The Local Organic Food Paradigm

Alex A. Avery and Dennis T. Avery

Over the next fifty years, human society and plant science will face the greatest conservation and humanitarian challenge in history: provide the means and the resources to support 9 billion members of the world population without imposing severe infringements on the environment and the climate. Yet, today, farmers are often told they should produce this abundance organically and locally, with half the system yields per acre of conventional farming, and despite the limitations of regional climate, soils, institutions, and infrastructure. Farmers are asked to grow energy crops that add massive and unnecessary burdens to farmland and other natural resources. Together, these are impossible demands based on a touching faith in the past successes of plant science. As in all things human, hard choices must now be made. We cannot produce meaningful amounts of biofuels and still have a relatively low-cost food supply. We cannot have a food supply that is abundant and cheap on the one hand and organic on the other. Moreover, we cannot have a predominantly local food system while simultaneously maintaining meaningful food security.

Biofuels add a significant burden to the global farm resource base. In particular, an increase in biofuels production will affect food prices and could result in habitat destruction. This paper will investigate the patterns in local and organic food agriculture and will specifically delve into the understated and sometimes neglected limitations of this pro-

Alex A. Avery is director of research at the Hudson Institute's Center for Global Food Issues.

Dennis T. Avery is director of Global Food Issues for the Hudson Institute of Washington, D.C. He was formerly the senior agricultural analyst at the U.S. State Department, where he won the National Intelligence Medal of Achievement. His latest book, co-authored with climate scientist S. Fred Singer, is *Unstoppable Global Warming—Every 1,500 Years.*

duction paradigm.

The world will more than double its demand for food and feed in the next fifty years due to two factors.[1] The first increase in demand will be from the expected 50 percent increase in global population. The world population will rise from today's 6.5 billion to a peak population of 9 to 10 billion by the middle of the century, entering a slow decline in growth toward the latter half of the twenty-first century. Second, rising personal incomes in developing economies are gradually leading to a shift from subsistence diets comprised mainly of cereals to more affluent diets higher in animal protein. Instead of supporting today's 1.5 billion affluent consumers, the world of 2050 will have to satisfy approximately 5 to 7 billion. Producing one calorie of animal protein requires more farm resources—land, water, and crop nutrients—than a calorie of cereals, such as corn, wheat, rice. This phenomenon already exists in China, where the per capita consumption of meat doubled between 1990 and 2000 because personal incomes more than doubled.[2] Demand for clothing fiber and pet food will also increase as populations amass wealth. If China alone reaches the United States' pet ownership density, the world will have to feed an additional 500 million additional cats and dogs each day.[3]

A predominantly local food system is a recipe for failure and possible famine.

Local Vs. Global Food Systems.

Given this major food challenge, many reactionaries advocate a return to "local" food systems rather than the increasingly global, integrated system that dominates trade today. Perhaps it is a natural inclination for those living in turbulent times to yearn for the simplicity and seeming security of the days of yore. Such advocacy is based on two fundamental viewpoints. First, many believe that foods produced locally are more resource and energy efficient because they do not require long-distance transportation and are hence more sustainable and environmentally friendly. Second, it is commonly advocated that a local food system provides greater food security for a population, promoting self-sufficiency by retaining control over production and supply chains. Both beliefs are suspect. A predominantly local food system is a recipe for failure and possible famine.

Local food production is not an efficient use of land inputs. When compared with globally integrated food systems that specialize on producing foods depending on where they grow best, local farmers do not have the same flexibility and require more land and energy to produce the same amount of food. Sugar and potato cultivation set a good example. Europe and the United States both produce significant amounts of sugar (sucrose) by growing sugar beets in cooler climates, such as the Northern Midwest. However, growing sugar cane in the tropics, by benefiting from multi-cropping and higher gross sugar yields from cane, produces about twice as much sugar per acre than the method of cultivating sugar beets. In contrast, potatoes grow best in

the cooler, temperate regions of North America and Europe. It makes the most environmental and economic sense to produce the world's sugar in the tropics and the world's potatoes in the temperate areas, and then to trade. Both regions would end up more "food rich" from trade and will also exhaust fewer land and farm resources required to produce a given amount of sugar and potatoes.

Opponents of global food trade often believe that the energy used to transport foods over long distances is high, but modern, long-distance transport networks are actually extremely efficient. Crops and commodities are mostly moved by rail and container or by bulk shipping, various transportation means that are very efficient per unit of food moved. Only the highest-value crops and farm products are transported by air. A recent analysis by Manchester Business School in the United Kingdom observed food lifecycle analyses and found no clear evidence in environmental terms to support locally-sourced rather than globally-sourced shopping. In fact, local food systems sometimes have a greater environmental impact than global food production and distribution by failing to exploit the benefits of comparative advantage and by using smaller and partially loaded trucks that are less energy efficient per unit of product transported, despite the long distances involved.[4] The low prices on long-distance rail and sea transport show that these methods have become increasingly efficient.

