

PLACE-BASED FOOD SYSTEMS KEYNOTE ADDRESS

Why place-based food systems? Food security in a chaotic world

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**PLACE-BASED
FOOD SYSTEMS
CONFERENCE:**

Making the Case, Making it Happen

August 9-10th, 2018

Submitted October 12, 2018 / Published online June 26, 2019

Citation: Rees, W. E. (2019). Why place-based food systems? Food security in a chaotic world. *Journal of Agriculture, Food Systems, and Community Development*, 9(Suppl. 1), 5–13. <https://doi.org/10.5304/jafscd.2019.091.014>

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Abstract

Techno-industrial society is founded on a ‘socially constructed’ myth of perpetual economic growth propelled by the cult of efficiency, expanding trade, and continuous technological progress. But this neoliberal vision has resulted in an increasingly unsustainable entanglement of nations in a world compromised by ecological overshoot. Today, many countries are dependent on others for critical resources, including food, even as population growth and increased consumption deplete and pollute the ecosystems essential for human survival. Climate change and energy uncertainty

further threaten trade-dependent populations. Indeed, societal collapse is a growing possibility. The future food security of cities—or any size of human settlement—lies in greater regional self-

Note: This paper is adapted from a keynote address given at the Place-Based Food Systems Conference, hosted by the Institute for Sustainable Food Systems at Kwantlen Polytechnic University in August 2018. The conference brought together community and academic leaders to share research and practice, and to foster effective collaboration. More information is at <https://www.kpu.ca/pbfs2018>

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reliance, particularly through the protection of arable land and the re-localization of both primary agriculture and food processing.

Global Context—Beyond Carrying Capacity

A small village on good land beside a river is a good idea, but when the village grows into a city and paves over the good land, it becomes a bad idea. (Wright, 2004, p. 108)

This paper makes the case that food security is a core element of sustainability and that both depend on how climate change and the composition of energy supplies evolve in coming decades. Based on current trends, the most food-secure populations by the second half of the 21st century will be those populations that have deliberately chosen and planned to re-localize as much of their own food systems as possible.

This prescription is at odds with the efficiency-based ‘globalize, specialize, and trade’ component of the neoliberal (neoclassical) economic ideology that currently dominates human material affairs. We should not be surprised, for both textbook neoliberalism and Ricardian trade theory date back to the 19th century, when the world was relatively pristine and, at least in human terms, ecologically empty.

That time has passed.

And the reason is simple. Consider the blinding pace of change since the Industrial Revolution. It took 200,000 years for the human population to reach its first billion in the early 1800s. Since then, energized by abundant fossil fuels, the human family has exploded by seven-and-a-half-fold. It hit 7.6 billion in just the next 200 years (by 2018)—*1/1000th of the time required to reach the first billion!* Meanwhile, real gross world product increased 100-fold and per capita incomes (consumption) increased by a factor of 13 (25 in rich countries) (Roser, 2018).

Most people today take this recent period of growth to be the norm. The reality is that it is the single most *anomalous* period in history. Only the last 8-10 generations of thousands of human generations have been around to enjoy it—and the next generation will have to suffer the negative

consequences. The human enterprise is well into overshoot.

The problem is that Earth didn’t get any bigger. In fact, one could argue that, in ecological terms, it has shrunk and diminished. The symptoms are the stuff of daily headlines: accumulating greenhouse gases, global climate change, dissipating soils, expanding deserts, shrinking tropical forests, acidifying oceans, rising sea levels, toxifying fresh waters, expanding marine ‘dead zones,’ collapsing fisheries, plummeting biodiversity (humans are extinguishing other species at up to 1,000 times the natural rate), etc., etc. These trends—many of which are accelerating—tell a story of gross human ecological dysfunction. The load imposed on the ecosphere by industrial civilization exceeds the long-term human carrying capacity of Earth.

The Human Eco-footprint

We can measure just how far we have overshoot carrying capacity by using ecological footprint analysis (EFA). EFA estimates the physical area of land and water ecosystems (biocapacity) that any specified population requires, on a continuous basis, to support its bio-resource consumption and waste production at a defined material standard of living (Rees, 2013a; Wackernagel & Rees, 1996). This area, composed of cropland, grazing land, forested land, carbon-sink land, productive marine area (fishing grounds), and built-up or urbanized land, constitutes the population’s ecological footprint.

