

# ***The Future of Food Systems: Global to Local***

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## **INTRODUCTION**

In agreeing to talk about the future of food systems, I'm venturing down a dark path where people from Thomas Malthus to the creator of Soylent Green have already walked. Mark Twain liked to say, "Prophecy is a good business, but it's mighty risky." Prognostication about food is especially risky. You might remember the prediction that we'd be popping pills by the year 2000 that would supply all of our bodily needs in one gulp... but instead we got Slow Food. And even astronauts get something more like real meals than squeeze packets now, because NASA has recognized that they need "authentic tastes".

The cultural historian Warren Belasco recently published a very entertaining book called Meals to Come: A History of the Future of Food. His thesis is that concerns about future food security are triggered by social turbulence, and the solutions that people put forth have more to do with their sociopolitical leanings than any objective evidence. At one end are the people fixated on limits and competition, like Malthus, who predict that food supplies are running out quickly and will inevitably deteriorate in quality over time. We might put in that category the folks who are especially concerned right now about conflict between growing biofuels and grains on limited arable land. At the other end of the spectrum are the Cornucopians, who predict a future of technological abundance. We might put the folks who predict that biotechnology will solve our food needs and hydrogen fuel cells will power the food system in that category.

I can't guarantee that I can see the future any more clearly than any of you can, but I hope that I'll provoke some thought and interesting discussion. What I'd like to do in my time with you is first, talk about how we conceptualize sustainability of food systems, because I think this determines the futures we are able to visualize. Second, I'll discuss some of the global environmental, health and sociodemographic trends affecting the sustainability of food systems, then talk about structural changes in the global food system and some of the options that are cropping up. There has been growing interest in local and regional food systems in the US, which have many potential benefits. I'll end with how we can help ensure that local food systems capture their potential advantages and move toward greater sustainability, and what the role of land-grant universities is.

## **CONCEPTUALIZING SUSTAINABILITY IN THE FOOD SYSTEM**

Food systems link social and natural systems. Sustainable food systems are most commonly depicted with a Venn Diagram, showing sustainability as the convergence of environmental quality, economic profitability and some social good. I would like to see this diagram put to rest forever, because I think it does more harm than good. Some of the questions it fails to answer include what exactly is being sustained and for whom. It implies that there are trade-offs among these three realms---that we might get a little more economic profitability, say, by squeezing out some environmental quality. And it implies that the three realms are of comparable importance.

However, socioeconomic attributes of food systems are always nested within and constrained by environmental rules. A second depiction of sustainable food systems conveys this better. We have ignored and violated these rules, and our options are changing as a consequence. I will talk about these rules in a minute, but first want to suggest a third conceptualization of sustainable food systems. We can think of the aspects we value in the food system---health of our children, thriving farms, working landscapes, biodiversity, other ecosystem goods and services---as eggs in a nest. Or, to make it simpler to sketch, as marbles in a bowl sitting on a table. The nest or bowl is made up of cultural traditions, institutions, and policies---the socioeconomic structures that humans create to manage food systems. Various forces are pushing on that tree, or rocking the table. The task of sustainable food systems is to keep the nest from being blown out of the tree (or the bowl from spilling all the marbles out). The shape and features of the nest or bowl determine whether it can be

sustained. Two characteristics of food systems that have a great deal of influence on whether they are sustainable are their resilience and adaptive capacity. We need both in abundance, to deal with the forces impinging on the food system now.

## **FORCES AFFECTING THE GLOBAL FOOD SYSTEM**

1) Climate change is the most important environmental force affecting the food system now. The 4<sup>th</sup> Assessment of the Intergovernmental Panel on Climate Change, which just started coming out at the beginning of this month, gave us the clearest statement we are likely to get from the world scientific community that climate change is real, humans caused it, it's already on us, and it will get a lot worse before it gets better.

Food systems aggravate climate change in many ways:

- a) The transportation sector accounted for about 27% of total US greenhouse gas emissions in 2003.
- b) Food is involved because of rising "food miles", or the distance food travels from farm to plate. In one Maryland study done a few years ago, the average distance produce traveled in the year 2000 was about 1,700 miles, a 25% increase since 1980 (Hora and Tick 2001). Other estimates range from 1,500 to 2,500 miles (Halweil 2002). The exact number isn't especially important---what matters is that the food system is generating greenhouse gases to distribute food.
- c) Another contributor to food miles is that we are eating more imported food. Overall US food imports are still rather low---the percent rose from 7 to 8.8% between 1992 and 2000---but the trend is up.
- c) Livestock contributions are also significant, according to a February report from the Food & Agricultural Organization or FAO (Livestock's Long Shadow) which attributed more greenhouse gas emissions to the livestock industry than to transportation. The livestock sector is the largest anthropogenic user of land: total area used for grazing is 26% of ice-free terrestrial surface and 33% of arable land is used to raise feed.

