Comment by:

Patrick J. Michaels and Paul C. Knappenberger
Center for the Study of Science
Cato Institute
Washington, DC

on the

Scientific Report of the 2015 Dietary Guidelines Advisory Committee

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Comment:

Summary

There are really only two reasons to discuss greenhouse gas emissions (primarily carbon dioxide) in the context of dietary guidelines in the U.S., and yet the USDA and HHS did neither in their *Scientific Report* of the 2015 Dietary Guidelines Advisory Committee (DGAC).

The first reason would be to discuss how the rising atmospheric concentration of CO_2—a result primarily of the burning of fossil fuels to produce energy—is a growing benefit to plant life. This is an appropriate discussion in a dietary context as atmospheric CO_2 is a fertilizer that promotes healthier, more productive plants, including crops used directly as food for humans or indirectly as animal feed. It has been estimated that from the atmospheric CO_2 enrichment to date, total crop production as increased by 10-15 percent. This is a positive and beneficial outcome and one that most certainly should be included in any discussion of the role of greenhouse gases emissions in diet and nutrition—but is inexplicably lacking from such discussion in the DGAC report.

The second reason to discuss greenhouse gas emissions in a diet and nutrition report would be to dispel the notion that through your choice of food you can "do something" about climate change. In this context, it would be appropriate to provide a quantitative example of how the dietary changes recommended by the DGAC would potentially impact projections of the future course

of the climate. Again, the DGAC failed to do this. We help fill this oversight with straightforward calculation of averted global warming that assumes all Americans cut meat out of their diet and become vegetarians—an action that, according to the studies cited by the DGAC, would have the maximum possible impact on reducing greenhouse gas emissions and thus mitigating future climate change. Even assuming such an unlikely occurrence, the amount of global warming that would be averted works out to 0.01°C (one hundredth of a degree) by the end of the 21st century. Such an inconsequential outcome has no tangible implications. This should be expressed by the DGAC and mention of making dietary changes in the name of climate change must be summarily deleted.

We recommend that if the DGAC insists on including a discussion of greenhouse gas emissions (and thus climate change) in it 2015 Dietary Guidelines, that the current discussion be supplemented, or preferably replaced, with a more accurate and applicable one—one that indicates that carbon dioxide has widespread and near-universal positive benefits on the supply of food we eat, and that attempting to limit future climate change through dietary choice is misguided and unproductive. These changes must be made prior to the issuance of the final guidelines.

Analysis and Discussion

Scattered throughout the DGAC 2015 Dietary Guidelines Report can be found the terms "greenhouse gas emissions" or "GHG emissions." In most instances, the terms are associated with an "environmental outcome" that is deemed as "favorable" if it were associated with fewer GHG emissions. For example,

Part B. Chapter 2, p3, lines 87-89:

> "…are associated with more favorable environmental outcomes (lower greenhouse gas emissions and more favorable land, water, and energy use) than are current U.S. dietary patterns."

In other cases, a negative connotation is implied with higher GHG emissions producing a "larger environmental impact" while positive associations are drawn from "lower emissions" and "lower environmental impact."

For example:

Part A: Executive Summary, p7, line 257-268

> The major findings regarding sustainable diets were that a diet higher in plant-based foods, such as vegetables, fruits, whole grains, legumes, nuts, and seeds, and lower in calories and animal based foods is more health promoting and is associated with less environmental impact than is the current U.S. diet. This pattern of eating can be achieved through a variety of dietary patterns, including the Healthy U.S.-style Pattern, the Healthy Mediterranean-style Pattern, and the Healthy Vegetarian Pattern. All of these dietary patterns are aligned with lower

> environmental impacts and provide options that can be adopted by the U.S. population. Current evidence shows that the average U.S. diet has a larger environmental impact in terms of increased greenhouse gas emissions, land use, water use, and energy use, compared to the above dietary patterns. This is because the current U.S. population intake of animal-based foods is higher and plant-based foods are lower, than proposed in these three dietary patterns. Of note is that no food groups need to be eliminated completely to improve sustainability outcomes over the current status.

This is misleading on two fronts. First, the dominant greenhouse gas emitted by human activities is carbon dioxide which is a plant fertilizer whose increasing atmospheric concentrations have led to more productive plants, increasing total crop yields by some 10-15 percent to date. So the DGAC is at odds with itself in casting a positive light on actions that are geared towards lessening a beneficial outcome for plants while at the same time espousing a more plant-based diet.