EFA is unique among sustainability indicators in that it enables us to compare a population’s demand for biocapacity with available supplies. It turns out that most countries today have eco-footprints that significantly exceed domestic supplies of biocapacity—that is, their populations depend, in part, on biocapacity imported from other countries or from the global commons (e.g., the oceans) (see Global Footprint Network [GFN], 2018, for examples). Such countries are running an ecological deficit with the rest of the world. This is the essence of overshoot.

The bigger problem is that the world as a whole (the ‘human enterprise’) is in eco-deficit. There are about 29 billion acres or 12 billion hec-

tares of ecologically productive land and marine habitat on Earth (most ocean area is biological desert), but by 2014 the aggregate human eco-footprint had already reached 19 billion global average hectares (gha). (That's 1.7 gha of available biocapacity per capita, compared to an average human EF of 2.6 gha/capita.) This means that humans are using Earth as if it were almost 60% larger than it is (data from World Wildlife Fund [WWF], 2014, 2016). Freed from natural negative feedback, *H. sapiens*' relationship to the rest of the ecosphere closely resembles that of parasite to host—we are literally growing ourselves by consuming the ecosphere from within.¹

One symptom of overshoot with which everyone is familiar is human-caused climate change. Carbon dioxide (CO₂), derived from burning fossil fuels,² wildfires, deforestation, and soil disturbance, is the greatest waste product of industrial societies by weight. It is also a major greenhouse gas (GHG) and a contributing factor to global warming. The atmospheric concentration of CO₂ averaged a record 410.8 parts per million (ppm) in June 2018, and the running average is about 408 ppm, almost 46% above the preindustrial level of 280 ppm. The rate of increase in atmospheric CO₂ concentrations is itself increasing, seemingly unaffected by the unenthusiastic policy responses to the series of global climate conferences and international agreements dating from the mid-1970s.

Temperatures are therefore also rising. The past four years are the four warmest years in the instrumental record: 2016 was the warmest, 2017 was second, followed by 2015 and 2014! In fact, 17 of the 18 warmest years on record have occurred in this young century (data from National Aeronautics and Space Administration [NASA], 2017, 2018; National Oceanic and Atmospheric Administration [NOAA], n.d.). (It should be noted in passing that the global food system accounts for as much as one-third of GHG emissions and

associated warming.)

We will return to the implications of accelerating carbon emissions and climate change below. For now, take them as indicative of human interference in important global life support systems and our general overuse of the ecosphere.

We can summarize our predicament as follows:

- The sheer scale of the human enterprise already exceeds the long-term carrying capacity of Earth; material production, consumption, and waste generation exceed the regenerative and assimilative capacities of the ecosphere.
- We are “financing” the growth of the human enterprise by liquidating essential natural capital upon which civilization depends for long-term survival.³

Globalization, Free Trade, and the Global Growth Fetish

Overshoot is, in part, a result of modern society's economic growth fetish. Recent decades of globalization and ever-freer trade has placed global growth on steroids. The dream of globalizers today is the dissolution of national boundaries and the horizontal integration of national economies into one highly efficient world economy.

According to Ricardian trade theory, if each country specializes in products for which it has a ‘comparative advantage’ (i.e., that it can produce most efficiently and at lower opportunity cost than its competitors), and then trades for everything else, the world can maximize global production. Because goods are being produced efficiently everywhere for the largest possible market, prices will be lower and demand higher. Both gross production and producers' incomes will increase. Higher incomes and lower prices enable people everywhere to maximize their consumption of goods from all over the world.

¹ A parasite gains its own vitality at the expense of the vitality of its host.

² Carbon-sink ecosystems account for over half the ecological footprint of many industrial countries.

³ Our ecological predicament has actually come about naturally. Like all other species, *H. sapiens* has an innate tendency to multiply and expand into new territory. Normally, however, negative ‘feedback’ (disease, resource, or habitat shortages, territoriality—often war in the case of humans—keeps things in check. The human difference is our technological prowess; we have eliminated (albeit temporarily) many important negative controls, and, with the aid of abundant cheap energy, have plundered the entire planet for the habitat, food, and other resources needed to expand the human enterprise.