In regards to food security, a local farm project is a lot more susceptible to various risks associated with the climate and the environment. Reliance on an individual region ultimately makes the producer and the consumer vulnerable to local pest and disease outbreaks and regional climate extremes such as drought or flooding. In contrast, a global food system that sources its product range from various locations is much more stable and secure. When one area experiences a devastating drought, others harvest a bumper crop. A global, integrated food system increases food supply security and distributes production risks globally by exploiting comparative advantages in climate, land, labor, and infrastructure inputs. This leads to a final benefit of a globally integrated food system: democratic societies that are interdependent on one another for basic foodstuffs are less likely to engage in conflict.

The Organic Straightjacket.

Another popular belief is that organic farming is more environmentally friendly than farming with chemicals. But here too, the reality is not as it seems. By far, agriculture is responsible for humanity's most dramatic impact on the planet and its ecosystems. Including pastures, 42 percent of the earth's land is already used for agriculture. We are farming half of the earth's land surface not covered with ice or desert, while more than two-thirds of human water use is used for farming.[5]

Unfortunately, developed countries are undergoing an anti-science campaign spearheaded by relatively small—but loud and effective—groups ranging from anti-technology activists, population growth opponents, and global warming alarmists to organic food proponents. We have all watched the demand for organic foods increase dramatically over recent decades, stemming from unsupported marketing assertions that organic foods are "safer" and "more nutritious." Not one of these claims has been empirically proven in the seventy-

five year history of the organic movement, and every professional food safety and nutrition organization has dismissed such claims. In the United Kingdom, for example, the Advertising Standards Authority prohibits organic marketers from claiming that organics offer increased safety or nutritional value, since the industry has yet to produce credible supporting evidence.

Without converting nearly all of the world's remaining wildlife habitat into farmland, organic farming methods simply cannot stock affluent consumers' demand for 9 billion protein-rich diets. In the context of the entire farm market, total yields from organic fields are little more than half as high as those from comparable high-yield farms. The measured yields per acre are typically 15 to 40 percent lower than from conventional farms, depending on the crop. However, organic farmers suffer the biggest productivity penalty when they refuse to use synthetic nitrogen fertilizer.

The invention of synthetic nitrogen fertilizer, in fact, spawned the organic food movement at the end of World War I. As the world's population grew in the seventeenth and eighteenth centuries, the lack of nitrogen fertilizer became a significant limiting factor in food production. In 1909, Fritz Haber and Carl Bosch invented a process to compress atmospheric air, which is 78 percent di-nitrogen, under heat and pressure to sustainably develop ammonia (NH_4) and nitrate (NO_3) for fertilizer. Both Haber and Bosch were eventually awarded separate Nobel Prizes for their invention, which is considered one of the most important technological advances in history. Without synthetic "fixed" nitrogen, far more land would need to be devoted to growing livestock forage, to produce manure in abundance, or nitrogen-fixing "green manure" legume crops. Green manure is the term for a legume crop that is grown and then plowed into the soil to fertilize a subsequent non-legume crop, rather than to be harvested.[6]

This inherent limit to organic productivity can be seen in the conclusions of a high-level Danish government report on the impacts of producing 100 percent organic crops. The Bichel Committee reported in 1998 that an all-organic farming mandate for Denmark would cut human food production by 47 percent, a task requiring the conversion of large portions of farmland presently used to grow food crops into areas for cattle foraging—to produce organic fertilizer from manure.[7] Professor Vaclav Smil, author of *Enriching the Earth*, estimates that giving up synthetic nitrogen fertilizer would require the manure from 5–7 billion additional cattle, or more than 5 times the current global cattle population.[8] The world simply does not have the extra land to "go organic" unless we convince billions of consumers to switch to an austere vegan diet or starve hundreds of millions of people.

A recent report from a group of environmental researchers at the University of Michigan garnered significant media attention by claiming that the world could *increase* its food production by "going organic."[9] Yet a detailed examination of their paper reveals that the authors claimed as "organic" the yield increases from studies using synthetic fertilizers, pesticides, and genetically-modified crops. In addition, they included yield increases from studies of highly dubious quality, conducted by organic activist groups, many of which compared "organic" yields to unrepresentatively low "conventional" crop yields

from extremely resource-poor farmers. This creates an illusion of organic yield increases that the majority of farmers cannot achieve.[10] In an editorial response published in the same issue of the journal, University of Nebraska agronomist Kenneth Cassman stated bluntly, "Their analyses do not meet the minimum scientific requirements for comparing food production capacity in different crop production systems."