And second, the impact that food choices have on GHG emissions is vanishingly small—especially when cast in terms of climate change. And yet it is in this context that the DGAC includes the discussion of GHGs in its report. The DGAC elevates the import of GHG emissions as a consideration in dietary choice far and above the level of its actual impact (as we will show in these comments).

Carbon Dioxide and Crops

The DGAC would do well to familiarize itself with the copious literature showing the overwhelming positive impacts that elevated atmospheric carbon dioxide levels have on the earth's plant life—including food crops. CO_2 acts as a fertilizer, increasing plant growth rate and mass by increasing photosynthetic capacity. It increases plant water use efficiency and drought tolerance as well as performance under low light conditions and in high temperatures. CO_2 also increases plants' abilities to grow in the presence of environmental hazards imposed by soil alkalinity, mineral stress, atmospheric pollutants (such as ozone) and UV-B radiation.

Perhaps a good place to start in exploring the topic is a 1995 book by Sylvan Wittwer titled *Food, Climate and Carbon Dioxide.* Wittwer was a renowned plant research who served as chairman of the National Research Council's Board on Agriculture, and his book is a comprehensive review of the subject CO_2's effect on crops and agriculture. Wittwer summarizes:

> [T]he effects of an enriched CO_2 atmosphere on crop productivity, in large measure, are positive, leaving little doubt as to the benefits for global food security. It is, therefore, inappropriate for public discussion of the issue to focus only on the hypothetical dangers of global warming that might result from higher CO_2 levels. It is equally important to stress the known benefits….
>
> …The rising level of atmospheric CO2 is a universally free premium, gaining in magnitude with time, on which we can all reckon for the foreseeable future.

> Direct effects of increasing CO_2 on food production and the output of rangelands and forests may be more important than the effects on climate.

Research subsequent to the mid-1990 publication of Wittwer's book has served to lend further support to his conclusions. A recent study (Idso, 2013) reviewed a large collection of the scientific literature as it applies to the world's 45 most important food crops (making up 95% of the world's annual agricultural production).

Idso (2013) summarized his findings on the increase in biomass of each crop that results from a 300ppm increase in the concentration of carbon dioxide under which the plants were grown. This table is reproduced below, and shows that the typical growth increase exceeds 30% in most crops, including 8 of the world's top 10 food crops (the increase was 24% and 14% in the other two). Considering the atmospheric CO_2 enrichment that has occurred to date (about 40% towards a 300ppm increase), it is reasonably expected that current crop production has been increased by approximately 10-15 percent from rising CO_2 levels.

Average percentage increase in biomass of each of the world's 45 most important food crops under an increase of 300ppm of carbon dioxide.

Crop	% Biomass Change	Crop	% Biomass Change
Sugar cane	34.0%	Rye	38.0%
Wheat	34.9%	Plantains	44.8%
Maize	24.1%	Yams	47.0%
Rice, paddy	36.1%	Groundnuts, with shell	47.0%
Potatoes	31.3%	Rapeseed	46.9%
Sugar beet	65.7%	Cucumbers and gherkins	44.8%
Cassava	13.8%	Mangoes, mangosteens, guavas	36.0%
Barley	35.4%	Sunflower seed	36.5%
Vegetables fresh nes	41.1%	Eggplants (aubergines)	41.0%
Sweet potatoes	33.7%	Beans, dry	61.7%
Soybeans	45.5%	Fruit Fresh Nes	72.3%
Tomatoes	35.9%	Carrots and turnips	77.8%
Grapes	68.2%	Other melons (inc.cantaloupes)	4.7%
Sorghum	19.9%	Chillies and peppers, green	41.1%
Bananas	44.8%	Tangerines, mandarins, clem.	29.5%
Watermelons	41.5%	Lettuce and chicory	18.5%
Oranges	54.9%	Pumpkins, squash and gourds	41.5%
Cabbages and other brassicas	39.3%	Pears	44.8%
Apples	44.8%	Olives	35.2%
Coconuts	44.8%	Pineapples	5.0%
Oats	34.8%	Fruit, tropical fresh nes	72.3%
Onions, dry	20.0%	Peas, dry	29.2%
Millet	44.3%		

The DGAC is amiss in not including this important positive impact in its discussion of GHG emissions—especially in light of the DGAC's preference for a heavier plant-based diet. This oversight clouds the current discussion of GHGs and calls into question the DGAC's negative associations with GHG emissions.

We recommend that the DGAC either include a discussion of the positive impacts on carbon dioxide emissions on crops and remove the negative connotations associated with GHG emissions, or else remove any and all discussions of GHG emissions from the Scientific Report of the 2015 Dietary Guidelines.