There are, however, major ecological downsides. Most importantly, global integration exposes the world's remaining pockets of resources and natural habitats to the largest possible market, one with an ever-increasing number of rich consumers willing to pay top dollar for whatever they fancy, legal or not. Humans are plundering the ecosphere at an accelerating pace; nothing is sacred or spared: consider just the destruction of the Sumatran orangutan habitat for commercial palm plantations and the tragic illegal poaching of remaining herds of African elephants—even in game reserves—for their ivory. Bottom line: liberalized borderless trade may facilitate GDP growth (i.e., production and consumption) at least dollar cost. However, it is also a prescription to maximize the overexploitation of resources, the degradation of ecosystems, and the emission of pollutants everywhere. The unaccounted social and ecological costs of growth (non-market 'externalities') may already exceed the economic value of growth at the margin—in which case we have entered an era in which growth is making us poorer rather than richer (Daly, 1999). Sometimes editorial cartoonists seem to grasp this reality more securely than politicians (see Figure 1).

Implicit in globalization and the cult of efficiency are a number of mostly unstated assumptions:

- Human happiness or well-being always increases with higher income and consumption;
- Any resource scarcity can be relieved by enhanced 'factor productivity' (efficiency) or factor substitution; and
- There are no ecological or geopolitical limits to growth (i.e., there is no threat from climate change, ecosystems collapses, or competition for resources).

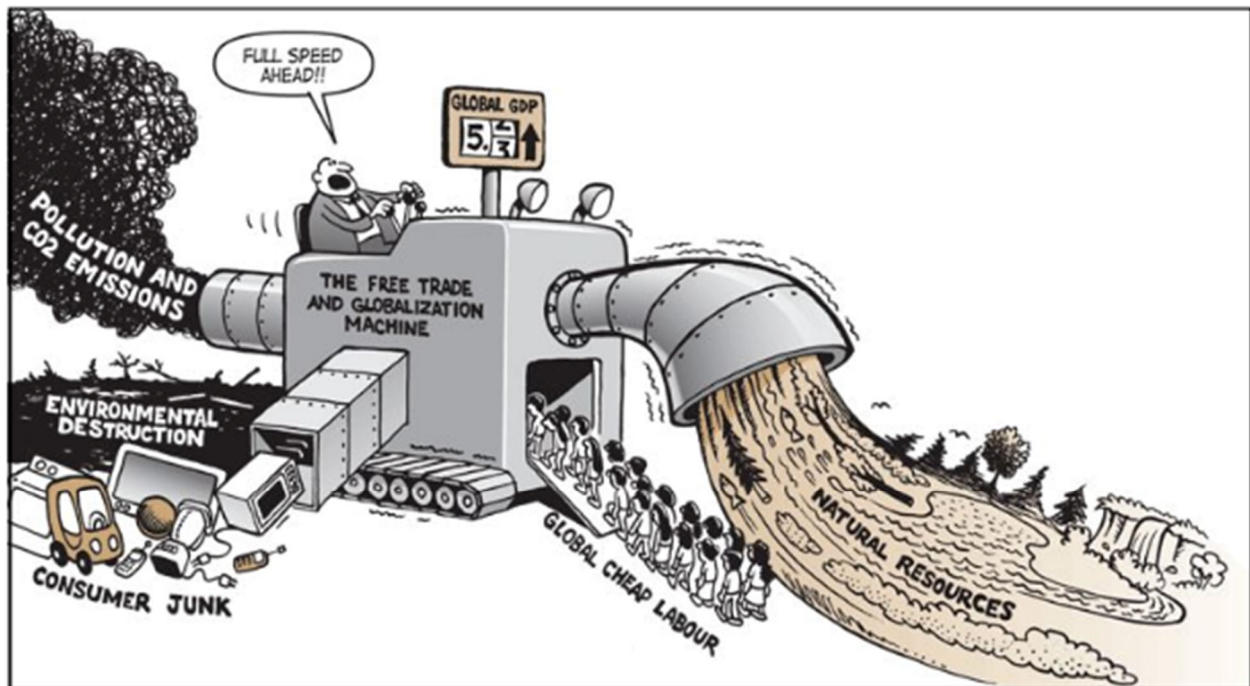
All of which implies that:

- The world is infinite;
- Geopolitical stability is assured; and
- There is no serious downside to inter-regional dependence.

All these assumptions are proving to be false.

Another problem derives from elevating economic efficiency above all other considerations.

