

Yesterday's dinner, tomorrow's weather, today's news? US newspaper coverage of food system contributions to climate change

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Abstract

Background: There is strong evidence that what we eat and how it is produced affects climate change.

Objective: The present paper examines coverage of food system contributions to climate change in top US newspapers.

Design: Using a sample of sixteen leading US newspapers from September 2005 to January 2008, two coders identified 'food and climate change' and 'climate change' articles based on specified criteria. Analyses examined variation across time and newspaper, the level of content relevant to food systems' contributions to climate change, and how such content was framed.

Results: There were 4582 'climate change' articles in these newspapers during this period. Of these, 2.4% mentioned food or agriculture contributions, with 0.4% coded as substantially focused on the issue and 0.5% mentioning food animal contributions. The level of content on food contributions to climate change increased across time. Articles initially addressed the issue primarily in individual terms, expanding to address business and government responsibility more in later articles.

Conclusions: US newspaper coverage of food systems' effects on climate change during the study period increased, but still did not reflect the increasingly solid evidence of the importance of these effects. Increased coverage may lead to responses by individuals, industry and government. Based on co-benefits with nutritional public health messages and climate change's food security threats, the public health nutrition community has an important role to play in elaborating and disseminating information about food and climate change for the US media.

Keywords
Climate change
Global warming
Food system
Agriculture
Media analysis

There is strong evidence that food systems are important contributors to climate change^(1–4). Actions to reduce food-related greenhouse gas emissions can have co-benefits for nutrition. The present paper describes how food and agriculture affect climate change and examines how this information has been communicated to the US general public via one medium: daily newspapers. While these messages may be greater or different in other media or other countries, US newspapers are important both because of newspapers' policy impact in the USA and globally because of this country's large carbon footprint. The discussion explores why food systems were under-represented in US news coverage compared with other contributors to climate change, and considers future opportunities and frames for communication. The paper does not address the expected major climate change

impacts on food systems^(5–8) or health^(9–14), although these are a key part of what makes climate change so relevant to the public health nutrition field.

Background

Food systems and climate change

We define food systems as everything and everyone involved in producing, processing, distributing, consuming and disposing of food, including policies, processes, products, individuals, businesses and governments. Taking a systems approach to food enables consideration of relationships between the above components and between food and other aspects of agriculture and society. A systems approach requires interdisciplinary

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thought and recognition that changes in one part of the system have ramifications elsewhere^(15–17). There is overlap and interchange among food systems serving localities, regions and nations, and between alternative and mainstream food systems. Herein, unless otherwise stated, we are referring to food systems at the US national level.

The Intergovernmental Panel on Climate Change indicated in 2007 that agriculture contributed 13.5% of world anthropogenic greenhouse gas emissions (CO₂ equivalent), and that forestry including deforestation contributed 17.4%⁽¹⁸⁾. Much of the latter contribution is associated with food. Even in the USA, with its major industry and transportation emissions, agriculture is estimated to contribute 10% of greenhouse gas emissions⁽¹⁹⁾. While food greenhouse gas emissions go well beyond agriculture, no broad US-based estimates are known to exist.

Among food categories, food animal production is by far the top climate change contributor. The FAO estimates that livestock production alone accounts for 18% of world anthropogenic greenhouse gas emissions – a greater contribution than transportation⁽¹⁾.

In food systems, the greenhouse gases CH₄ (especially from animal enteric fermentation and manure) and N₂O (especially from fertilizers) are top anthropogenic contributors to climate change, although CO₂ (especially from manufacturing, transportation and supplying energy) also plays an important role. Beyond emissions, food systems also affect the extent to which greenhouse gases are released into the atmosphere or trapped in soil and plants. A top contributor to climate change is deforestation for food production, particularly in tropical forests where some US food and animal feed imports originate. Conversely, practices like setting aside crop lands for conservation and no-till agriculture can sequester substantial amounts of CO₂^(1,3,4,19,20). While 'food miles', or the distance food is transported from production to market, have received much attention, analyses suggest that transportation may account for a relatively small (though not insignificant) portion of food system impacts^(21–25). Using food crops for fuel also affects emissions; although some evidence suggests costs outweigh benefits^(26–28).

The above-described food system effects on climate change are complex, interactive and dependent on many factors. Regardless, the evidence is clear that the impact is substantial.

