfolio analyzed the sustainability of different dietary patterns using life cycle assessment (LCA), a form of modeling that assesses the multiple cradle-to-grave environmental impacts of goods and services. While life cycle modeling dates back to the 1970s, only in the past several years have farm-to-fork studies of food and diet become more common (Mogensen et al. 2011). LCA was originally developed to analyze the resource and energy flows defining the "life" of manufactured goods, and to help industries produce those goods more efficiently. Similar to other fields that use mechanical analogies to conceptualize complex biological systems—or, as Joan Fujimura puts it, to "know nature" (Fujimura 2011)—LCA's engineering origins inform its modeling of food and other products of land and sea (Canals 2011). This means it captures some aspects of their ecological existence better than others.

I return shortly to LCA's strengths and weaknesses as an approach to assessing dietary sustainability. First, though, it is worth asking why it became *the* approach that most informed DGAC's sustainable diet recommendations. In part, the committee simply followed convention: existing national guidelines, such as those for Sweden and the Netherlands, also relied on LCA research (Livsmedelsverket 2015; Health Council of the Netherlands 2011). In part, the committee found recent research in this field especially abundant; its report noted that "several relevant studies" came out even after the NEL had finished compiling the evidence portfolio (DGAC 2015a). This abundance reflects high demand for information about different foods' farm-to-fork environmental impacts, on the part of policymakers (especially in Europe), nongovernmental organizations, and above all the food industry (Freidberg 2014). Food companies are especially interested in LCA's ability to help them identify resource-saving measures that will both cuts costs and demonstrate improved sustainability, at least in efficiency terms (as I discuss later, those measures can come with tradeoffs). As a field that has always depended on industry sponsorship (Freidberg 2015), LCA has responded to this interest, making "agro-food LCA" a booming subfield. Not least, DGAC turned to LCA-based studies on dietary sustainability because they yielded the *right kind* of evidence, compatible with mainstream nutritional science's own metrics, categories, and broader assumptions about the healthfulness of different dietary patterns.

Agro-food LCA consists of two broad types of studies. The first and more common type treats food like any other product, in that it quantifies how the estimated environmental impacts of specific units—a liter of milk, a kilo of salmon, a frozen dinner—compare across the food life cycle (i.e., production versus packaging) or according to different parameters (i.e., conventional versus organic, air-freighted versus locally trucked) (Ziegler et al. 2012; Schmidt Rivera, Espinoza Orias, and Azapagic 2014). Cumulatively, this literature finds that on-farm production usually accounts for most environmental impacts—not, as often assumed, transport or packaging (Weber and Matthews 2008; Mogensen et al. 2011). It also supports the DGAC claim that the impacts of animal-based foods tend to be higher than those for plant-based ones, at least according to common measures such as greenhouse gas (GHG) emissions, water use, and land use (Baroni et al. 2014; Pelletier et al. 2011; Scarborough et al. 2014; Nijdam, Rood, and Westhoek 2012). At the same time, though, this research finds significant variation between different plant- and animal-based foods, depending not

only on the plant or animal in question (corn versus oats, pig versus chicken) but also where, when, and how they are produced (Hospido 2009). It also finds tradeoffs are more the norm than the exception. Organic milk, for instance, appears to contribute more to global warming than conventional milk (due to the reduced yields per acre and animal) but less to other environmental problems, such as water pollution, pesticide drift, and phosphorus depletion (Cederberg and Mattsson 2000). Almonds may be notoriously water-intensive, but their carbon footprint is modest relative to, say, cheese (Kendall et al. 2015).

Overall, LCA has helped debunk assumptions about the environmental significance of "food miles," while drawing attention to less obvious yet often larger parts of food's footprint, such as emissions from fertilizer production (Avetisyan 2013; Gazulla 2010). But LCA's "big picture" perspective is in some ways a blurry one. Its lack of geographical specificity, for instance, owes both to the design of the models themselves and to practitioners' reliance on global or regional databases (rather than actual field sites) for much if not all of their data. A study comparing a hamburger versus a veggie burger can thus quantify the energy, resource use, and assorted emissions implicated in their respective farm-to-fork (or even landfill) lives, but it cannot show how those impacts affect, move through, and vary between specific places (Davis et al. 2009; Newell and Vos 2011). This means study results are approximate at best, depending on the modeling assumptions and data sources (Herrero 2011); it also means that LCA cannot assess products' inherently site-specific impacts on, say, biodiversity or water quality (van der Werf et al. 2014; Notarnicola et al. 2012). As it happens, some of the criticisms leveled at DGAC's recommendations about animal- versus plant-based foods invoked exactly these types of concerns.

A second type of agro-food LCA research builds off the first, but focuses on quantities of nourishment rather than individual foods. DGAC drew on several such studies, which it found especially useful for answering its basic question about the relationships between population-level dietary patterns and sustainability. This type of modeling in turn relies heavily on nutritional science for data, metrics, categories, and even co-authors, as most LCA practitioners are not themselves nutrition experts (see for example Heller, Keoleian, and Willett 2013). For example, some studies on dietary sustainability combine LCA and "nutrient profiling" models. The latter are algorithms used to rank foods according to their calculated nutritional quality, or density. Nutritionists have devised many such algorithms, ranging from a simple ratio of recommended daily allowance nutrients over calories (Sorenson et al. 1976) to more recent and complex formulas such as the Overall Nutritional Quality Index, which scores foods on the basis of how much they contain of sixteen good nutrients versus five presumably bad ones (saturated and trans-fats, sodium, sugar, and cholesterol) (Katz et al. 2009). Not surprisingly, nutritionists debate the assumptions underlying the different algorithms (Scarborough and Rayner 2014; Foltran et al. 2010; Townsend 2010). But within the emergent field of sustainable diet modeling, the quantified scores make it relatively straightforward to determine which foods and diets deliver the most nutrition with the least environmental impact. At the same time, they make clear how much the choice of model matters. A number of studies find that some of the most nutrient-dense foods, such as low-fat milk and yogurt, are also more emissions-intensive than sugary snacks (Drewnowski et al. 2015). Even fruits and vegetables appear to have large footprints relative to junk food if impacts are calculated per unit of caloric energy rather than per unit of weight (Vieux et al. 2013).