Of course, food production, packaging and distribution are only part of the behaviors and industries causing global climate change. In combination, the impacts are severe and have serious implications for food systems. Among the most important impacts are rising temperatures, greater storm intensity, sea-level rise, and species migration. In Massachusetts, temperatures by the year 2100 are predicted to increase by about 4 degrees F. in winter and spring and about 5 degrees F. in summer and fall, and precipitation is estimated to increase by about 10% in spring and summer, 15% in fall, and 20-60% in winter. The amount of precipitation on extreme wet or snowy days in winter is likely to increase, while the frequency of extreme hot days in summer would also increase. This means that heat-related deaths could increase by 50% by the year 2050. Predicted sea-level rise---one of the more contentious climate change impacts, since estimates of how quickly the Greenland Ice Sheet and West Antarctica Ice Shelf are melting have been revised upward quite recently---is likely to wipe out significant real estate in Cape Cod, the south-facing shore of Massachusetts and Rhode Island, and low-lying parts of Boston. Hopefully our politicians will start addressing climate change in a serious way before the predictions get worse.

2) The next most important force impinging on food systems is water shortages, due to overpumping, degradation of groundwater and surface water and competition for use. Water shortages are intimately connected with climate change; even in regions where the amount of precipitation will increase, the amount of usable freshwater may not go up because the precipitation will occur as extreme events. The FAO predicts now that 64% of the world's population is expected to live in water-stressed areas by 2025.

3) The third most important force affecting food systems may be loss of biodiversity and crop biodiversity. Human activities have led to massive species extinctions, including crop and livestock genetic resources. Of more than 7,600 breeds in the FAO's global database of farm animal genetic

resources, 190 have become extinct in the past 15 years and a further 1,500 are considered at risk of extinction.

4) A fourth force affecting agriculture is the “peak oil” phenomenon, or the point at which global oil production is at its highest level. This seems to track the date at which oilfield discovery peaks in any given area in a predictable way, leading most industry analysts to claim that global oil production is peaking right about now. Even though this means that there is as much oil remaining underground as has been extracted to date, it will become increasingly difficult and expensive to get. Since every stage of the food system, from producing fertilizer to hauling off food waste, depends on fossil fuel now, peak oil portends increasing prices or the need to dramatically change how we produce and supply food.

5) A fifth force affecting agriculture is the emergence of new infectious diseases, such as AIDS and BSE, as well the resurgence of antibiotic-resistant strains of some “old” diseases such as malaria. Like water shortages, many infectious diseases are closely connected with global climate change. Increasing temperatures mean not only that infectious disease vectors but other kinds of crop pests as well move into areas they have previously been restricted from because of regular freeze cycles. Avian flu, the latest global infectious disease scare, has killed 164 people to date (mostly in Asia) and about 200 million birds have died or been killed as a result. (Little-known outbreak in a Florida trailer park)

6) Moving to sociodemographic forces affecting food systems, the most consequential are probably increasing urbanization and population. The ways in which a population uses technology are even more important than their actual numbers in affecting its ecological footprint and impacts on sustainability. A third sociodemographic force to be reckoned with is increasing rates of migration, again associated with climate change as sea-levels rise and force people out of low-lying areas. Several small island nations have already been evacuated because of sea-level rise, and given that most of the world’s population lives within a few miles of the coast, global migration could well have major impacts on where food is grown and who gets it.

## **HOW WELL IS THE GLOBAL FOOD SYSTEM FEEDING PEOPLE NOW?**

It’s fair to say that the global food system is out of balance. We see hunger rising in some parts of the world, at the same time that more and more grains are going to feed livestock or produce fuel and an epidemic of obesity threatens the well being of the next generation and overburdens health care systems. In the United States, 11% of households are food-insecure (12.6 million people); about 1/3 of these are food-insecure with hunger---this includes children in 270,000 households. Worldwide, about 850 million people are malnourished and about 1 in 4 children has protein-energy malnutrition; more than 70 percent of children with PEM live in Asia, 26 percent in Africa. Although some progress has been made toward meeting the Millennium Development Goal of halving hunger and extreme poverty by the year 2015, countries in sub-Saharan Africa have reversed course and there are more people suffering hunger there now than a year ago.