Individuals, business and government can reduce food-related greenhouse gas emissions. While much more research and life-cycle analysis is needed to enable prioritizing responses for the US context, some beneficial individual responses include: eating lower on the food chain and particularly reducing beef and dairy consumption; wasting less food; eating foods that are less processed, seasonal, not air-freighted or raised in green-

houses, locally produced, sustainably produced and that have long shelf-lives; avoiding packaging and plastic bags; reducing refrigeration, freezing and shopping trips; and eating less overall. McMichael *et al.* find that to stabilize livestock-related greenhouse gas emissions at 2005 levels, global meat consumption would need to drop to 90 g/d per person by 2050, based on expected population rises and increasing wealth and meat consumption in developing countries⁽⁴⁾. To comply in the USA, we calculate that per capita meat consumption would need to drop by nearly two-thirds⁽²⁹⁾. While these changes can be difficult to make and sustain, cumulatively and via the effects of consumer demand on business, they could impact emissions substantially.

Beyond individuals, the magnitude of effort needed to reverse or minimize catastrophic climate change calls for focused responses from business and government. Such efforts are just beginning in the USA, far behind Europe and the UK. Food industry efforts to reduce emissions include selective and local purchasing, product labelling, reduced packaging, energy efficiency and carbon offsetting⁽³⁰⁾. Agricultural enterprises have reduced emissions including through changes in animal feeds, soil conservation and no-till farming, reduced fertilizer and pesticide use, energy efficiency, increased local distribution, improved waste management, and on-farm energy generation^(2,30). Government incentives that could support such changes and motivate others include stimulating local and seasonal food economies, reducing governmental subsidies for animal feed grains, raising awareness about meat and dairy climate change consequences, mandating energy efficiency in vehicles, equipment and facilities used by food systems, and requiring labelling and reduced packaging. More broadly, federal and state policy makers could better incorporate food and agriculture into climate change mitigation strategies, and expand research support.

Such actions will be unlikely without public support and consumer engagement on the demand side. The US nutritional public health community can play an important role in communication and can take advantage of 'co-benefits' in opportunities to improve nutrition and mitigate climate change through individual and social food choices. To better shape and improve communication efforts, we need to understand more about what the US public currently hears about food and climate change.

Public awareness and concern about climate change

It is established that media coverage plays a key role in shaping which issues are considered important by the public and elected officials^(31,32) and that it can be associated with behaviour change⁽³³⁾. Further, it is established that article framing influences how audiences perceive problems and assign problem-solving responsibility^(31,34,35). The media analysis field has moved far beyond the idea

that these relationships are simple and linear^(36–39), and similarly, behavioural science has moved far beyond the idea that accurate knowledge or even intention to act necessarily leads to action^(40–42). At minimum, however, knowledge is a ‘floor’; the public cannot be expected to take action on a problem until they know about it.

The literature indicates multiple factors driving newspapers’ agendas regarding topics warranting coverage. In addition to ‘objective’ newsworthiness, these include: journalist and editor judgement; issue promotion by interest groups; pressures to present a ‘good story’; advertiser pressures; and coverage in other sources^(31,37,43–46). Literature on public agenda-setting suggests that issues framed as systemic (government, business) responsibilities may be seen as more important and thus more newsworthy than those framed as individual responsibilities^(34,47,48).

Media analysis

The present study analysed US newspaper coverage of climate change and food systems’ contributions to climate change. From among the media sources, newspapers were chosen for their broad readership, policy impact and role as a source of record. The study aimed to:

1. Describe ‘food and climate change’ (FCC) coverage – time trends; newspapers; level of focus on food and agriculture; and type of article – all in the context of ‘climate change’ (CC) coverage.
2. Examine the food system components attributed as affecting climate change in FCC articles.
3. Examine how the FCC articles were framed, including whether the stated or implied responsibility for action lay with individuals, business or government.

Methods

Data

The newspaper sample included sixteen of the top twenty US newspapers based on print circulation⁽⁴⁹⁾. Newspapers included were (in circulation order): *New York Times*, *Washington Post*, *Chicago Tribune*, *Philadelphia Inquirer*, *Rocky Mountain News (Denver)*, *Houston Chronicle*, *New York Post*, *Detroit Free Press*, *Dallas Morning News*, *Minneapolis Star Tribune*, *Boston Globe*, *Newark Star-Ledger*, *Atlanta Journal-Constitution*, *Arizona Republic*, *Long Island Newsday* and *San Francisco Chronicle*. These papers, together, distributed an average of 10.7 million copies/d in 2006⁽⁵⁰⁾, with expected print readership over double this figure⁽⁵¹⁾. (The other four top-twenty newspapers were unavailable via the Access World News database.)

Articles were collected for the 29-month period from September 2005 to January 2008. The ‘initial period’ of the study started three months before the premier of Al

Gore’s documentary film ‘An Inconvenient Truth’ at the Sundance Film Festival, and stopped just before May 2007. To update the investigation, searches were repeated for the nine months from May 2007 to January 2008, referred to as the ‘follow-up period’.