Several of the studies consulted by DGAC quantify and compare the overall environmental impacts of predetermined dietary patterns, i.e., vegan, Mediterranean, recommended US diet, average US diet (van Dooren et al. 2014; Sáez-Almendros et al. 2013; Hendrie et al. 2014; Meier and Christen 2012). Some went a step further and modeled diets "optimized" for health, environment, and cultural acceptability (Wilson et al. 2013; Hoolohan et al. 2013). These show how, for instance, British consumers could eat more healthfully and sustainably—again, according to certain metrics—without entirely foregoing meat, cheese, or canned peas (Macdiarmid et al. 2012; Thompson et al. 2012). According to one study they could also reduce deaths from cancer and heart disease (Scarborough et al. 2012). This type of research supported DGAC's basic claim that even a modest shift from animal- to plant-based foods would improve both the healthfulness and sustainability of the average American diet. It also fits with a broader shift in mainstream nutritional advice, away from warnings about specific nutrients and toward a "total diet approach" (Freeland-Graves, Nitzke, and Academy of Nutrition and Dietetics 2013). But the studies comprising DGAC's evidence base ultimately started from nutritional science's long-held assumptions about the nutrient content that makes certain prototypical diets, i.e., "Mediterranean style," apparently more healthful than the current American one (Sáez-Almendros et al. 2013). In their use of LCA, most of these studies also only considered GHG emissions and a handful of other aspatial environmental impacts, namely those that can be credibly modeled without data about specific environments (for an exception see Peters, Wilkins, and Fick 2007). Together, they generated the consistent evidence DGAC needed to show "compatibility . . . between favorable health and environmental outcomes," and to argue that a dietary pattern lower

in animal-based foods could deliver both (DGAC 2015a: 10). But the uncertain and often contingent nature of the studies' findings did not, in the committee's view, allow it to go beyond its basic plant/animal distinction, even though those same findings showed how much differences between species, production practices, and geographies matter. Nor could these studies speak to the counter-evidence, both dietary and environmental, put forward by critics of the committee's advice.

Popular Critics

DGAC's call for Americans to cut back on animal-based foods was far more controversial than any of its other recommendations, contributing to the record number of public comments (more than 29,000 versus around 1,000 in 2010). Both the livestock industry and NGOs supportive of the DGAC recommendation made their opinions known in Washington and through online petition campaigns (i.e., Meat Institute 2015; My Plate, My Planet 2015a); they also provided their supporters with templates for public comments, meaning many are identical. But the comments also make clear that opinions did not fall along a simple industry versus environmentalist/academic divide. Some of the criticisms of the DGAC sustainability recommendation, for instance, were also de facto critiques of industrial livestock production. These particular views and the types of evidence they invoke—some of it peer-reviewed research, some of it experiential, even embodied knowledge—help to illustrate the particular wickedness of sustainable diet guidance.

Three broad arguments run through these critical public comments. The first questions the committee's credibility, often in reference to its past advice. The second defends the healthfulness of diets high in animal-based foods (at least some of them), while the third focuses on the environmental benefits of livestock. The first two arguments in particular often overlap, and have been popularized by recent books such as *Good Calories, Bad Calories* (Taubes 2008), *Death by Food Pyramid* (Minger 2014), and especially *The Big Fat Surprise: Why Butter, Meat, and Cheese Belong in a Healthy Diet* (Teicholz 2014). All of these books blame rising rates of obesity and diabetes on the "shoddy science" behind official dietary guidance, and especially the guidance that led Americans to restrict saturated fat—and thus animal-based foods—in favor of processed carbohydrates. Ancel Keys's famous "Seven Countries" study of diet–heart disease relationships (Keys 1980) comes in for especially harsh criticism. Although the authors do not directly discuss dietary sustainability, their critique challenges the metrics of nutritional quality used in the LCA studies on this topic. These books have their own critics, of course, some of whom accuse them of relying on the same types of evidence they question: small, short-term, and otherwise unrepresentative clinical studies, and cohort studies that demonstrate association, not causation (Yoder 2015).

The ongoing debate between advocates of animal protein–centered, low-carb high-fat (LCHF) diets and supporters of DGAC's recommendations reflects the difficulty of "paradigmatic uncertainty" of nutritional science more generally (Sanabria and Yates-Doerr 2015), given the complexity of diet-health relationships and the practical and ethical difficulties of investigating them. Exactly how a particular way of eating impacts individual bodily health can no more be measured or verified than can its impact on global warming. At the same time, given this uncertainty, the debate testifies to the limits of scientific evidence and credentialed nutritional expertise as sources of credibility. Steven Shapin, among others, contrasts the scientific field's interest in population-scale evidence with popular diet writers' attention to particular individuals, usually including themselves (Shapin 2007; Penders 2014; Jauho 2014). While hardly a new way to sell diet books, authors' interweaving of personal redemption stories with scientific explanation has in recent years encouraged readers both to try alternative diets, many of them a variation on the LCHF theme, and to take seriously their own experience of those diets—regardless of what the official guidance says (Gunnarsson 2012; Huovila 2015). This emphasis on "dietetic individualism," Huovila and Saikkone (2015) contend, is not merely a rhetorical strategy but an *epistemic stance*, one that does not reject scientific evidence but (unlike the stance that mainstream nutrition has traditionally defended) also does not see it as the final authority (Maki et al. 2014; Moore and Hoffmann 2014).

In the public comments on the DGAC report, arguments against its endorsement of diets "higher in plant-based foods" (which, again, do not necessarily represent a majority) commonly invoke both scientific evidence and personal experience. As these examples show, in some cases the most important experience was abandoning the plant-heavy eating patterns recommended by the DGA.

> As a fifth generation rancher, a big fan of science-based research, and a very healthy marathon runner, Crossfitter, and adherent to a Paleo diet (lots of red meat), I do NOT support the Committee's recommendation to remove lean meats from the Dietary Guidelines. Science shows that Americans are fat because of overconsumption of carbohydrates, not fat and protein. (Comment ID# 23858)
>
> After adopting a paleo diet including lots of healthy saturated fats . . . my children's rashes and eczema left and have never returned, we all lost weight, got off medications, moods and behaviors improved. To this day

any time I eat grains I start to experience a return of body wide pain and swelling and my children have intense stomach pains and migraines. I'm so glad I left the suggested eating guidelines behind!! (Comment ID#8595)