Figure 1. Full Speed Ahead



Source: Unknown.

While it might initially seem odd to balk at economic efficiency, a moment's thought gives us pause. What would your life be like if the only consideration were to maximize the efficiency of everything you did? (Why prepare a gourmet meal if tossing everything in a blender and compressing the product into edible pucks would save so much time and energy?) What might we be losing by organizing the global economy around a singular objective? Among the many other values that are sacrificed or impaired are:

- Local economic diversity and resilience in the face of market or ecological fluctuations;
- A multiskilled population with the diverse capacities to respond to new challenges;
- Community integrity and cohesion (because of the loss of traditional economic sectors);
- Local (and national) self-reliance in key economic sectors, especially food systems;
- The conservation of arable land ("We can always import food from somewhere else").

On all these grounds, neoliberal globalization on a finite planet is arguably producing an increasingly unstable and inherently unsustainable entanglement of interdependent nations and regions (Rees, 2013b).

Consider the most essential of resources: food. Trade enables countries to vastly exceed domestic biocapacity and the ability of local agriculture to sustain their growing populations. Various United Nations (UN) and Food and Agriculture Organization of the UN studies show that globally, a significant proportion of the human population already relies on imported food: at least 34 countries are unable to produce much or most of their own food, 50 countries have some degree of food insecurity, and about 108 million people are severely food insecure. With population growth,

water shortages, and land degradation, the situation is worsening—by 2050 more than half the world's population is expected to be reliant on food produced in other countries, a situation that cannot be sustained unless climate, geopolitics, and other factors remain 'normal.'⁴

The Southwest British Columbia bioregion is only about 40% food self-reliant (Mullinix et al., 2016). If imported animal feed had not been available, its total dietary self-reliance would be only 12% (Mullinix et al., 2016). The majority of the BC population currently depends on imports for most of its food. How secure should we feel in an era of accelerating global degradation and geopolitical instability?

The Particular Vulnerability of Cities

Globalization made today's mega-cities possible but may soon turn against them. The problem is that, in biophysical terms, cities are incomplete heterotrophic (literally 'other feeding') ecosystems. They are consumptive nodes that produce and maintain themselves by feeding on the productivity of rural ecosystems. (In this respect, cities are the human equivalents of livestock feedlots). To be considered whole or complete, the human urban ecosystem must include both the consuming node and the vastly larger rural productive area (Rees, 2012). Together, these areas compose the city's true ecological footprint EF, and many cities' EFs are several hundred times larger than their political or geographic areas.

Consider the city of Vancouver proper (not the metro region): Vancouver's population of approximately 632,000 geographically occupy about 11,500 ha (28, 400 acres), but the city's actual EF is close to 3,150,000 gha (about 8 million acres) (~5 gha/capita). If we assume Vancouverites enjoy a typical high meat-protein diet, then it takes almost 315,000 hectares (about 778,000 acres) (~.5 ha/capita) of crop- and grazing land elsewhere just to feed the city (this is 27 times Vancouver's political area).⁵

⁴ National eco-deficits must be made up by natural capital depletion or from surplus biocapacity elsewhere. For example, Kissinger and Rees (2009) found that over 60% of Canada's prairie cropland is already effectively 'exported' as food exports, often to eco-deficit countries.

⁵ Note that this number would be even larger if converted to global average hectares (gha), because North American agricultural lands are on average more productive than world average land types.

Moore and Rees (2013) found that, all in all (i.e., including carbon assimilation land, etc.), the agri-food system composed half of the city's total EF.

It should be clear from this example that urban dependence on the rural is absolute. If any modern city were enclosed in an impermeable glass bell-jar—cut off from its supportive ecosystems—its population would simultaneously starve and suffocate. Disturbingly, because of globalization and trade, cities' sprawling EFs are increasingly scattered all over the world. By increasing the distance between the consumptive and productive components of typical 'urban ecosystems,' globalization increases the urban components' vulnerability to accelerating global change. Indeed, climate chaos, energy shortages, geopolitical discord, etc., all have the potential to destroy transportation links and isolate cities from their life-support hinterlands.