We coded articles as ‘climate change’ (CC) if they had ‘global warming’ and/or ‘climate change’ in lead or first paragraphs. Among CC articles, we coded those that had the words ‘food’, ‘farm’ or ‘agriculture’ anywhere in their text as ‘food and climate change’ (FCC). We then excluded articles that in no way referenced food system impacts on climate change, including those focused on how climate change impacts food systems, and extraneous usages such as ‘Farmington, CT’. Articles discussing biofuels were included if they mentioned the impact on food systems. Because of the large number of CC articles, during the initial analysis a random sample was selected for closer reading (23% after exclusions).

Coding

Table 1 describes variables examined. Two coders reviewed the articles. The lead author trained coders and evaluated consistency. Coders reviewed discordances together at the end. The mean κ statistic evaluating initial inter-reviewer concordance was 0.66 for the CC sample analysis (rising to 0.78 after excluding three subjective variables), suggesting good concordance. The κ was 0.51 for the initial FCC analysis, driven down by the low n and number of options on some variables.

Analysis

We performed descriptive analyses primarily involving frequencies and percentages, and, in selected cases, t tests and χ^2 analyses. We did not statistically compare the FCC with the CC articles due to sample overlap and small numbers. Because there were so many CC articles, the 658 article sample during the initial period was used for analyses involving reviewing CC articles directly. Thus, different data aggregations were used: across time (all FCC *v.* all CC); across newspaper (all FCC *v.* CC sample); key themes and responsible party (initial FCC and later FCC). Analyses were performed using the software packages STATA version 9 (StataCorp, College Station, TX, USA) and Excel (Microsoft Corp., Redmond, WA, USA).

Results

Level of coverage

As shown in Table 2, the terms, ‘food’, ‘farm’ or ‘agriculture’ were mentioned in 109 (2.4%) of the 4582 articles with ‘climate change’ or ‘global warming’ in their lead paragraphs from the sixteen selected top newspapers between September 2005 and January 2008. Twenty (0.44%) were coded as substantially focused on food or agriculture contributions to climate change, forty-four

Table 1 Data items collected from 'climate change' (CC) and 'food and climate change' (FCC) articles in a sample of sixteen leading US newspapers from September 2005 to January 2008

	FCC articles			CC articles	
	Initial period* (n 52)	Follow-up period* (n 57)	Initial period (n 658)	All initial + follow-up (n 4582)	
Title	×	×	×	×	
Date	×	×	×	×	
Newspaper	×	×	×	×	
Type of article (news, opinion/editorial, letters, arts/entertainment, other)	×	×	×	×	
Level of focus on food systems (minimal = 1 paragraph, short mention = 1–3 paragraphs, substantial = >3 paragraphs; or for shorter articles, based on coder judgement)	×	×	×	×	
Part/s of food systems attributed as causes (land use; transportation; livestock; industrial production; pesticides; fertilizers; food availability v. biofuels; general/mixed; other/unspecified)	×	×	×	×	Mentions food systems? (y/n)
Climate change causes a focus of article? y/n	×	×	×	×	
Responsible party (individual/business/government)	×	×	×	×	
Theme	×	×	×	×	

*Initial period = September 2005 to April 2007; follow-up period = May 2007 to January 2008.

Table 2 Coverage overview of 'climate change' (CC) and 'food and climate change' (FCC) articles in a sample of sixteen leading US newspapers from September 2005 to January 2008

	n	% of CC articles
CC articles	4582	100
FCC articles	109	2.4
'Substantial' focus on issue	20	0.4
Mentions meat/dairy contributions	22	0.5

(0.96%) had short mentions and forty-five (0.98%) had minimal mentions, as defined in Table 1. There was considerable change across time. In the first six months, a mean of 0.8% of CC articles mentioned food contributions, while in the final six months this figure rose significantly to 2.9% ($P=0.01$, Satterthwaite's $df=7.75$). In looking at the percentage of articles coded as substantially focused on food and climate change, small numbers motivated extending the comparison to the first fourteen analysis months v. the last fourteen (leaving one month in between). In the first half of the study, one article fit the criteria (0.07% of the total), whereas nineteen (0.63%) did so the latter half. Comparing article type coded in the initial part of the analysis, FCC articles were more likely than CC articles to be letters to the editor (23% v. 9%) while CC stories were more likely than FCC articles to be news (52% v. 42%).

Figure 1 shows articles by month across the full study period. Monthly numbers of FCC articles ranged from zero (October and November 2005) to ten (June 2007), with a mean of 3.8 (SD 2.8). For comparison, CC articles ranged from fifty-seven (November 2005) to 305 (April 2007), with a mean of 158.8 (SD 69.8). The two followed a similar time trend, with the CC articles peaking earlier. (Note that in this and other figures, directly contrasting the numbers is inappropriate because of sample overlap.)