In the US, 30% of adults 20 years of age and older—over 60 million people—are obese. The percentage of young people who are overweight has more than tripled since 1980: 16% of children and teens aged 6–19 years (over 9 million young people) are considered overweight. Globally, there are more than 1 billion overweight adults, and at least 300 million of them obese. Ironically, obesity and malnutrition can be present in the same populations because people who don’t have reliable access to high-quality food tend to buy cheap, high-calorie or high-fat foods that appease hunger pangs.

## **STRUCTURAL CHANGES IN THE FOOD SYSTEM**

The global food system has responded to the forces impinging on it and consumer demand in ways which dramatically affect control of food supply decisions, and distribution of wealth through the food system (that is, how much goes to CEOs of agribusinesses vs. farmers and farmworkers). We are seeing a bifurcation in the food system now along several planes: global and fragmented, market and

subsistence, “bottom-line driven” and multifunctional. The International Assessment of Agricultural Science & Technology for Development is using a schematic of food systems that my team created to show this. Right now, there is a massive domination of the food system by the first quadrant, but I’ll talk about some new value chains that are emerging in the fourth quadrant in just a few minutes.

The first quadrant is where we see impacts of increasing concentration in the food system, and the businesses located here are swallowing up most of the traditional independent businesses in the second quadrant by capitalizing on economies of scale. What we are seeing is a food system controlled by a smaller and smaller number of key businesses that have bottleneck functions. Most of these businesses are based in the US, UK and EU, although some South American and Southeast Asian agribusinesses are very strong. They acquire strength in a variety of well-documented ways: horizontal and vertical integration, globalization to allow buying cheap and selling at a profit, sophisticated marketing, and policy influence via substantial campaign contributions. And they have been very successful.

A commonly used measure of the degree of horizontal consolidation or concentration in a market is referred to as the four-firm ratio or CR4: the sum of the percentage of market shares of the four largest firms participating in the market. In the general economy of the United States, the level of horizontal consolidation or concentration settled between 40-45% for most market sectors in the 1980s and has remained in that range since then. Among economists who use the CR4 measure, a rule of thumb is that as the ratio increases above about 40% the market’s competitiveness begins to decline. The higher the ratio above that level, the less competitive the market. Yet some sectors of the food system have CR4s as high as the 80s now (grain-milling, beef-packing, poultry-processing, etc.) Concentration in the retail sector is the newest phase of integration into global value chains, and most advanced in the EU. Wal-Mart is now the largest supermarket globally, with its movement into the UK, India and China; it holds an estimated 20% of US retail grocery and consumables business. It is also the largest private employer in the US and Mexico. Concentration in retail doesn’t necessarily give consumers better quality food at lower prices, but the connection with global wealth couldn’t be clearer: five heirs of Sam Walton rank #17-21 in Forbes 2006 of the richest people in the world (they have slipped down in the ranks somewhat since 2004, when five heirs placed in the top 10).

## **EMERGING FOOD VALUE CHAINS**

While it’s important to pay attention to what is happening in Quadrant 1 in the IAASTD diagram with agribusiness concentration, some very interesting developments are occurring in Quadrants 3 and 4 too, as the food system has become more consumer-driven. This affects concentrated agribusinesses, but it is also creating a space that local and regional food systems are exploiting.

### ***Local and regional food systems***

By a local food system, I mean a food supply chain that allows farmers to interact directly with customers where they get their food. And by a regional food system, I mean a food supply chain that sources first from growers who are closest to the point of consumption; may involve brokers or intermediaries that allow producers to consolidate supply or buyers to consolidate purchasing power. Both systems are open and operate alongside global supply chains; even the most dedicated local or regional shoppers usually buy some globally sourced items, such as coffee and tea.

There are many signs of growth in local and regional food systems. For example, the Robyn van En Center for CSA Resources reports at least 1140 CSAs in the US (a number which is surely on the conservative side). There were at least 6020 community gardens in 38 cities as of ACGA’s last national survey in 1996. The Agricultural Marketing Service reported 4385 farmers’ markets in 2006, compared with only 1755 12 years ago. The Ag Census shows a 37% increase in direct marketing between 1997 and 2002. Massachusetts is a national leader in the growing local foods movement. We rank first in the nation for the value of average direct market sales per farm at \$24,900 per farm.

Why are local food systems growing so rapidly, despite the economic forces that are driving and rewarding concentration in most of the food system? They have several potential advantages:

1) They can improve the economic viability of communities and farmers. For example, a study in Iowa found that if consumers increased their fruit and vegetable purchases from local sources by 10%, total net impact of these additional local purchases would be \$302.4 million in new industrial output, \$112.6 million in labor income, and 4,094 new jobs. According to a Michigan study, doubling or tripling the amount of fresh produce that farmers sell in fresh produce markets could generate up to 1,889 new jobs across the state and \$187 million in new personal income (Cantrell et al. 2006). According to a recent UK study, money spent at a CSA was multiplied 250% in the local area, compared with just 140% when the same amount was spent in a supermarket.