In the 1990's, I put my entire family on the diet recommended by the US government dietary guidelines—a low-fat and low-meat diet. Several years later, both I and my daughters were all struggling with major health issues . . . I was diagnosed at the Mayo Clinic as suffering from fibromyalgia. I went to a fibromyalgia specialist in California, and he put me on a low-carb, high protein diet, similar to the Atkins diet. My body began to recover—and I lost weight! . . . My generation has been severely damaged by the bad diet advice from Ancel Keys which began in the 1950's. We Americans are less healthy than our ancestors, and certainly many times fatter! When will it stop? (Comment ID# 5283)

And while comments from industry organizations such as the Meat Institute stressed the "nutrient density" of all meat—red or white, processed or not—some individuals spoke only of the healthfulness of non-industrial animal products, i.e., free-range beef or raw milk:

As a farmer of 20 years, and a former vegetarian, and even vegan, I would like to state that my health and quality of life have improved tremendously since switching to a pastured-animal centered lifestyle of farming . . . I have more energy, better immunity, have lost weight, enjoy better digestion, and increased mental function than when I was a vegetarian. (Comment ID#4953)

For the past fifteen years I have purposely not followed U.S. Govt, [sic] dietary guidelines knowing that doing so would leave me lacking in essential nutrients. Not only that, I believe following the "Pyramid" or "Plate" would have caused me to gain weight and head me towards diabetes with its emphasis on starches and grains. Instead I have followed a Weston A Price Foundation–style diet, focusing on truly nutrient-dense, traditional foods including plenty of animal fats from pasture-raised livestock. (Comment ID #5124)

Not surprisingly, the DGAC report also generated comments from people who recounted how much their own health improved once they stopped eating animal products. While organizations such as My Plate, My Planet later counted these comments as proof of DGAC's broad public support (MyPlate, MyPlanet 2015b), for the committee's own purposes they mattered no more or less than the views of Paleo adherents. DGAC could accommodate the public's diverse and situated experiences of eating animal foods (or not) only after its population-level research demonstrated that "a variety of dietary patterns" (DGAC 2015a: 9), all relatively low in those foods, qualify as more healthful and sustainable than the current US diet.

Ethnographies and histories of dietary knowledge production abound with examples of expert practices and institutions that ignore, devalue, and often actively suppress popular understandings of healthful eating (Yates-Doerr 2012; Mol 2012; Kimura 2014; Mudry 2006; Biltekoff 2013). Indeed, with big enough power differentials between experts and eaters, dietary guidance arguably poses no wicked problem, insofar as the latter have little say in what they are fed or taught to value in food. My point, though, is not that DGAC's approach to producing its sustainable diet guidance was new or unusual (it was not, except in its consulting a body of modeling literature new to most of its members) but rather that including sustainability as a dietary concern adds more sources of urgency, uncertainty, and alternative knowledge. "Alternative" here means simply knowledge produced at scales and about concerns unaddressed by DGAC's own evidence base, namely the LCA modeling studies.

The urgency comes from the increasingly well-documented knowledge that food globally contributes significantly to climate change and other forms of environmental degradation which, if left unchecked, will eventually erode everybody's dietary choices, not to mention overall well-being (Springmann et al. 2016). Especially in wealthy and relatively well-fed countries, this is one obvious argument for encouraging people to eat less of the most environmentally impactful foods, whatever their nutritional virtues. And much research in and beyond LCA has established that animal products in general count among those foods, simply because animals must themselves consume either plants or other animals (Pimentel and Pimentel 2003; Smil 2013). Up to a point, the environmental case for DGAC's recommendations might seem more straightforward or at least less disputable than the health case.

Yet it was disputed, and not only by the livestock industry and its academic proponents. Indeed the beef industry's criticisms in particular were less compelling than many, in that they simply referred to industry-sponsored LCA research showing that its overall footprint, as defined by several indicators (GHG emissions, water, land use, solid waste, among others), had decreased by seven percent since 2005 (Oltjen et al. 2013).

Many of the public comments defend the sustainability of livestock on very different grounds. Rather than playing up overall efficiency improvements (which owe partly to the practices of "concentrated animal feeding operations" [CAFO] that are themselves controversial [Garnett, Röös, and Little 2015]) they focus on specific types of environments, as well as ecological processes and scales and concerns that LCA modeling does not capture and therefore cannot rebut. These comments point out that cattle can graze land unsuitable for crop production, converting grasses that humans cannot eat into protein they can. They also play up livestock's role in conserving habitats as well as livelihoods:

Here in the Great Plains, the most sustainable land use is grass for grazing . . . If diet is going to be about land use then saving the last of our

prairies has to be considered urgently, and recognize that keeping prairie alive means keeping cattle and bison on the land, and including their meat in our diet. For those who wish to do so, at least. There are so many issues involved in meat-eating, I get that, but . . . I think you should advocate eating red meat as a "green" choice for those who care about prairies. (Comment ID #2332)

Where I live in the Great Plains, land use for livestock grazing should be counted as a positive FOR red meat. Grasslands, or prairie, are the native habitat here. Your guidelines are considering environmental impacts of food production, so the loss of native prairie ought to be considered . . . Grazing by livestock is basically what is keeping the prairie alive today, both economically—as a viable alternative to crop farming—and ecologically, as the prairie is adapted to grazing . . . Somehow, your guidelines . . . need to include an exception for livestock grazing on the Great Plains. (Comment ID #23487)

As a livestock producer that uses cattle as a tool to provide the disturbance necessary to enhance the ecological sustainability of the millions of acres of grazing land in the west and sustain the social and economic viability of the rural communities that support the open space all Americans seek, I cannot support these dietary guidelines. (Comment ID #11935)

Other comments, many apparently submitted by producers of grass-fed livestock, refer to the climate benefits of their practices relative to CAFO production methods:

As ranchers and farmers who produce meat in a way that's humane for animals as well as healthy for people, the environment, and the economy, we were happy to see the consideration of sustainability in the 2015 USDA dietary guidelines . . . [but] the Dietary Guidelines Advisory Committee . . . ignores the substantial differences in meat production practices and makes the blanket recommendation to consume less red meat and dairy. This does a disservice to consumers and producers alike . . . The GHG emissions from grassfed and pastured animals are offset by the lessened air and water pollution from feedlots, the soil destruction from monocropped grain production used for animal feed, and the reduced need for petrochemical inputs . . . we respectfully request that the Dietary Guidelines Advisory Committee examine those benefits and incorporate them into their final recommendations for the 2015 USDA Dietary Guidelines. (Comment ID #23996)