Additionally, the analysis glosses over the fundamental lack of organic nitrogen fertilizer to grow these crops, stating that enough nitrogen could theoretically be fixed by growing legume crops in between food crops. But as Craig Meisner of Cornell University summarized in a recent article, "For such a crop to be used in Bangladesh, it would have to take the place of a food crop, effectively halving the amount of food the land can provide."[11] He also cites a recent study showing that the biochemical makeup of plants grown in purely organic conditions is no different from those cultivated with fertilizers.

Can Humanity Afford to Reject High-Tech? The Green Revolution is the antithesis of organic farming. Pioneered by plant breeding and supported by increased use of synthetic nitrogen fertilizer, pesticides, and irrigation, the revolution and its strategies have been opposed by a range of professional environmental activists and non-governmental organizations (NGOs), including Greenpeace and the Sierra Club. More recently, activists have led a campaign against genetically modified crops that has been highly successful in well-fed Europe, an initiative that has influenced regulatory policies in developing countries.

In 2002, the government of Zambia rejected U.S. food aid, stating that the corn was "poison" because of testimonials by European and North American biotech NGO critics. One pundit told a delegation from Zambia that biotech corn was fit only for livestock feed and that regulatory authorities "would never have approved" biotech corn if the authorities "felt that a sizeable portion of the populations of people consuming [it] would eat it directly. . . [or if] the corn might make up as much as half or two-thirds of daily caloric intake."[12] In fact, all biotech food crops pronounced fit for human consumption by the U.S. Food and Drug Administration and other food safety authorities have been approved under an assumption of high direct consumer consumption. Five years after the events in Zambia, no credible incident of biotech crops harming either humans or the environment has surfaced anywhere in the world.

There are numerous biotech virus-resistant crops that are available but yet sit completely unutilized on the shelves of universities and private companies due to the souring of public opinion affected by anti-biotech NGOs. Golden Rice, engineered to produce beta-carotene to prevent blindness and death in millions of children from vitamin A deficiency, is already in field trials at the International Rice Research Institute in the Philippines. When the product reaches farmers' fields, tentatively after 2009, it will help improve the nutrition of millions and prevent the needless deaths of tens of thousands each year.

Herbicide tolerant crops drastically reduce soil erosion from plowing by allowing farmers to control weeds without disturbing the soil. This practice, "no tillage" or "no-till" farming, is the most significant advance in agricultural

sustainability over the past seventy-five years. While there are some legitimate safety concerns about the misuse of herbicides, they have been used without major incident for more than fifty years. Moreover, biotechnology is influencing farmers to use the safest, most eco-friendly herbicide. For example, glyphosate, commonly known as Roundup, has such a strong safety profile that environmental agencies routinely use it to combat harmful, non-native invasive weeds emerging in sensitive wetland environments. Moreover, glyphosate is half as toxic as table salt and rapidly breaks down into harmless by-products.

Not only did the Green Revolution save lives, it also saved an estimated 16 million square miles of global forests from being cut down and converted into farm fields.

The Conservation Tillage Information Center reports that no-till fields gained 590 pounds of soil carbon per acre, increased their earthworm numbers by three- to six-fold, and provided improved habitat for birds.[13] In the United States today, conservation and reduced tillage systems encouraged by genetically engineered, herbicide-tolerant crops account for more than 60 percent of corn and full-season soybean acres, as well as more than three-quarters of double-cropped soybean acres.[14] Combined, these account for more than 160 million acres and represent a significant advance in sustainability.

Far from helping only developed country farmers, as is often claimed, herbicide-tolerant crops can directly help improve the food security of millions of small-holder farmers in Africa. With a natural tolerance for the herbicide *imazapyr*, corn has been shown to dramatically reduce the threat of the endemic African crop parasite witchweed called *Striga*. This scourge lurks in 40 million hectares of African cropland, infects plants via their roots, and can reduce harvestable grain yields to zero. Pioneer Hi-bred International discovered the herbicide-tolerant corn variety and made it available to the International Maize and Wheat Improvement Center in Kenya for crossbreeding into African farmers' corn varieties. Treating the seeds with the herbicide confers protection against *Striga*, killing it upon infection of the newly sprouted corn plant. Yields have increased up to four-fold during field trials in *Striga*-plagued areas of Africa. Claims that African farmers lack the knowledge and financial resources to utilize these crops are unfounded.[15]

Science, Regulation, and Solving Real Problems. Though free trade will increase the challenges to plant health, the land use efficiency advantages of globalization are too great to ignore. The ongoing trend for increased global trade in food and fiber requires an equally advanced and adept global system for regulating and facilitating trade in farm products, especially with regard to the rapidly expanding portfolio of genetically modified crop varieties. Yet, the

current regulatory system under the WTO is proving cumbersome and susceptible to political manipulation.