2) A second advantage is that local food systems can help kids and adults understand where their food comes from and how it's raised. This is valuable to many consumers who feel disconnected from their food sources.

3) Local food systems can bring culturally appropriate foods to customers in ways that increase profits for local farmers. This has been demonstrated very nicely in Massachusetts with the ethnic marketing studies.

4) Local food systems can reduce greenhouse gas emissions. For example, an Iowa study found that producing and transporting 10% more of the produce in an Iowa-based food system would result in savings ranging from 280,000 to 346,000 gallons of fuel (depending on the production system and truck type), and a reduction in carbon dioxide emissions by 6.7 to 7.9 million pounds.

5) Local food systems can build public support for agriculture, especially more sustainable farming practices, because there is more direct contact between farmers and their customers and the public sees the aesthetic and economic value of farming more clearly.

6) Local food systems can improve public health and nutrition. CSA membership is associated with higher vegetable consumption by adults and children (which comes as no surprise to anyone who has ever bought a CSA share and tried to deal with mountains of greens and assorted other vegetables that keep coming relentlessly, whether you eat them or not). Local food systems can reduce risk from food contamination by containing it and keeping growers directly accountable to their customers. The plant thought to be responsible for the spinach contamination by E. coli O157:H7 a few months ago washes over 26 million servings of salad every week, and is one of two plants in the US to process 75% of precut salads. Michael Pollan summarized the situation: "In effect, we're washing the whole nation's salad in one big sink." The over-connectedness of the concentrated food system increases the probability of widespread contamination due to human error or intentional sabotage. In a study of agro-terrorism done a couple of years ago, the authors showed that only 4 grams of botulinum toxin dropped into a milk production facility could cause serious illness and even death for 400,000 people in the United States.

7) In a similar way, local and regional food systems can promote greater security and less vulnerability to disruption in food supplies. The global environmental, sociodemographic and structural trends we just discussed---peak oil, climate change, urbanization, increasing complexity and concentration---make our food system extremely vulnerable to disruption. Local food systems allow a lot more control of the food supply and buffer us from many kinds of disruptions. This final advantage of local and regional food systems may be the most significant, in the long run.

### ***Eco-labeling and various certification schema***

A second emerging alternative is differentiated by certification of attributes that the public values. Examples are organic food, eco-labels, pasture-raised, cage-free, and other indicators of how food was raised and marketed (UCS, A-Z). To go back to our analogy of sustainable food systems, these value chains are taking advantage of greater public awareness and interest in the other eggs in the nest (or marbles in the bowl).

### ***"Fair" food systems***

Fair Trade labeling deserves to be singled out, because it counteracts many of the undesirable social and environmental externalities of the dominant global food system. Fair Trade, with the words capitalized, refers to a specific certification system that guarantees farmers a fair price for their goods along with other specifications of how foods are produced and how profits are used. Fair Trade started out as a way that consumers in wealthy industrialized countries could stack the deck in favor of producers in poor developing countries. But the general concept of fairness is being explored more and more, in the US as well as in developing countries. And not just for farmers but also for wage-workers who are often invisible to the final consumer: the people who cut up poultry, pick and process fruit, drive trucks, and work at low wages and sometimes under despicable working conditions throughout the food system.

Conflicts between fair and local food are beginning to pop up. In the UK, Tesco stores are putting little airplanes on products to show whether they were flown into the country, because customers are demanding more locally grown foods. I was at a conference in London a couple of weeks ago, and our group went to an "organic pub" where we were greeted by the owner who said first of all, "Nothing we serve was flown in!" I was struck by the fact that "food miles" is such a familiar concept in the UK. A study by Bill Vorley from the International Institute of Environment & Development introduces the concept of "fair miles" to refute what seems to be a fetishization of locally-grown foods. He and his co-author point out that food flown in from sub-Saharan African countries makes a tremendous difference to those countries' economies, yet contributes very little relatively to the total emission of greenhouse gases in the UK. Over one million livelihoods in Africa are supported by UK consumption of imported fresh fruit and vegetables, and not buying fresh produce air-freighted from Africa will reduce UK total emissions by less than 0.1%.

"Fairness" is only one of many important characteristics of food systems, of course. In the United States, there are few ways for people to find out whether their foods embody many of the attributes they value. It is impossible to find out in supermarkets, for example, where most food originated, how it was grown, whether workers were treated with dignity, or whether animals were treated humanely. The Henry A. Wallace Center at Winrock International is developing indicators of sustainable community-based food systems to help identify which attributes matter to customers, how they can be communicated, and what proportion of the US food system currently meets these standards of sustainability.