The manure and grazing activity of the pastured animals is of supreme importance to the fertility and productivity of our farm. I don't believe that a plant-based diet is necessarily best for the environment . . . Production of vegetables and grains is very fossil fuel dependent; pasturing animals not only sequesters carbon, but frees up land to produce food without oil inputs . . . And of course, this is true only of pastured animal products, raised and harvested responsibly . . . None of what I have said above applies to CAFO animal production. (Comment ID #4953)

That prairie ecosystems need grazing is not in question; neither is their capacity to store carbon. But questions about how *many* animals can sustainably graze different range and pasturelands, how *much* carbon those lands can store, and especially how the environmental footprints of the different livestock production methods compare—these remain unresolved and hotly argued. Indeed, the controversies surrounding certain alternative rangeland management practices (in particular the "Holistic Management" approach advocated by Allan Savory) resemble those around LCHF diets both in their fervor and in the incommensurability of scientific versus experiential evidence (Briske et al. 2013; Teague 2014; Briske et al. 2011). The debate about the overall environmental merits of grass-fed versus CAFO production methods, meanwhile, reflects not only highly incomplete knowledge but also (and more fundamentally) different normative views on tradeoffs. On one hand, many LCA studies find that CAFO meat, dairy, and eggs are less carbon and resource-intensive simply because they come from animals who live short and compact lives relative to their free-ranging peers (Pelletier, Pirog, and Rasmussen 2010; Capper 2011; Leinonen et al. 2012). On the other hand, such efficiency has often come at the expense of animal and worker welfare, as well as the livability of local environments (Garnett, Röös, and Little 2015; Pew Commission 2008; Thu 2002). In short, the question of sustainable meat (and eggs and dairy, for that matter) runs into "wickedness all the way down" (Law 2014).

Losing the Win-Wins

"One size cannot fit all in a wicked world," Law (2014: 13) observes, whether in policy or science. Critics of the Dietary Guidelines for Americans have made essentially the same point (Broad and Hite 2014). Yet in attending to bodily, cultural, and ecological diversity we should not forget how gravely all this diversity is threatened by climate change and other forms of environmental degradation, to which food production alone (not even counting the rest of its farm-to-landfill life) contributes significantly. The magnitude of this threat underscores both the insufficiency and need for broad-scale dietary change—especially in industrialized countries—and for guidelines that could help to drive it. But what should they say? To answer this question with a prescriptive list would invalidate this essay's entire argument. To punt and say the answer lies in further research would do the same, because more evidence on the sustainability of different dietary patterns (while needed) will not make its translation into guidance any less a wicked problem.

The controversy surrounding the 2015 DGAC report does, however, suggest two possible ways that this problem could be at least partially tamed. Debates about what count as healthful and sustainable dietary patterns will not likely go away, but they might be rendered more productive. The first way would be for the expert bodies such as DGAC to more openly acknowledge uncertainties, tradeoffs, and disagreements. To

assert that *the* science has spoken is to disavow not just many unresolved scientific questions (nutritional, biomedical, and ecological) but also other ways and scales of knowing about food's relationships to bodily and environmental health. Such disavowal obviously does not deflect accusations of bias and incompetence; if anything, the reverse. By contrast, admitting to what is unsure, contested, and likely costly—what Rayner (2012) calls "uncomfortable knowledge"—could help preempt claims that nothing be said or done about dietary sustainability until all doubts are resolved (McGoey 2012).

Second and related, sustainable diet guidance could acknowledge the obvious point that food's production—where and how, with what inputs, emissions, and exposures—matters. LCA and ecological nutrition have in different yet complementary ways shown that both the healthfulness and sustainability of any dietary pattern depends to some extent on these upstream concerns, just as they do on the plant or animal origins of specific foods. In the United States, legislative and political constraints have traditionally kept references to food production out of the official dietary guidelines. The 2015 DGAC report mentioned the need for less impactful agricultural practices, but otherwise followed in this tradition. By contrast, Brazil's and Sweden's new dietary guidelines discuss the environmental merits of specific plant- and animal-based foods (root vegetables versus greens, chicken versus beef) as well as of specific production methods and landscapes (Ministry of Health of Brazil 2014; Monteiro et al. 2015; Livsmedelsverket 2015). In light of the polarized state of US food politics, one might argue that this approach to dietary guidance would open up a Pandora's box of controversies over everything from genetically modified organisms to animal welfare. But one could also point to ample evidence—in the public response to the DGAC report, among other places—that this box was opened a while ago, and that no efforts at dietary guidance can entirely evade its contents.

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NOTES

1. DGAC held seven public meetings in 2013 and 2014; all were available as webcasts and some were transcribed. The proceedings of the subcommittee meetings were not made public, but subcommittee members reported on them at the larger DGAC meetings (see http://health.gov/dietarguidelines/2015/meetings.asp). I also interviewed members of DGAC's subcommittee on sustainability.
2. Interview conducted July 20, 2015.

REFERENCES

Avetisyan, Misak, Thomas Hertel, and Gregory Sampson. 2014. "Is Local Food More Environmentally Friendly? The GHG Emissions Impacts of Consuming Imported Versus Domestically Produced Food." *Environmental and Resource Economics* 58(3): 415–462.

Balint, Peter J., Ronald E Stewart, and Anand Desai. 2011. *Wicked Environmental Problems: Managing Uncertainty and Conflict*. Washington, DC: Island Press.

Baroni, Luciana, Marina Berati, Maurizio Candilera, and Massimo Tettamanti. 2014. "Total Environmental Impact of Three Main Dietary Patterns in Relation to the Content of Animal and Plant Food." *Foods* 3(3): 443–60.

Biltekoff, Charlotte. 2013. *Eating Right in America: The Cultural Politics of Food and Health*, Durham, NC: Duke University Press.

Bottemiller Evich, H. B. 2015. "Vilsack: DGA Is 'Complicated and Science Conflicting." [Morning Agriculture]. www.politico.com/tipsheets/morning-agriculture/2015/03/team-flotus-maps-out-future-obesity-efforts-vote-a-rama-leaves-food-ag-amendments-on-the-table-slaughter-advocates-disappointed-by-potus-antibiotics-plan-212543.

Briske, David D., Nathan F. Sayre, L. Huntsinger, M. Fernandez-Gimenez, B. Budd, and J. D. Derner. 2011. "Origin, Persistence, and Resolution of the Rotational Grazing Debate: Integrating Human Dimensions into Rangeland Research." *Rangeland Ecology and Management* 64(4): 325–34.