Figure 2 shows the initial period distribution of FCC articles by newspaper, with the same-period CC article sample for comparison. The graph reflects significant variation between newspapers but an overall similar pattern across article types. The number of FCC articles ranged from zero (*Dallas Morning News*, *New York Post*) to eleven (*New York Times*), with a mean of 3.3 (SD 2.9); four newspapers had only one article. In the later time period, the mean increased to 3.6 (SD 3.5), but four newspapers published zero FCC articles (*Dallas Morning News*, *New York Post*, *Philadelphia Inquirer* and *Detroit Free Press*). The highest number was still eleven (*New York Times*). One newspaper, the *Newark Star-Ledger*, substantially increased its coverage, from one to nine articles, across the two time periods.

Per newspaper CC articles ranged from five (*New York Post*) to 176 (*New York Times*), with a mean of 41.1 (SD 41.8) in the initial period. During that time, the *New York Times* ran over 2.3 times the number of CC articles as the

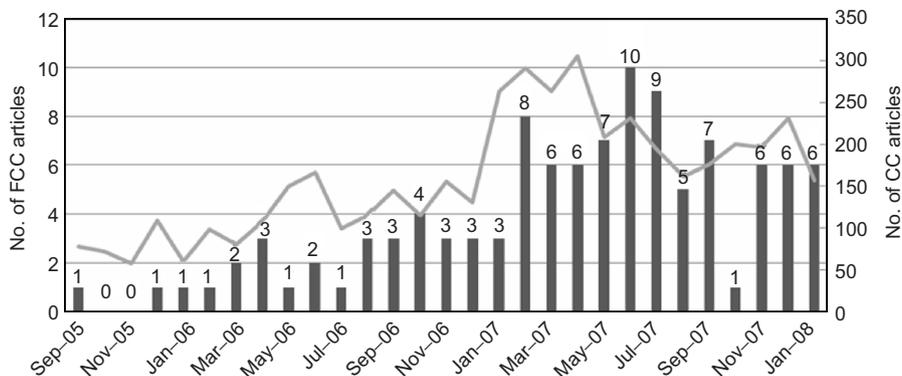


Fig. 1 Number of articles on ‘food and climate change’ (FCC; ■, *n* 103) and ‘climate change’ (CC; –, *n* 4582) by month, in a sample of sixteen leading US newspapers from September 2005 to January 2008

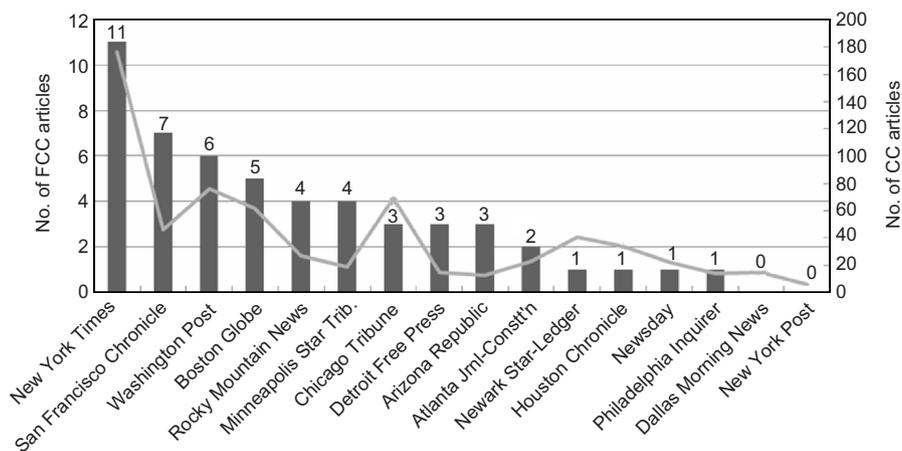


Fig. 2 Number of articles on ‘food and climate change’ (FCC; ■, *n* 52) and ‘climate change’ (CC; –, *n* 658) by newspaper, in a sample of sixteen leading US newspapers from September 2005 to April 2007

Washington Post, the newspaper with the next highest number.

Content of coverage

We examined the news coverage content in terms of the food system components to which articles directly or indirectly attributed climate impacts. The highest percentage (29%) of articles were general, such as attributing the problem to ‘food’. About 13% referred to livestock and 12% each to transportation and land use. Eleven per cent referred to pesticides and fertilizers, with most of these in the initial period referring to pesticides, and in the later period more often referring to fertilizers, which do have a higher impact. Nine per cent were coded as referring to the industrial nature of food production, with many specifying energy use. Finally, 15% referred to biofuels; in the follow-up, these shifted in tone from generally positive to universally questioning or critical.