Influence of Dietary Choice on Projections of Future Climate Change

The only reason to be interested in GHG emissions, outside of CO_2's direct benefit to crops, is over concerns related to climate change caused by global warming. And yet, the DGAC explicitly states that it did not address this topic.

In Part B., Chapter1: Introductions, Table B2.1, p.9, under the heading "Addressed in DGAC report" there is an entry for "greenhouse gas emissions" and under the column heading "Other factors not addressed in the DGAC report "global climate change" is listed.

Table B2.1: Components of the Conceptual Model

Influences/Determinants

	Factors	**Addressed in the DGAC report**	**Other factors <u>not</u> addressed in the DGAC report**
	Ecosystems (national to global)	the natural environment, including farmland; plant, animal, marine, land, and water ecosystems; renewable energy resources; land/water/air and soil environments and quality; plant conservation, biodiversity; greenhouse gas emissions, pollution/contamination	plant and natural resources management and conservation; carbon footprint; global climate change

Discussing changes in greenhouse gas emissions without discussing subsequent impacts on climate change is like discussing dietary guidelines without discussing how they influence your health. In each case, the former is worthless without being backed by the latter. And yet when it comes to GHG emissions and climate change, this is precisely what DGAC has decided to do. The result is a meaningless, and worse, misleading, discussion. We hypothesize that DGAC was aware that a quantitative analysis would reveal the utter futility of their proposed policy, and that they purposefully went forward for political reasons.

To rectify that situation, we have performed a straightforward calculation that they did not do. Our results will show that it is incumbent upon DGAC to drop all references to climate change mitigated by dietary changes. If they do not do so, they may be legally challenged under the Federal Data Quality Act.

We work through the extreme case that all Americans switch to eating only a plant-based diet (not a current recommendation of the DGAC, but one which will produce the largest possible reduction of GHGs as a result of dietary choice).

According to a 2013 report from the U.N.'s Food and Agriculture Organization (Gerber et al., 2013), globally, in 2005, greenhouse gas emissions from livestock production produced 7,100 million metric tons of carbon dioxide equivalents ($mmtCO_2$-eq). Of this amount, 45% came from feed production, 39% from enteric fermentation, 10% from manure, and the remainder from bringing the products to market.

Of this global total, North American livestock production was responsible for just under 10%, or about 650 $mmtCO_2$-eq.

Scarborough et al. (2014) compared the carbon footprint for different types of diets. They found that diets high meat had about twice the carbon footprint of vegetarian diets.

Combining the results of those studies (and assuming U.S. production amounts to about 90% of the North American total livestock emissions), we find that if all Americans become vegetarians, it would reduce greenhouse gas emissions by about 300 $mmtCO_2$ per year.

We now need to convert 300 $mmtCO_2$ into climate units. To do this, we use the MAGICC climate model simulator (MAGICC: Model for the Assessment of Greenhouse-gas Induced Climate Change). MAGICC was developed by scientists at the National Center for Atmospheric Research under funding by the U.S. Environmental Protection Agency. MAGICC is a standard reference model used worldwide.

MAGICC is itself a collection of simple gas-cycle, climate, and ice-melt models to efficiently emulate the output of complex climate models. MAGICC projects the global average temperature and sea level change under user-configurable emissions scenarios and model parameters. Here, MAGICC is run using its default model parameter settings (for example, an equilibrium climate sensitivity of 3.0°C). To simulate the impact of all Americans removing meat from their diet (and thus ceasing all livestock production and associated GHG emissions), we adjust the SRES A1B (mid-range) emissions scenario for future carbon dioxide emissions downward by 300$mmtCO_2$ (0.082PgC) each year between 2020 and 2100.

When we run MAGICC with the emissions adjusted to account for the elimination of CO_2-eq GHG emissions associated with livestock production in the US and compare that with the baseline scenario, we find that the amount of projected global warming averted by the year 2100 is 0.01°C—one hundredths of a degree Celsius. The impact of a strict adherence to the DGAC recommended 2015 Dietary Guidelines—which do not recommend a complete shift to a 100% plant-based diet—would necessarily be considerably less.

It is clear that the influence of the diet of Americans on future climate change is environmentally insignificant and scientifically undetectable. Therefore, the consideration of greenhouse gas emissions has no place in the discussion of dietary choice.

This is the message that the DGAC should be spreading—not the one which implies the opposite.

Our recommendation is that the DGAC remove all discussion of greenhouse gas emissions from the new Guidelines. Without a quantitative climate change analysis, the DGAC's current discussion of greenhouse gas emissions lacks context and is misleading, and should be removed. Leaving this report intact may subject it to a challenge under the Federal Data Quality Act.

References

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