Briske, David D., Brandon T. Bestelmeyer, Joel R. Brown, Samuel D. Fuhlendorf, and H. Wayne Polley. 2013. "The Savory Method Cannot Green Deserts or Reverse Climate Change." *Rangelands* 35(5): 72–74.

Broad, Garrett, and Adele Hite. 2014. "Nutrition Troubles." *Gastronomica: The Journal of Critical Food Studies* 14(3): 5–16.

Canals, Llorenç Milà i, Adisa Azapagic, Gabor Doka, Donna Jefferies, Henry King, Christopher Mutel, Thomas Nemecek, et al. 2011. Approaches for Addressing Life Cycle Assessment Data Gaps for Bio-based Products. *Journal of Industrial Ecology* 15(5): 707–725.

Capper, J. L. 2011. "Replacing Rose-tinted Spectacles with a High-Powered Microscope: The Historical Versus Modern Carbon Footprint of Animal Agriculture." *Animal Frontiers* 1(1): 26–32.

Cederberg, Christel and B Mattsson. 2000. Life Cycle Assessment of Milk Production—A Comparison of Conventional and Organic Farming. *Journal of Cleaner Production* 8(1): 49–60.

Charles, D. 2014. "Congress to Nutritionists: Don't Talk about the Environment." *The Salt (NPR)*. www.npr.org/blogs/thesalt/2014/12/15/370427441/congress-to-nutritionists-dont-talk-about-the-environment.

Clay, J. 2011. "Freeze the Footprint of Food." *Nature* 475(7356): 287–89.

CSPI (Center for Science in the Public Interest). 2015. "Congressional Catering: How Big Food and Agricultural Special Interests Wield Influence in Congress and Undermine Public Health." https://cspinet.org/new/pdf/riders-dga-campaign-analysis-report.pdf.

Davis, J., Ulf Sonesson, D. Baumgartner, and Thomas Nemecek. 2009. "Environmental Impact of Four Meals with Different Protein Sources: Case Studies in Spain and Sweden." *Food Research International* 43(7): 1874–84.

DGAC. 2013. "Meeting 1, Day 2 Transcript." Dietary Guidelines Advisory Committee. http://health.gov/dietaryguidelines/2015-BINDER/meeting1/docs/Transcript-Day-2.pdf.

———. 2014. "Meeting 2 Summary." Dietary Guidelines Advisory Committee. http://health.gov/dietaryguidelines/2015-BINDER/meeting2/docs/Minutes_DGAC_Mtg_2.pdf.

———. 2015a. "Part D. Chapter 5: Food Sustainability and Safety." In *Scientific Report of the 2015 Dietary Guidelines Advisory*