Responsible party

Most FCC articles directly or indirectly implied roles for individual, business and/or government in addressing the

problem. Of sixty action codes overall in the initial analysis (articles could have more than one code), twenty-seven indicated individual responsibility for action, while twenty-two indicated business and eleven government responsibility. In the follow-up, these numbers were seventeen, twenty-eight and twenty-four ($\chi^2 = 7.22$, $P = 0.03$), suggesting an increasing focus on the ‘big picture’.

Discussion

The present analysis identified a substantial gap in US coverage of food systems’ contributions to climate change among the sixteen top newspapers studied, as well as evidence that coverage is increasing slowly. The findings can provide a basis for increased communication on these issues, while the science review in the introduction to the paper can help inform future messages.

In sum, we found that the terms ‘food’, ‘farm’ or ‘agriculture’ were mentioned in 109 (2.4%) of the 4582 articles with ‘climate change’ or ‘global warming’ in

their lead paragraphs between September 2005 and January 2008. Twenty of these (0.4% of the total) substantially focused on the issue, with increasing coverage across time. Of the FCC articles, 29% referred to food only in general ways. Based on the review in the introduction, the issues of livestock, land use and fertilizer might be highlighted as among the key food system factors in climate change. Respectively, these were mentioned in 13%, 12% and less than 11% of FCC articles; or, in the context of CC articles, 0.48%, 0.46% and less than 0.41%. Coverage varied by newspaper. The articles increasingly addressed the bigger picture of business and government responsibility compared with tips for individuals.

We suggest five possible reasons why US newspaper coverage of food-related contributions has lagged behind overall climate change coverage.

1. History

Food systems' effects on climate change were relatively late to be highlighted by scientific, governmental and reviewing experts, particularly in the USA. Thus, the new information had to confront the barrier of pools of expert advocates, scientists and journalists communicating based on existing knowledge and expectations. The film 'An Inconvenient Truth', which played an important role in education about climate change in the USA, also did not mention food or agricultural contributions. Further, because CO₂ is the top greenhouse gas of concern, it is possible that a 'CO₂ bias' in awareness may have operated, whereby other greenhouse gases such as the CH₄ and N₂O dominant in agriculture were inadvertently discounted. It is notable that so many CC articles appeared in a single newspaper; these were often written by one journalist. Individual journalist and editor interest is also part of an issue's idiosyncratic history and can play an important role in coverage.

2. Information

There is little available life-cycle analysis data to enable quantifying and prioritizing among US food-related contributions to climate change. By contrast, in Europe, numerous research articles and non-governmental reports have described and quantified these contributions, highlighting the problem's extent and nature (see, for example, the several dozen food life-cycle analysis reports and articles compiled at the British Food and Climate Research Network website, including only two papers about the USA)^(25,52). This data gap and the further lack of lay-targeted US information on food contributions to climate change more generally make it challenging for reporters to write on the issue.

3. Framing

In US society, food and nutrition concerns are more commonly constructed as individual problems with individual

solutions than as social problems with social solutions^(34,48). This framing can lead editors to perceive these issues as less newsworthy or as belonging in newspaper sections such as 'Lifestyle'. In the initial analysis, FCC articles were weighted towards individual frames, but by the later analysis, business-framed articles led, seconded by articles framing the issue in relation to government. This shift could support further increased news coverage and expand the recognized options to address the problem.

4. Advocate interest

Environmental advocacy groups have played an important role as media sources and in raising climate change's public profile in the USA. In the past, these groups have focused primarily on sectors such as energy and transportation. While US animal welfare groups have campaigned on climate change issues⁽⁵³⁾, environmental groups are just beginning to address the issue. Environmental advocates may have feared that messages about reducing meat consumption and changing eating behaviour might undermine other climate change efforts by alienating the public, leading to prioritizing behaviours and interventions with relatively less impact, or simply by confusing people.

5. Industry responses

Sectors such as energy are commonly socially constructed as 'big business' and with a political- or conflict-oriented frame. Members of these industries may have inadvertently solidified this impression through efforts to foment doubt about climate change science⁽⁵⁴⁾. Accordingly, climate change advocates may gravitate towards these industries as adversaries, while the media gravitates towards the conflict. Food industries by contrast have generally laid low on climate issues in the USA. As public awareness grows, some have engaged in well-publicized efforts such as purchasing carbon credits, fashioning themselves as partners in reducing greenhouse gases rather than opponents⁽⁵⁵⁾. It is also possible that ubiquitous supermarket advertising in newspapers might have a subtle impact on news editorial choices⁽⁴⁶⁾.