The Climate Change-Energy Conundrum

Interregional dependence, climate change, and energy choices are converging in ways that put cities in a particularly difficult position. As noted previously, climate-forcing CO₂ concentrations are at record levels. The exponential growth in consumption of fossil fuel means that more carbon has been released into the atmosphere since the late 1980s than in the entire previous history of civilization! Meanwhile, other GHGs are increasing as fast as or faster than CO₂. As a result, the world is on track for warming by 3 to 5 Celsius degrees (C°) (5.4 to 9 Fahrenheit degrees or F°).

A 5 C° (9 F°) warming would be catastrophic, perhaps fatal, to urban civilization. Even a three-degree (5.4 F°) warming implies widespread disaster—and Robert Watson, a former director of the United Nations Intergovernmental Panel on Climate Change, has asserted that a “3-degree warming is the realistic minimum” we can expect (cited in Rich, 2019, para. 3; see also Kirby, 2013). Change is so rapid and responses so slow that some scientists believe that climate chaos and soci-

etal collapse are now inevitable (Bendell, 2018; Institute for Leadership and Sustainability [IFLAS], 2018).

But what about international climate agreements? These have so far been ineffective.⁶ For example, the national emissions-reductions targets agreed to in the 2015 Paris climate accord are only a third of what is necessary to achieve the ostensible goal of less than 1.5 C° (2.7 F°) warming. And even if the full Paris goals were met, there is a growing risk of Earth entering “Hothouse Earth” conditions, in which a 1.5 C° or 2.0 C° (2.7 F° or 3.6 F°) warming might be enough to trigger irreversible positive feedbacks (permafrost thaw, loss of methane hydrates from the ocean floor, weakening land and ocean carbon sinks, increasing bacterial respiration in the oceans, Amazon rainforest dieback, boreal forest dieback, reduction of northern hemisphere snow cover, loss of Arctic summer sea ice, reduction of Antarctic sea ice and polar ice sheets., etc.) that would accelerate warming. Be warned! “Hothouse Earth” implies a catastrophic long-term global average temperature at least 4 C° to 5 C° (7.2 F° to 9 F°) higher than pre-industrial temperatures, with sea levels 10 to 60 meters (33 to 197 feet) higher than today (Steffen et al., 2018).

Clearly urban civilization must decarbonize as rapidly as possible. Many people, aware of the falling costs and much-vaunted rapid uptake of wind and solar electricity generation in the past couple of decades, believe that the renewable energy transition is already well underway. This is incorrect. Global society remains addicted to fossil carbon. In 2017, global energy consumption rose by 2.2%, with fossil fuels contributing 70% of the increase and 85% of total world primary supply. (After remaining flat for three years, carbon dioxide emissions increased by almost 1.5%). Renewables (wind, solar, geothermal, biomass, and waste), starting from a much lower base, did see the highest rate of growth but altogether supplied only a quarter of the increase and only 3.6% of total

⁶ “In 1979, the World Meteorological Organization . . . convened the first international climate conference in Geneva. At that time, annual carbon emissions of about 5 gigatonnes per year (GtC/yr) were increasing atmospheric CO₂ content by about 0.5 ppm per year. Now 30 [sic] years later, after 29 international climate meetings, and with over 800 international climate laws on the books, carbon emissions have grown to over 10 GtC/yr, and — since carbon sinks have become saturated — we are now increasing atmospheric CO₂ content by about 3.5 ppm per year, seven times faster” (Weyler, 2018, “We’ll always have Paris,” para. 4).

demand (see data in BP, 2018). (Other estimates put the contribution of renewables at less than 3%.) And just when it should be ramping up, investment in green energy seems to be stalling. It hasn't increased in the Americas since 2007, in Asia since 2015, and has actually been declining in Europe since 2011, where new investment is approaching zero in the UK and Germany. Meanwhile, coal consumption and emissions seem set to rise again dramatically in energy-hungry China (Hao, 2018).

There is another problem: most renewable energy, including wind and solar, is in the form of electricity, which still typically provides less than 20% of final energy consumption. Even if all electrical generation turned green, electricity is not yet a viable substitute for fossil fuel in the key areas accounting for 80% of urban society's energy consumption, including mining, various industrial processes, heavy construction, intercity transportation (air and highway), *and agriculture*. Our modern industrial trade-based food system floats on fossil fuels, soaking up 10 calories of commercial energy for every food calorie produced (for a simple breakdown, see Starrs, 2009).