## **CONCLUSIONS**

It is important to be clear about the real goals of the food system in order to achieve greater sustainability. For example, local food systems are a great way to achieve many goals simultaneously, but they can have unintended side effects if we just assume that because something is local it's better. Customers might be able to have more control over whether food systems actually embody all the values that are important to them, when they are local; but they can't go on faith alone. And consumer demand for local products may in fact result more in what is being called "glocal", or the penetration of local markets by agribusiness. We see this in some large supermarkets that are intentionally stocking more locally grown food. While this is probably a good thing for local growers, it won't necessarily achieve many of the other advantages of local and regional food systems. Reaching the goals we want as a society from our food system, including sustainability, will take systemic changes in agricultural production, consumer purchasing behavior, labeling and distribution of food, and policy.

To ensure that local and regional food systems realize their potential benefits without causing harm, the following measures are important:

- 1) Pay attention to the whole life cycle of food products to determine environmental costs and benefits. This can give some surprising results. For example, a European study found that Spanish tomatoes consumed in Denmark had lower carbon dioxide emissions than home-grown tomatoes because the Spanish tomatoes were raised in open fields while the Danish tomatoes required heated greenhouses, and therefore used more fossil fuel energy during the production stages. Similarly, there were more greenhouse gas and particulate matter emissions from production and marketing of UK tomatoes raised in the UK than from imported

Spanish tomatoes. And In the US, keep in mind that hundreds of shareholders driving in SUVs to a distant farm to pick up their shares may generate more greenhouse gas emissions than a truck hauling produce to a supermarket in town.

- 2) Make sure that local and regional food systems actually improve economic viability for farmers, workers and communities by making a commitment to fair prices, equity and long-term relationships between people working in different sectors.
- 3) Make high-quality food from local food systems accessible and affordable to people who need it most. Local foods have been called the “new organic” elite food, only available to people who can afford to pay extra. Of course, the reason that alternatives are so cheap in supermarkets is that many of the true costs have been externalized; fixing this will require policy changes. But meanwhile, we can try to get higher-quality food into schools and low-income neighborhoods where intake of fresh fruits and vegetables is especially low and the prevalence of diet-related diseases is especially high. I am constantly amazed that the US public doesn’t demand better quality food for children in schools; several projects around the country are showing that it can be done, and children’s health improves as a result.
- 4) Make sure that LFS don’t diminish opportunities for farmers in other countries who desperately need a source of income. The concept of “fair miles” is a good antidote to overly enthusiastic zeal for local foods. But again, in the long run, this is an area that will require policy changes to institute fair trade and internalize the externalities that the dominant food system spins out.

In sum, I’d like to leave you with the following thoughts:

First, environmental constraints are fundamental to food system sustainability. The top environmental constraints on food systems are climate change, limits on water, and limits on both availability and use of fossil fuel. Therefore, sustainable production will increasingly favor energy and water efficiency, and marketing will increasingly favor less global transport because there are no likely options for replacing all of the fuel now squandered in food transport. We need to work toward greater self-sufficiency and independence of local and regional food systems by examining all the ways in which they depend on the global supply chain for energy and other inputs, and try to figure out how to supply those things internally or reduce reliance on them.

Next, solutions to food system problems depend more on social factors and interdisciplinary knowledge than more narrow technological knowledge at present. Agroenvironmental knowledge will help us understand the environmental “rules of the game” better---those forces impinging on the food system and threatening to blow the nest out of the tree or jostle the marbles out of the bowl. University-based knowledge is vital to learning how to increase resilience and adaptive capacity in the food system. Examples include promoting more crop diversity and marketing diversity to buffer against shocks and safeguard threatened ecosystem goods and services. University expertise can also continue to help create better options for nutrient recycling and pest management to reduce reliance on imported inputs.

We also need better social and cultural knowledge to develop marketing options that can decrease global transport of food, and encourage behavioral changes among consumers to support more sustainable paths. Policy research and policy changes are needed to figure out ways to increase the number of farmers and relocalize economies, for example, by building up the necessary infrastructure for processing, slaughtering, warehousing and marketing. And finally, we need to figure out how to get by with less and more thoughtful trade in the food system, between food systems that are set up to assure fairness and sustainability.

The task of creating more sustainable food systems is daunting, and the global challenges are tremendous. But everything we value is at stake. Local solutions are possible and---if implemented widely---will have global impacts that let more of the world’s population enjoy nutritious, safe, tasty and affordable food.