Opportunities to increase newspaper coverage

The present analysis suggests several opportunities to increase attention to food system and food animal production contributions to climate change in the USA. First, the food/climate change issue lends itself readily to some key article schemas newspaper journalists seek: investigative, consumer/health interest, events, conflict, local, telling a story. As public concern about climate change continues to grow and coverage increases, reporters also need new angles, and may thus focus on food. The public's increasing interest in sustainable and local food production – and recognition of ancillary benefits such as taste and healthfulness – may also lead to coverage

opportunities. Journalists are likely to receive more information about food system impacts, as environmental advocacy groups are increasingly recognizing this issue's importance and animal welfare groups continue their communications campaign.

The American Public Health Association designated climate change as a theme for 2008's Public Health Week and recognized health co-benefits of addressing food contributions to climate, designating one weekday for this topic⁽⁵⁶⁾.

Strengths and limitations

The present study has an unusually large sample of newspapers compared with other media analyses. For example, most other climate change media analyses we reviewed used three to seven newspapers^(38,57,58) and one identified top wire stories in 255 papers⁽⁵⁹⁾. The sampling and analysis were performed using methods consistent with those in the literature^(60,61), including using two coders, κ analysis and meeting to resolve discordance. Finally, the discussion was grounded in theory and prior literature.

The chief limitation is that it is not possible to determine how well these newspapers reflect all national newspapers, which differ in size and audience, among other factors. (None the less, smaller papers do use the same wire services, and these prominent papers have particular media agenda-setting, social and policy impact.) Coverage may also differ in other sources including television journalism, entertainment and blogs; this is a valuable area for future exploration. The searches may have missed some articles, and some of the coding was necessarily subjective. Finally, the large number of climate change articles and labour intensiveness of coding prevented us from being able to code them all so as to present consistent comparisons throughout.

Conclusion

Food, agriculture and land-use change are recognized by scientists as important contributors to climate change – for example, the latter two account for an estimated third of world greenhouse gas emissions, while livestock alone is estimated to contribute 18% of anthropogenic greenhouse gas emissions. However, this information was not well disseminated to the US public in the selected major newspapers during the study period. Furthermore, even the rare articles that mention food system contributions often directed reader attention to relatively less pressing aspects of the issue, particularly in the earlier months. Given the US carbon footprint, reaching the US public with accurate information is important.

News coverage of food and climate change is clearly improving. The media follows political leader, advocacy group and expert agendas. As these groups increasingly

incorporate food into their discussions of climate change, media coverage may be expected to increase further.

Greater public awareness could lead to consumer demand for food produced with a lighter environmental impact, industry actions including increased use of lower-emission agriculture and food production methods, efforts to change policy including incorporating food and agricultural policy into climate change mitigation strategies, and increased support for research.

The more we know about climate change news coverage, the more effectively we can intervene to improve message accuracy, framing and effectiveness. Public health nutrition has an important role to play. Building on co-benefits with other nutritional messages such as reducing meat consumption, and on the field's expertise in social, environmental and biological aspects of nutrition^(13,62,63), public health nutrition can help close the information gap as well as further elaborating the science. The urgency of making rapid cuts in greenhouse gas emissions means that all avenues for reduction must be promoted. As stated in the Giessen Declaration, 'Now is the time for the science of nutrition... to meet the challenges and opportunities faced by humankind in the twenty-first century'⁽⁶⁴⁾.

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References

1. Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M & de Haan C (2006) *Livestock's Long Shadow: Environmental Issues and Options*. Rome: FAO.
2. Paustian K, Antle JM, Sheehan J & Paul EA (2006) *Agriculture's Role in Greenhouse Gas Mitigation*. Arlington, VA: Pew Center on Global Climate Change.
3. Smith P, Martino D, Cai Z *et al.* (2007) Agriculture. In *Climate Change 2007: Mitigation Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 499–540 [B Metz, OR Davidson, PR Bosch, R Dave and LA Meyer, editors]. New York: Cambridge University Press.
4. McMichael AJ, Powles JW, Butler CD & Uauy R (2007) Food, food production, energy, climate change,