The Green Revolution of the 1960s achieved a near-miraculous tripling of crop yields on much of the world's high-quality land, with its plant breeders leading the effort. Thanks to the momentum from the world's past investments in education and agricultural research, farm productivity has continued to increase significantly in the years since 1970. Plant science overcame the 1960s specter of a billion starving Asians thanks to the Green Revolution, the intensive effort to breed higher-yielding crop varieties and the increased use of pesticides and synthetic nitrogen fertilizers. Not only did the Green Revolution save lives, it also saved an estimated 16 million square miles of global forests from being cut down and converted into farm fields. The challenge today is to repeat the success of the Green Revolution.

Anti-biotech propaganda does not cause Americans much inconvenience, but what about the tens of millions of children suffering blindness from severe Vitamin A deficiency that could easily be remedied by eating Golden Rice? Over-regulation of this single innovation has already delayed the rice's planting by at least five years, contributing to the needless death each year of an estimated 40,000 in India alone.[16]

The only strategies available to meet the real and unavoidable challenge of soaring food and fiber demand are the following: first, to increase free world trade in farm products so that each country can produce the goods in which it has the greatest comparative advantage, thereby allowing the densely populated regions to import food products they are unable to grow at home; second, to apply even more science and technology to create higher-yield farming. Though neither of the two is actively embraced and implemented by the developing or the developed nations, these policies have a vast potential to create food sustainability and security. Given the current population growth, consumption patterns, and the depletion rates of natural resources, the twenty-first century food challenge is quickly approaching. The stakes for humanity and the planet have never been higher.

NOTES

1 Robert Thompson, "Overcoming Supply Side Constraints: Making the Agricultural Sector a Priority," presentation to the International Food and Agricultural Trade Council, June 2006.

2 "China Livestock Sector Brief, 2005" Food and Agriculture Organization of the UN, http://www.fao.org/ag/againfo/resources/en/publications/sector_briefs/lsb_CHN.pdf.

3 "Pet Food and Pet Care Products in the United States.," Euromonitor International, 2005.

4 Foster, Chris, K. Green, M. Bleda, P. Dewick, B. Evans, A. Flynn, and J. Mylan. "Environmental Impacts of Food Production and Consumption: A Report to the Department for Environment, Food, and Rural Affairs," Manchester Business School, 2007.

5 "World Agriculture: Towards 2015/2030," UN Food and Agriculture Organization, 2002.

6 Mäder, Paul, Andreas Fließbach, David Dubois, Lucie Gunst, Padruot Fried, and Urs Niggli, "Soil Fertility and Biodiversity in Organic Farming," *Science* 296 (2002): 1694-1697.

7 Alex Avery, *The Truth About Organic Foods* (Chesterfield, MO: Henderson Communications, 2006).

8 "The Bichel Committee Report," Miljøstyrelsen, http://mst.dk/udgiv/publications-/2001/87-7944-622-1/pdf/87-7944-624-8.pdf.

9 Vaclav Smil, in discussion with the author.

10 Badgley, Catherine, Jeremy Moghtader, Eileen Quintero, Emily Zakem, M. Jahi Chappell, Katia Avilés-Vázquez, Andrea Samulon and Ivette Perfecto, "Organic Agriculture and the Global Food Supply," *Renewable Agriculture and Food Systems* 22 (June 2007): 86-108.

11 Alex Avery, "Organic Abundance Report Fatally Flawed," *Renewable Agriculture and Food Systems* (December 2007).

12 Craig Meisner, "Why Organic Food Can't Feed the World," *Cosmos Magazine*, 24 September 2007.

13 Charles Benbrook, in discussion with Zambian delegates, 2002.

xivDan Towery, "Conservation Tillage and New Technology," Conservation Tillage Information Center, 2002.

15 "National Crop Residue Management Survey," Conservation Technology Information Center, in discussion with author,

http://www.ctic.purdue.edu/ctic/CRM2004/1990-2004data.pdf.

16 De Groote, Hugo, Lucy Wangare, and Fred Kanampiu, "Evaluating the Use of Herbicide-Coated Imidazolinone-Resistant (IR) Maize Seeds to Control *Striga* in Farmers' Fields in Kenya," *Crop Protection* 26, no. 10 (October 2007): 1496-1506.

17 Ingo Potrykus, in discussion with author, 2007.