Committee. Washington, DC: Department of Health and Human Services.
———. 2015b. "Appendix E-2.37: Dietary Patterns and Sustainability Evidence Portfolio." In *Scientific Report of the 2015 Dietary Guidelines Advisory Committee*. Washington, DC. www.health.gov/dietaryguidelines/2015-scientific-report/14-appendix-E2/e2-37.as.
Drewnowski, Adam, Colin D. Rehm, Agnes Martin, Eric O. Verger, Marc Voinnesson, and Philippe Imbert. 2015. "Energy and Nutrient Density of Foods in Relation to Their Carbon Footprint." *American Journal of Clinical Nutrition* 101(1): 184–91.
Farrell, Katharine N. 2011. "Snow White and the Wicked Problems of the West: A Look at the Lines Between Empirical Description and Normative Prescription." *Science, Technology, & Human Values* 36(3): 334–361.
Foltran, F., E. Verduci, M. Ghidina, C. Campoy, K-D Jany, K. Widhalm, G. Biasucci, C. Vogele, G. Halpern, and D. Gregori. 2010. "Nutritional Profiles in a Public Health Perspective: A Critical Review." *Journal of International Medical Research* 38(2): 318–85.
Freeland-Graves, Jeanne H., Susan Nitzke, and Academy of Nutrition and Dietetics. 2013. "Position of the Academy of Nutrition and Dietetics: Total Diet Approach to Healthy Eating." *Journal of the Academy of Nutrition and Dietetics* 113(2): 307–17.
Freidberg, Susanne. 2014. "Footprint Technopolitics." *Geoforum* 55: 178–89.
———. 2015. "It's Complicated: Corporate Sustainability and the Uneasiness of Life Cycle Assessment." *Science as Culture* 24(2): 157–82.
Fujimura, Joan H. 2011. "Technobiological Imaginaries: How Do Systems Biologists Know Nature?" in *Knowing Nature: Conversations at the Intersection of Political Ecology and Science Studies*, edited by M. J. Goldman, P. Nadasdy, and M.D. Turner, 65–80. Durham, NC: Duke University Press.
Garnett, Tara. 2014. "What Is a Sustainable Healthy Diet?" Discussion Paper. Food Climate Research Network. www.fcrn.org.uk/fcrn/publications/fcrn-discussion-paper-what-sustainable-healthy-diet.
———, Elin Röös, and David Little. 2015. "Lean, Green, Mean, Obscene . . . ? What Is Efficiency? and Is It Sustainable?" Discussion Paper. Food Climate Research Network. www.fcrn.org.uk/fcrn-publications/discussion-papers/lean-green-mean-obscene.
Gazulla, Cristina, Marco Raugei, and Pere Fullana-i-Palmer. 2010. "Taking A Life Cycle Look at Crianza Wine Production in Spain: Where Are the Bottlenecks?" *The International Journal of Life Cycle Assessment* 15(4): 330–337.
Gunnarsson, Andreas and Mark Elam. 2012. "Food Fight! The Swedish Low-Carb/High Fat (LCHF) Movement and the Turning of Science Popularisation Against the Scientists." *Science As Culture* 21(3): 315–334.
Gussow, Joan Dye. 1978. *The Feeding Web: Issues in Nutritional Ecology*. Palo Alto, CA: Bull (Hawthorn Books).
———. 1997. "Can an Organic Twinkie Be Certified?" In *For All Generations: Making World Agriculture More Sustainable*, ed. S. G. Chaplowe and J. P. Madden, 143–53. Glendale, CA: OM.
———, and Katherine L Clancy. 1986. "Dietary Guidelines for Sustainability." *Journal of Nutrition Education* 18(1): 1–5.
Guthman, Julie. 2011. *Weighing In: Obesity, Food Justice, and the Limits of Capitalism*, Berkeley: University of California Press.
———, and Becky Mansfield. 2012. "The Implications of Environmental Epigenetics: A New Direction for Geographic Inquiry on Health, Space, and Nature-Society Relations." *Progress in Human Geography* 37(4): 484–502.
Hamblin, James. 2015. "Who Controls Diet Guidelines? Industry." *The Atlantic*, October 8.
Hayes-Conroy, Allison, and Jessica Hayes-Conroy. 2013. *Doing Nutrition Differently: Critical Approaches to Diet and Dietary Intervention*. Farnham, UK: Ashgate.
Health and Human Services. 2016. *2015–2020 Dietary Guidelines*. Washington, DC. http://health.gov/dietaryguidelines/2015/guidelines/.
Health Council of the Netherlands. 2011. *Guidelines for a Healthy Diet: The Ecological Perspective*. www.gezondheidsraad.nl/sites/default/files/201108E.pdf.
Heller, Martin C., Gregory A. Keoleian, and Walter C .Willett. 2013. "Toward a Life Cycle-Based, Diet-Level Framework for Food Environmental Impact and Nutritional Quality Assessment: A Critical Review." *Environmental Science and Technology* 47(22): 12632–47.
Hendrie, Gilly A., Brad G. Ridoutt, Thomas O. Wiedmann, and Manny Noakes. 2014. "Greenhouse Gas Emissions and the Australian Diet: Comparing Dietary Recommendations with Average Intakes." *Nutrients* 6(1): 289–303.
Herrero, M, P Gerber, T Vellinga, T Garnett, A Leip, C Opio, HJ Westhoek, et al. 2011. "Livestock and Greenhouse Gas Emissions: The Importance of Getting the Numbers Right." *Animal Feed Science and Technology* 166-167:779–782.
Hoolohan, C., M. Berners-Lee, J. McKinstry-West, and C. N. Hewitt. 2013. "Mitigating the Greenhouse Gas Emissions Embodied in Food through Realistic Consumer Choices." *Energy Policy* 63: 1065–74.
Hospido, A., Milà I Canals, L.M.I.C.A.L., Mclaren, S., Truninger, M., Edwards-Jones, G. & Clift, R. 2009. "The Role of Seasonality in Lettuce Consumption: A Case Study of Environmental and Social Aspects." *The International Journal of Life Cycle Assessment*, 14(5): 381–91.
Huovila, Janne and Sampsa Saikkonen. 2015. "Establishing Credibility, Constructing Understanding: The Epistemic Struggle Over Healthy Eating in The Finnish Dietetic Blogosphere." *Health*, doi:10.1177/1363459315595849.
Jauho, Mikko. 2014. "The Social Construction Of Competence: Conceptions Of Science and Expertise Among Proponents of the Low-Carbohydrate High-Fat Diet in Finland." *Public Understandings of Science*. doi:10.1177/0963662514558167.
Katz, David. 2016. "2015 Dietary Guidelines: A Plate Full of Politics." *Huffington Post*, January 7. www.huffingtonpost.com/david-katz-md/2015-dietary-guidelines-a_b_8930098.html.
———, Valentine Y. Njike, Zubaida Faridi, Lauren Q. Rhee, Rebecca S. Reeves, David J. A. Jenkins, and Keith T. Ayoob. 2009. "The Stratification of Foods on the Basis of Overall Nutritional Quality: The Overall Nutritional Quality Index." *American Journal of Health Promotion* 24(2): 133–43.
Kendall, Alissa, Elias Marvinney, Sonja Brodt, and Weiyuan Zhu. 2015. "Life Cycle–based Assessment of Energy Use and Greenhouse Gas Emissions in Almond Production, Part I: Analytical Framework and Baseline Results." *Journal of Industrial Ecology* 19(6): 1008–1018.
Keys, Ancel. 1980. *Seven Countries: A Multivariate Analysis of Death and Coronary Heart Disease*. Cambridge, MA: Harvard University Press.
Kimura, Aya H., Charlotte Biltekoff, Jessica Mudry, and Jessica Hayes-Conroy. 2014. "Nutrition as a Project." *Gastronomica: The Journal of Critical Food Studies*. 14(3): 34–45.
Klein, K. C. 2013. "Ecological Nutrition: Redefining Healthy Food in Health Care." PhD dissertation, University of California, Berkeley.
Landecker, Hannah. 2013. "Postindustrial Metabolism: Fat Knowledge." *Public Culture* 25(371): 495–522.