- and health (Series on Energy and Health #5). *Lancet* **370**, 55–65.
5. Intergovernmental Panel on Climate Change (2007) Summary for policymakers. In *Climate Change 2007: Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 7–22 [ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson, editors]. Cambridge: Cambridge University Press.
 6. Lobell DB, Burke MB, Tebaldi C, Mastrandrea MD, Falcon WP & Naylor RL (2008) Prioritizing climate change adaptation needs for food security in 2030. *Science* **319**, 607–610.
 7. Brown ME & Funk CC (2008) Climate. Food security under climate change. *Science* **319**, 580–581.
 8. Tubiello FN, Soussana JF & Howden SM (2007) Crop and pasture response to climate change. *Proc Natl Acad Sci U S A* **104**, 19686–19690.
 9. McMichael AJ, Friel S, Nyong A & Corvalan C (2008) Global environmental change and health: impacts, inequalities, and the health sector. *BMJ* **336**, 191–194.
 10. Luber G & Hess J (2007) Climate change and human health in the United States. *J Environ Health* **70**, 43–44, 46.
 11. Jackson R & Shields KN (2008) Preparing the US health community for climate change. *Annu Rev Public Health* **29**, 57–73.
 12. Patz J, Campbell-Lendrum D, Gibbs H & Woodruff R (2008) Health impact assessment of global climate change: expanding on comparative risk assessment approaches for policy making. *Annu Rev Public Health* **29**, 27–39.
 13. Schwartz BS, Parker C, Glass TA & Hu H (2006) Global environmental change: what can health care providers and the environmental health community do about it now? *Environ Health Perspect* **114**, 1807–1812.
 14. McMichael AJ, Woodruff RE & Hales S (2006) Climate change and human health: present and future risks. *Lancet* **367**, 859–869.
 15. Sobal J, Khan LK & Bisogni C (1998) A conceptual model of the food and nutrition system. *Soc Sci Med* **47**, 853–863.
 16. Leischow SJ & Milstein B (2006) Systems thinking and modeling for public health practice. *Am J Public Health* **96**, 403–405.
 17. von Bertalanffy L (1950) An outline of general system theory. *Br J Philos Sci* **1**, 134–165.
 18. Intergovernmental Panel on Climate Change (2007) *Climate Change 2007: Synthesis Report*. New York, NY: Cambridge University Press.
 19. US Environmental Protection Agency (2008) *Draft Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2006*. Washington, DC: US EPA.
 20. Nabuurs GJ, Masera O, Andrasko K, Benitez-Ponce P, Boer R, Dutschke M, Elsiddig E, Ford-Robertson J, Frumhoff P & Karjalainen T (2007). Forestry. In *Climate Change 2007: Mitigation Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 543–584 [B Metz, OR Davidson, PR Bosch, R Dave and LA Meyer, editors]. New York: Cambridge University Press.
 21. Weber CL & Matthews HS (2008) Food-miles and the relative climate impacts of food choices in the United States. *Environ Sci Technol* **42**, 3508–3513.
 22. Collins A & Fairchild R (2007) Sustainable food consumption at a sub-national level: an ecological footprint, nutritional and economic analysis. *J Environ Policy Plann* **9**, 5–30.
 23. Pretty JN, Ball AS, Lang T & Morison JLL (2005) Farm costs and food miles: an assessment of the full cost of the UK weekly food basket. *Food Policy* **1**, 1–19.
 24. Saunders C, Barber A & Taylor G (2006) *Food Miles – Comparative Energy/Emissions Performance of New Zealand's Agriculture Industry*. Lincoln, NZ: Agribusiness and Economics Research Unit, Lincoln University.
 25. Brodt S (2007) *Assessment of Energy Use and Greenhouse Gas Emissions in the Food System: A Literature Review*. Davis, CA: Agricultural Sustainability Institute, University of California at Davis.
 26. Fargione J, Hill J, Tilman D, Polasky S & Hawthorne P (2008) Land clearing and the biofuel carbon debt. *Science* **319**, 1235–1238.
 27. Hill J, Nelson E, Tilman D, Polasky S & Tiffany D (2006) Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. *Proc Natl Acad Sci U S A* **103**, 11206–11210.
 28. Searchinger T, Heimlich R, Houghton RA, Dong F, Elobeid A, Fabiosa J, Tokgoz S, Hayes D & Yu TH (2008) Use of US croplands for biofuels increases greenhouse gases through emissions from land-use change. *Science* **319**, 1238–1240.
 29. US Department of Agriculture, Economic Research Service (2008) Food Availability: Red meat, poultry and fish (boneless). <http://www.ers.usda.gov/Data/FoodConsumption/FoodAvailSpreadsheets.htm> (accessed July 2008).
 30. Garnett T (2007) The world on a plate: reducing the food chain's role in greenhouse gas emissions. <http://www.fcrn.org.uk/> (accessed July 2008).
 31. Wallack L, Dorfman L, Jernigan D & Themba M (1993) *Media Advocacy and Public Health*. Newbury Park, CA: Sage.
 32. Smith KC, Wakefield M & Edsall E (2006) The good news about smoking: how do US newspapers cover tobacco issues? *J Public Health Policy* **27**, 166–181.
 33. Institute of Medicine (2002) Media. In *The Future of the Public's Health in the 21st Century*, pp. 307–357. Washington, DC: National Academies Press.
 34. Kim SH & Willis LA (2007) Talking about obesity: news framing of who is responsible for causing and fixing the problem. *J Health Commun* **12**, 359–376.
 35. Iyengar S (1996) Framing responsibility for political issues. *Ann Am Acad Pol Soc Sci* **546**, 59–70.
 36. Kioussis S (2004) Explicating media salience: a factor analysis of *New York Times* coverage during the 2000 US presidential election. *J Commun* **71**–87.
 37. Smith J (2005) Dangerous news: media decision-making about climate change risk. *Risk Anal* **25**, 1471–1482.
 38. Carvalho A (2007) Ideological cultures and media discourses on scientific knowledge: re-reading news on climate change. *Public Underst Sci* **16**, 223–243.
 39. Wammes B, Breedveld B, Looman C & Brug J (2005) The impact of a national mass media campaign in the Netherlands on the prevention of weight gain. *Public Health Nutr* **8**, 1250–1257.
 40. Jackson T (2005) *Motivating Sustainable Consumption*. Surrey, UK: Sustainable Development Research Network.
 41. Stamm KR, Clark F & Reynolds Eblacas P (2000) Mass communication and public understanding of environmental problems: the case for global warming. *Public Underst Sci* **9**, 219–237.
 42. Krosnick JA, Holbrook AL, Lowe L & Visser PS (2006) The origins and consequences of democratic citizens' policy agendas: a study of popular concern about global warming. *Climatic Change* **77**, 7–43.
 43. Clayman SE & Reisner A (1998) Gatekeeping in action: editorial conferences and assessments of newsworthiness. *Am Sociol Rev* **63**, 178–199.
 44. Song HJ (2004) Media Agenda as the Result of the Interaction between the Source and the News Media. Paper presented at International Communication Association, New Orleans, LA.
 45. Dorfman L, Thorson E & Stevens JE (2001) Reporting on violence: bringing a public health perspective into the newsroom. *Health Educ Behav* **28**, 402–419.

