

Commentary and Responses

Editors' Preface

As the Editor-in-Chief of *Renewable Agriculture and Food Systems (RAFS)*, I received an e-mail from Alex Avery, Director of Research at the Center for Global Food Issues on 10 September 2007. It read, 'Dr. Doran, as a non-subscriber to *RAFS* I do not know where to submit the following set of misrepresentations and errors in the paper published in July in *RAFS* by Badgley et al. from the University of Michigan. Thus, I am sending it directly to you.'

In response, I stated that his 'critique' of the Badgley et al. paper entitled 'Organic agriculture and the global food supply', which was actually published in June (not July), would be presented as a Commentary critique together with an editorial response from the authors, and those involved in the peer-review process in an upcoming issue of *RAFS*.

The Editorial staff has decided to publish the Avery 'critique' as a Commentary in the Journal with responses from the authors, Catherine Badgley and her co-authors, and William Liebhardt, who were the main subjects of

Avery's criticism. Publication of the Commentary and responses is done in the interest of fair play and a desire to provide all viewpoints on the important issue of meeting future food and resource needs as indicated by the Editorial in the June, Vol. 22(2), issue of *RAFS* entitled 'Balancing food, environmental, and resource needs'.

In that Editorial, a paraphrased quote has particular relevance to the current debate: 'Ultimate success in alleviating hunger, malnutrition, poverty and global resource degradation in the technically complex 21st Century will not come solely from intensive input or organic agriculture but rather a hybridization of both approaches.' It is my hope that we can move forward as a civilization as we LISTEN and LEARN from each other with the primary goal of achieving a more sustainable and equitable agriculture, whatever the approach taken.

John W. Doran
Editor-in-Chief, *RAFS*

'Organic abundance' report: fatally flawed

Alex Avery

Director of Research, Hudson Institute's Center for Global Food Issues, Churchville, VA, USA.
September 2007

Commentary

Abstract

Fatal flaws in the recent report from Badgley et al. claiming that organic agriculture 'could produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without increasing the agricultural land base'. Among the serious problems identified: over 100 non-organic yield studies were claimed as organic; organic yields were misreported; false comparisons were made to unrepresentative low non-organic yields; high organic yields were counted 2, 3, even 5 times by citing different papers that referenced the same data; favorable and unverifiable 'studies' from biased sources were given equal weight to rigorous university studies. This report is being submitted to the Editor of the journal, *Renewable Agriculture and Food Systems*, for publication and response. It is only being released in the interest of public debate and discussion during the much-touted 'organic fortnight'.

The recent report from Catherine Badgley et al. at the University of Michigan (*Renewable Agriculture and Food Systems*, June 2007) claimed that 'organic agriculture has the potential to contribute quite substantially to the global

food supply' and said, 'organic methods could produce enough food on a global per capita basis to sustain the current human population, and potentially an even larger population, without increasing the agricultural land base'.

© 2007 Cambridge University Press

This claim is simply not credible given the following internal fatal flaws:

1. claiming yields from non-organic farming methods as organic;
2. comparing 'organic' yields to non-representative 'non-organic' yields;
3. double, triple, even quintuple counting of organic yields from the same few research projects;
4. omitting non-favorable crop yields while using favorable yields from the same studies;
5. misreporting yield results.

Non-organic Yields Used to Inflate Organic Productivity

In perhaps the most brazen example of research misrepresentation in decades, 105–119 studies claimed as 'organic' by the University of Michigan group were not organic. Only 11–21% of 'developing world' yields cited were from studies actually using organic farming methods. Some 'organic' examples even used genetically modified organisms (GMO) crops; many (if not most) used synthetic fertilizers and pesticides. The researchers did not provide enough detail to determine the exact number of misrepresented studies, but their main source (Pretty and Hine, 2001) stated clearly in their reports that only 14 of 208 studies in their database are 'organic'. The Michigan group relied on 70 of these for their paper. They also labeled as 'organic' 49 yield ratios from the 'System of Rice Intensification' which is not organic. Combined, these represent 79–89% of the 133 'developing world' yield ratios included in the study.

As an example, Badgley et al. claim that organic methods increased Argentine maize yields by 37% (source: Roberto Pieretti in 'Pretty and Hine, 2001'). In fact, this statistic comes from Argentine farmers using herbicides to kill weeds, growing GMO herbicide-tolerant soy, GMO insect- and herbicide-resistant maize, and extensively using synthetic fertilizers and organic-prohibited pesticides. To label these yield gains as 'organic' is absurd (source: personal communication, Mr Roberto Peiretti, past president of the Argentinean No-Till Farmers Association, 31 August 2007).

Another misrepresentation is China maize yield increase of 38%, reported from the East Gansu project run by the Chinese government. The primary source (Pretty and Hine, 2001) reports that 'Grain output and food per capita [in the project area] have increased greatly because of improved crops varieties, runoff harvesting and water-saving irrigation, *and fertilizers and pesticide use*' [emphasis added].

These facts are made clear in the research reports used in the Badgley et al. report, so their ignoring the non-organic reality of these projects is hard to explain. It is especially hard to explain given supervising author Ivette Perfecto's clear statement in a press release issued by the University of Michigan that 'My hope is that we can finally put a nail in the coffin of the idea that you can't produce enough

food through organic agriculture' (press release available at <http://www.ns.umich.edu/htdocs/releases/story.php?id=5936>; verified 27 September 2007).

False Comparisons with Low Non-organic Yields

The amazingly high yield increases reported in the developing world should have been a red flag that the non-organic yields used in the comparisons were uncommonly low.