Lang, Tim. 2014. "Sustainable Diets: Hairshirts or a Better Food Future?" *Development* 57(2): 240–56.
Lappé, Anna. 2016. "Lobbyists Distort Our Idea of a Healthy Diet." *Al Jazeera America*, January 21.
Law, John. 2014. "Working Well with Wickedness." *CRESC Working Paper*, no. 135.
Leinonen, I., A. G. Williams, J. Wiseman, J. Guy, and I. Kyriazakis. 2012. "Predicting the Environmental Impacts of Chicken Systems in the United Kingdom through a Life Cycle Assessment: Egg Production Systems." *Poultry Science* 91(1): 26–40.
Livsmedelsverket. 2015. *Find Your Way: To Eat Greener, Not Too Much and Be Active*. Livsmedelsverket. www.livsmedelsverket.se/globalassets/english/food-habits-health-environment/dietary-guidelines/kostraden-eng-a4-utskriftversion.pdf?id=8199.
Macdiarmid, Jennie I., Janet Kyle, Graham W. Horgan, Jennifer Loe, Claire Fyfe, Alexandra Johnstone, and Geraldine McNeill. 2012. "Sustainable Diets for the Future: Can We Contribute to Reducing Greenhouse Gas Emissions by Eating a Healthy Diet?" *American Journal of Clinical Nutrition* 96(3): 632–39.
Maki, Kevin C, Joanne L Slavin, Tia M Rains, and Penny M Kris-Etherton. 2014. "Limitations of Observational Evidence: Implications for Evidence-based Dietary Recommendations." *Advances in Nutrition* 5(1): 7–15.
McGoey, Linsey. 2012. "Strategic Unknowns: Towards a Sociology of Ignorance." *Economy and Society* 41(1): 1–16.
Meat Institute. 2015. "Petition to Tom Vilsack, Sylvia Burwell: Hands Off My Hot Dog: Inject Common Sense in 2015 Dietary Guidelines." *Change.org*. www.change.org/p/tom-vilsack-sylvia-burwell-hands-off-my-hot-dog-inject-common-sense-in-2015-dietary-guidelines.
Meier, Toni, and Olaf Christen. 2012. "Environmental Impacts of Dietary Recommendations and Dietary Styles: Germany as an Example." *Environmental Science and Technology* 47(2): 877–88.
Merrigan, Kathleen, Timothy Griffin, Parke Wilde, Kimberly Robien, Jeanne Goldberg, and William Dietz. 2015. "Designing a Sustainable Diet." *Science* 350(6257): 165–66.
Minger, Denise. 2014. *Death by Food Pyramid: How Shoddy Science, Sketchy Politics and Shady Special Interests Have Ruined Our Health*. New York: Primal Nutrition.
Ministry of Health of Brazil. 2014. *Dietary Guidelines for the Brazilian Population*. Brasilia: Ministry of Health of Brasil.
Mogensen, Lisbeth, John E. Hermansen, Niels Halberg, Randi Dalgaard, Jan Kees Vis, and B. Gail Smith. 2011. "Life Cycle Assessment across the Food Supply Chain." In *Sustainability in the Food Industry*, ed. Cheryl Baldwin. Ames, IA: Wiley-Blackwell.
Mol, Annemarie. 2012. "Mind Your Plate! The Ontonorms of Dutch Dieting." *Social Studies of Science* 43(3): 379–396.
Monteiro, Carlos Augusto, Geoffrey Cannon, Jean-Claude Moubarac, Ana Paula Bortoletto Martins, Carla Adriano Martins, Josefa Garzillo, Daniela Silva Canella, et al. 2015. "Dietary Guidelines to Nourish Humanity and the Planet in the Twenty-first Century: A Blueprint from Brazil." *Public Health Nutrition* 18(13): 1–12.
Moore, Kelly, and Matthew C Hoffmann. 2014. "The Tip of the Day: Field Theory and Alternative Nutrition in the US." In *Fields of Knowledge: Science, Politics and Publics in the Neoliberal Age*, ed. Scott Frickel and David J. Hess, 223–58. Bingley, UK: Emerald Group.
Mudry, Jessica J. 2009. *Measured Meals: Nutrition in America*, Albany, NY: SUNY Press.
——. 2006. "Quantifying an American Eater: Early USDA Food Guidance, and a Language of Numbers." *Food, Culture and Society* 9(1): 49–67.
My Plate, My Planet. 2015a. "Food for a Sustainable Nation: An Open Letter to Secretary of Health and Human Services Sylvia Mathews Burwell and Secretary of Agriculture Tom Vilsack." www.myplatemyplanet.org/.
——. 2015b. "The Dietary Guidelines Advisory Committee Report: Support for Sustainability in the Public Comments." www.myplatemyplanet.org/downloads/2_Comments%20Analysis_Final.pdf.
Newell, J. P., and R. O. Vos. 2011. "Papering over Space and Place: Product Carbon Footprint Modeling in the Global Paper Industry." *Annals of the Association of American Geographers* 101 (4): 730–41.
Nijdam, Durk, Trudy Rood, and Henk Westhoek. 2012. "The Price of Protein: Review of Land Use and Carbon Footprints from Life Cycle Assessments of Animal Food Products and Their Substitutes." *Food Policy* 37(6): 760–70.
Notarnicola, Bruno, Kiyotada Hayashi, Mary Ann Curran, and Donald Huisingh. 2012. "Progress in Working towards a More Sustainable Agri-food Industry." *Journal of Cleaner Production* 28: 1–8.
Nutrition Evidence Library. n.d. *2015 Dietary Guidelines Advisory Committee Nutrition Evidence Library Methodology*. www.nel.gov/topic.cfm?cat=338.
Oltjen, James W., Ermias Kebreab, Hélène Lapierre, K. R. Stackhouse-Lawson, J. O. Reagan, B. J. Isenberg, E. J. Pollak, et al. 2013. "Environmental, Social, and Economic Footprints of Current and Past Beef Production Systems." In *Energy and Protein Metabolism and Nutrition in Sustainable Animal Production*. EEAP Publication no. 134.
Orr, J. B. 1929. *Minerals in Pastures*. London: HK Lewis.
Pelletier, Nathan, Rich Pirog, and Rebecca Rasmussen. 2010. "Comparative Life Cycle Environmental Impacts of Three Beef Production Strategies in the Upper Midwestern United States." *Agricultural Systems* 103(6): 380–89.
Pelletier, Nathan, Eric Audsley, Sonja Brodt, Tara Garnett, Patrik Henriksson, Alissa Kendall, Klaas Jan Kramer, David Murphy, Thomas Nemecek, and Max Troell. 2011. "Energy Intensity of Agriculture and Food Systems." *Annual Review of Environment and Resources* 36(1): 223–46.
Pimentel, David, and Marcia Pimentel. 2003. "Sustainability of Meat-based and Plant-based Diets and the Environment." *The American Journal of Clinical Nutrition* 78(3): 660S–663S.
Penders, Bart. 2014. "Mythbusters: Credibilising Strategies in Popular Nutrition Books by Academics." *Public Understanding of Science* 23(8): 903–910.
Peters, Christian, J. L. Wilkins, and G. W. Fick. 2007. "Testing a Complete-Diet Model for Estimating the Land Resource Requirements of Food Consumption and Agricultural Carrying Capacity: The New York State Example." *Renewable Agriculture and Food Systems* 22(2): 145–53.
Pew Commission. 2008. *Putting Meat on the Table: Industrial Farm Animal Production in America*. Baltimore, MD: Johns Hopkins Bloomberg School of Public Health.
Rayner, Steve. 2012. "Uncomfortable Knowledge: The Social Construction of Ignorance in Science and Environmental Policy Discourses." *Economy and Society* 41(1): 107–25.
Renner, Martin. 2012. "Conservative Nutrition: The Industrial Food Supply and Its Critics, 1915–1985." PhD dissertation History, University of California, Santa Cruz.
Rittel, Horst W. J., and Melvin M. Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4(2): 155–69.
Sáez-Almendros, Sara, Biel Obrador, Anna Bach-Faig, and Lluis Serra-Majem. 2013. "Environmental Footprints of Mediterranean versus Western Dietary Patterns: Beyond the Health Benefits of the Mediterranean Diet." *Environmental Health* 12: 118.
Sanabria, Emilia and Emily Yates-Doerr. 2015. "Alimentary Uncertainties: From Contested Evidence to Policy." *BioSocieties* 10(2): 117–124.