46. An S & Bergen L (2007) Advertiser pressure on daily newspapers: a survey of advertising sales executives. *J Advert* **36**, 111–121.
47. Stone DA (1989) Causal stories and the formation of policy agendas. *Pol Sci Q* **104**, 281–300.
48. Lawrence RG (2004) Framing obesity: the evolution of news discourse on a public health issue. *Harvard Int J Press/Politics* **9**, 56–75.
49. Audit Bureau of Circulations (2006) Top 200 Newspapers by Largest Reported Circulation. <http://www.infoplease.com/ipea/A000420.html> (accessed July 2008).
50. Audit Bureau of Circulations (2007) Newspaper Circulation data for 2006. Schaumburg, IL: ABC.
51. Newspaper Association of America (2007) Daily and Sunday newspapers, 2007 readers per copy. <http://www.naa.org/marketdatabank/RPC2007.pdf> (accessed September 2007).
52. Garnett T (2008) Food and Climate Research Library: Food and its life cycle: impacts, analysis and options. <http://www.fcrn.org.uk/researchLib/lifecycle.htm> (accessed March 2008).
53. Deutsch CH (2007) Trying to Connect the Dinner Plate to Climate Change. *The New York Times*, 29 August, C3.
54. Boykoff MT & Boykoff JM (2004) Balance as bias: global warming and the US prestige press. *Global Environ Change* **14**, 125–136.
55. Deutsch CH (2008) Attention Shoppers: Carbon Offsets in Aisle 6. *The New York Times*, 7 March, H1.
56. American Public Health Association (2008) National Public Health Week 2008. Climate Change: Our Health in the Balance. <http://www.nphw.org/nphw08> (accessed July 2008).
57. Carvalho A & Burgess J (2005) Cultural circuits of climate change in UK broadsheet newspapers, 1985–2003. *Risk Anal* **25**, 1457–1469.
58. Boykoff MT & Rajan SR (2007) Signals and noise: mass-media coverage of climate change in the USA and the UK. *EMBO Rep* **8**, 207–211.
59. Antilla L (2005) Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environ Change* **15**, 338–352.
60. Smith K, Cho J, Gielen A & Vernick J (2007) Newspaper coverage of residential fires: an opportunity for prevention communication. *Inj Prev* **13**, 110–114.
61. Durrant R, Wakefield M, McLeod K, Smith K & Chapman S (2003) Tobacco in the news: an analysis of newspaper coverage of tobacco issues in Australia, 2001. *Tob Control* **12**, ii75–ii81.
62. Lang T (2005) Food control or food democracy? Re-engaging nutrition with society and the environment. *Public Health Nutr* **8**, 730–737.
63. Beauman C, Cannon G, Elmadfa I *et al.* (2005) The principles, definition and dimensions of the new nutrition science. *Public Health Nutr* **8**, 695–698.
64. Anon. (2005) The Giessen Declaration. *Public Health Nutr* **8**, 783–786.