An Existential Risk to Civilization

Urban civilization is squarely stuck between a carbon-emissions rock and an energy-deficit hard place. An insufficiently rapid transition to renewable energy implies that the world will remain reliant on fossil fuels; atmospheric carbon dioxide and other GHGs will increase for decades; and the ecosystem will experience 3 C° or more warming. That warming would result in widespread disaster: more and longer heat waves and droughts, accelerating desertification, melting permafrost, Arctic summers free of sea ice, rising sea levels, water shortages, disrupted agriculture, the eventual loss of many coastal cities, mass migrations, civil unrest, and geopolitical chaos.⁷ Many cities will be isolated from food land and other essential resources⁸;

urban life may become untenable in the more vulnerable parts of the world.

On the other hand, as of yet, there are no adequate substitutes for fossil fuels. If we have to abandon fossil fuels in the coming decades to avoid climate disaster, the world may face crucial energy shortages and shrinking economies. This implies falling agricultural production, reduced trade, broken international supply lines, failing intercity transportation, declining incomes, widespread unemployment (i.e., global depression), and international conflict. Urban populations are again particularly at risk. As matters stand, it is likely many countries will experience both more dramatic climate events and energy shortfalls.

Toward Place-based Food Systems

Society is only three square meals away from anarchy. (Anonymous)

Either accelerating climate change or energy shortages could make it impossible to provision or maintain many existing cities, let alone accommodate the additional 2.5 billion urban dwellers expected by midcentury. Ample food produced locally for local consumption will enhance any city's chances for survival. Indeed, it is possible that for much of the world, place-based food will be the only food available by late this century.

To acknowledge and prepare for this possibility, governments everywhere should⁹:

1. Implement serious energy-conservation measures to reduce consumption, lower carbon emissions to safe levels, and conserve fossil fuels (we may still need them in 50 years);
2. Develop an implementation strategy to allocate or ration the remaining fossil fuel budget to essential uses only (e.g., food production, intercity road transport);

⁷ Remember, even 2 C° warming could generate positive feedbacks that would push the system toward "Hothouse Earth" catastrophe and the collapse of global civilization (see Steffen et al., 2018).

⁸ "Agriculture is in fact the real underlying problem produced by climate change. Even without climate change, it would be somewhere between hard and impossible to feed 11.2 billion people, which is the median UN forecast for 2100" (Grantham, 2018, p. 3).

⁹ See Rees (2018) for an expanded rationale and prescription for planning in the Anthropocene.

3. Ramp up investment in renewable energy and infrastructure beyond the current total investment in energy;
4. Acknowledge publicly that to act consistently with our best science may well require a planned economic contraction;
5. Plan for the consequences of reduced GDP/capita, including developing strategies for income redistribution (climate justice); and
6. Implement carrot and stick policies (e.g., positive incentives taxes and consumption-related taxes) to encourage people to adopt 'One Earth' lifestyles (implies a 66% reduction in energy and material consumption by Vancouverites and 75% in most of North America).


Measures specifically directed at re-localizing food production should include:

1. Reshaping city form and governance into more self-reliant urban-centered bioregions (eco-city states) that incorporate as much as possible of their extended eco-footprints, particularly food- and fiber-producing ecosystems;
2. Conserving regional farmland; encouraging food co-ops; re-localizing food production and processing ("trade if necessary, but not necessarily trade");
3. Increasing local and regional food storage

capacity to buffer populations against drought or other climate-induced local crop failures and the contraction of interregional trade; and

4. Densifying urban development to reduce demand for arable land and increase the efficiency of urban infrastructure (transportation, water, sewage, electrical, and recycling systems).

Societal collapse and the policy measures necessary to avoid or mitigate its consequences seem impossibly radical notions to people accustomed to continuous growth and rising expectations. Even many who acknowledge the severity of our predicament remain confident in rescue-by-technology. It seems that *H. sapiens*' natural expansionist tendencies combined with our global cultural myth of perpetual growth are sufficient to override rational responses to existing data and prevailing trends. Mainstream global society remains woefully unprepared for the story that our best analyses are telling us.

Hope resides in the beliefs and actions of grassroots movements by clear-eyed people committed to trying another path. The worldwide surge of interest in place-based food systems is surely one of the most important and potentially catalytic of such community-oriented initiatives. After all, there can be little doubt that food security is a prerequisite for humanity to learn to live more equitably within the means of nature. 

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