Scarborough, P., S. Allender, D. Clarke, K. Wickramasinghe, and M. Rayner. 2012. "Modelling the Health Impact of Environmentally Sustainable Dietary Scenarios in the UK." *European Journal of Clinical Nutrition* 66(6): 710–15.
Scarborough, Peter, Paul N. Appleby, Anja Mizdrak, Adam D. M. Briggs, Ruth C. Travis, Kathryn E. Bradbury, and Timothy J. Key. 2014. "Dietary Greenhouse Gas Emissions of Meat-Eaters, Fish-Eaters, Vegetarians and Vegans in the UK." *Climatic Change* 125(2): 179–92.
Scarborough, Peter, and Mike Rayner. 2014. "When Nutrient Profiling Can (and Cannot) Be Useful." *Public Health Nutrition* 17(12): 2637–40.
Schmidt Rivera, Ximena C., Namy Espinoza Orias, and Adisa Azapagic. 2014. "Life Cycle Environmental Impacts of Convenience Food: Comparison of Ready and Home-Made Meals." *Journal of Cleaner Production* 73: 294–309.
Scrinis, G. 2013. *Nutritionism: The Science and Politics of Dietary Advice*. New York: Columbia University Press.
Secretary of Health and Human Services. 2013. *Charter: 2015 Dietary Guidelines Advisory Committee*. Washington, DC: HHS. http://health.gov/dietaryguidelines/dgac2015-charter-final.pdf.
Shapin, Steven. 2007. "Expertise, Common Sense, and the Atkins diet." In *Public Science in Liberal Democracy*. Ed. J Porter and W B Phillips, 174–193. Toronto: University of Toronto Press.
Shellenberger, Michael. 2015. "Wicked Fat: Harvard Historian of Science Steven Shapin on the Nutrition Wars." *Breakthrough Journal*. http://thebreakthrough.org/index.php/issues/food-and-farming/wicked-fat.
——, and Ted Nordhaus. 2013. "Wicked Polarization: How Prosperity, Democracy and Experts Divided America." *Breakthrough Journal*. http://thebreakthrough.org/index.php/journal/past-issues/issue-3/wicked-polarization.
Smil, Vaclav. 2013. *Should We Eat Meat? Evolution and Consequences of Modern Carnivory*. New York: Wiley.
Sorenson, Anne W., Bonita W. Wyse, A. J. Wittwer, and R. Gaurth Hansen. 1976. "An Index of Nutritional Quality for a Balanced Diet: New Help for an Old Problem." *Journal of the American Dietetic Association* 68(3): 236–42.
Springmann, M., Mason-D'Croz, D., Robinson, S., Garnett, T., Godfray, H. C. J., Gollin, D., et al. 2016. "Global and Regional Health Effects of Future Food Production under Climate Change: A Modelling Study." *Lancet, Online First*, March 2.
Stier, Jeff. 2014. "Obama Administration Pollutes Guidelines for Healthy Eating with Unhealthy Ideologies." *Washington Examiner*, March 9.
Taubes, Gary. 2008. *Good Calories, Bad Calories: Fats, Carbs, and the Controversial Science of Diet and Health*. New York: Anchor Books.
Teague, Richard. 2014. "Deficiencies in the Briske et al. Rebuttal of the Savory Method." *Rangelands* 36(1): 37–38.
Teicholz, Nina. 2014. *The Big Fat Surprise: Why Butter, Meat, and Cheese Belong in a Healthy Diet*. New York: Simon and Schuster.
Telford, E. 2014. "Pyramid Scheme Meet the 'GreenÌ Radicals Who Want to Plan Your Menu." Capital Research Center, September 23. http://capitalresearch.org/wp-content/uploads/2014/09/GW1409-final-for-posting-140827.pdf.
Thompson, S., Gower, R., Darmon, N., Vieux, F., Murphy-Bokern, D., and Maillot, M. 2012. *A Balance of Healthy and Sustainable Food Choices for France, Spain and Sweden*. World Wide Fund for Nature (WWF).
Thu, Kendall M. 2002. "Public Health Concerns for Neighbors of Large-Scale Swine Production Operations." *Journal of Agricultural Safety and Health* 8(2): 175–84.
Townsend, Marilyn S. 2010. "Where Is the Science? What Will It Take to Show that Nutrient Profiling Systems Work?" *American Journal of Clinical Nutrition* 91(4): 1109S–15S.
van der Werf, Hayo M.G., Tara Garnett, Michael S. Corson, Kiyotada Hayashi, Donald Huisingh, and Christel Cederberg. 2014. "Towards Eco-efficient Agriculture and Food Systems: Theory, Praxis and Future Challenges." *Journal of Cleaner Production* 73: 1–9.
van Dooren, C., Mari Marinussen, Hans Blonk, Harry Aiking, and Pier Vellinga. 2014. "Exploring Dietary Guidelines Based on Ecological and Nutritional Values: A Comparison of Six Dietary Patterns." *Food Policy* 44: 36–46.
Vieux, Florent, Louis-Georges Soler, Djilali Touazi, and Nicole Darmon. 2013. "High Nutritional Quality Is Not Associated with Low Greenhouse Gas Emissions in Self-Selected Diets of French Adults." *American Journal of Clinical Nutrition* 97(3): 569–83.
Weber, Christopher L., and H. S. Matthews. 2008. "Food-Miles and the Relative Climate Impacts of Food Choices in the United States." *Environmental Science and Technology* 42(10): 3508–13.
Wilson, Nick, Nhung Nghiem, Cliona Ni Mhurchu, Helen Eyles, Michael G. Baker, and Tony Blakely. 2013. "Foods and Dietary Patterns that Are Healthy, Low-Cost, and Environmentally Sustainable: A Case Study of Optimization Modeling for New Zealand." *PLoS One* 8(3): e59648.
Yates-Doerr, E. 2012. "The Opacity of Reduction: Nutritional Black-boxing and the Meanings of Nourishment." *Food, Culture and Society* 15(2): 293–313.
Yoder, Seth. "Food and Nutrition." http://sethyoder.com/writing/food-and-nutrition/
Ziegler, Friederike, Ulf Winther, Erik Skontorp Hognes, Andreas Emanuelsson, Veronica Sund, and Harald Ellingsen. 2012. "The Carbon Footprint of Norwegian Seafood Products on the Global Seafood Market." *Journal of Industrial Ecology* 17(1): 103–16.