For example, Badgley et al. report one study where Peruvian organic potato yields were 340% higher than non-organic (yield ratio of 4.40). Yet the 'higher' organic potato yields (reported as '8000 to 14,000 kg/ha', or 11,000 average) are below the year-2000 average potato yield for Peru, reported by the United Nations Food and Agriculture Organization (FAO) at 11,221 kg/ha in the year 2000. Many farmers in developing countries using non-organic methods report potato yields well above 15,000 kg/ha and non-organic potato yields in developed countries are routinely above 40,000 kg/ha—each considerably higher than the 'high' organic potato yields.

Double, Triple, even Quintuple Counting of Yields from the Same Research Projects

The paper claims to analyze a 'global dataset of 293 examples', yet there are numerous instances of repeated counting of yields from the same long-term studies.

For example, the maize yields from the long-term Farming Systems Trial project conducted by the pro-organic Rodale Institute (Kutztown, PA, USA) are reported four times: once in a 'case study' in a 1989 report from the National Research Council, twice in a report from Pimentel et al., and once in a 2001 newsletter article by Bill Liebhardt.

Soy yields from the same Rodale FST project are reported five times: once by the 1989 NRC report, once by Liebhardt, once by Hanson et al., and twice by Pimentel et al.

Omitting Non-favorable Crop Yields and Cherry-picking Data

The paper reports the favorable yields of specific organic crops from research, while omitting the unfavorable yields of other crops reported in the same research. In addition, non-favorable study results from organic research groups were entirely omitted.

Four different favorable potato yield ratios are cited from one research project in Germany (90–106% of non-organic yields), while unfavorable organic potato yield data (75% of non-organic potato yields) published in the very same journal in which the Badgley paper appeared was omitted! (Gallandt et al. 1998. *American Journal of Alternative Agriculture* 13:146–161, which is now *Renewable Agriculture and Food Systems*).

The paper cites four separate favorable yield ratios for wheat from the first 3 years of a long-term California research project (McGuire et al., 1998), but they omit the drastically lower organic maize yields from the same project reported in 2004. The non-organic maize yields were 52% higher than the organic from 1996 to 2004. This result in particular calls into question one of the Michigan group's major claims: that organic farming can obtain ample nitrogen by growing off-season green-manure crops to replace the inorganic synthetic nitrogen fertilizer that currently underpins roughly half of global crop production. In this case, the legume crop costs half the ensuing corn crop. Thus, the green-manure strategy, implemented worldwide, threatens a major cropland expansion due to lower per acre yields and the ensuing loss of wildlife habitat and biodiversity.

Moreover, while there were 'no statistical differences in tomato yields among [the different systems]' during those 8 years, conventional irrigated wheat yields were nearly 30% higher than irrigated 'organic' wheat over the same period.

Many of the studies cited by Badgley et al. are from organic activists with a clear agenda in reporting only high organic yields. The Michigan researchers call these sources 'grey literature', but a more accurate term would be 'biased observers with a clear economic and reputational stake in the outcome'.

For example, there are numerous yield ratios gleaned from reports from 'biodynamic' societies such as the Anthroposophic Society, the Institute for Biodynamic Research, and anti-GM/anti-conventional agriculture pressure groups such as Food First.

This clearly skews the results. A recurrent source for 'developed country' yield ratios is an article written by Bill Liebhardt, published in the quarterly newsletter of an organic promotion organization. Liebhardt cites a 0.95

yield ratio for organic maize following a legume–soybean rotation in comparison to continuous maize yields—despite the fact that the same research Liebhardt cites shows that non-organic maize following soybeans out-yields organic by 10–30%. This is a clear case of favoring the organic perspective.

More egregiously, Liebhardt combines tomato yields from two separate projects to claim 'equal' organic tomato yields when the studies he cites found organic tomato yields were significantly lower yielding. In the first 3 years of one project, non-organic tomatoes out-yielded organic by 66%. So in the fourth year, the researchers started giving the organic tomatoes a literal head start by transplanting tomato plants started weeks earlier in a greenhouse—while still using tomato seeds in the non-organic plots. Yet the non-organic tomatoes continued to out-yield the organic by an average of 20% in the following 4 years. So in year 7 of the project, the researchers tripled the amount of poultry manure applied to the organic plots, giving the organic tomatoes 3–4 times more nitrogen than the non-organic. Only after all these changes did the organic tomato yields surpass the non-organic by 9%. Even then, organic fruit quality was lower, used more irrigation water, had far greater weed problems, and cost hundreds of dollars more per acre to grow—losing money without a high price premium.

Misreporting of Yields

The authors simply misreport organic yields compared to conventional in at least one instance. Badgley et al. report that organic apples achieve 100% equal yields (ratio of 1.00) in a study published in *Nature* (Reganold et al. 2001. *Nature* 410:926–930). The study actually reported that organic apples achieved only 93% of non-organic yields (ratio of 0.93).

Strengthening the case for organic agriculture: response to Alex Avery

Catherine Badgley, Ivette Perfecto, M. Jahi Chappell and Andrea Samulon¹

University of Michigan, Ann Arbor, MI, USA.

Response

The paper by Badgley et al. (2007), 'Organic agriculture and the global food supply' (*RAFS* 22(2):86–108), presents

the case that organic agriculture has the potential to feed the current human population. This conclusion comes from an analysis of 293 yield ratios comparing organic to non-organic production in studies from around the world. In addition, we present data from temperate and tropical agroecosystems showing that leguminous cover crops grown

¹Current address: Rainforest Action Network, San Francisco, CA, USA.