




Environmental Sustainability

WITH A FOCUS ON FOOD SYSTEMS

Created by Donald Swen & Nathan Hechtman | Take a Break 2017 | Willamette University

"EVERYTHING IS WAITING FOR YOU" by David Whyte



Your great mistake is to act the drama
as if you were alone. As if life
were a progressive and cunning crime
with no witness to the tiny hidden
transgressions. To feel abandoned is to deny
the intimacy of your surroundings. Surely,
even you, at times, have felt the grand array;
the swelling presence, and the chorus, crowding
out your solo voice. You must note
the way the soap dish enables you,
or the window latch grants you freedom.
Alertness is the hidden discipline of familiarity.
The stairs are your mentor of things
to come, the doors have always been there
to frighten you and invite you,
and the tiny speaker in the phone
is your dream-ladder to divinity.

Put down the weight of your aloneness and ease
into
the conversation. The kettle is singing
even as it pours you a drink, the cooking pots
have left their arrogant aloofness and
seen the good in you at last. All the birds
and creatures of the world are unutterably
themselves. Everything is waiting for you.

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Intruductions from your facilitators

Dear friends,

I've decided to commit to co-leading the Environmental Sustainability trip for TaB this year. Initially, I was drawn to this because I had read a summers worth of books on environmental sustainability and ethics.

The books were:

- Gardeners of Eden: Rediscovering Our Importance to Nature by Dan Dagget
- The Spell of the Sensuous by David Abram
- The One-Straw Revolution by Masanobu Fukuoka
- My Story as Told by Water by David James Duncan
- The Open Space of Democracy by Terry Tempest Williams

Most recently I have read

- Globalize Liberation: How to Uproot the System and Build a Better World by David Solnit

And I took a class

- Western Civilization & Sustainability by Professor Wendy Petersen Boring

Through my readings and the class I took, I have started to come closer to just exactly what we are facing. We are facing a pre-existing system that distributes wealth to corporations, profits off of racism and those less abled, and a culture that promotes massive consumption and a welfare society. The consumption is scary and I'm sure we've all seen it. In fact, we are even part of it.

But I am hopeful because humans have responded to climate change many times in the past, each time creating a new system to deal with the problems. These include the creation of the welfare state, transition to agriculture, to a paper economy. Actually though, these responses have created the problems today, but solved the problems in their day. We are dealing with those old systems. And we have to do an update. But also what's scary *now* is that we are in the Anthropocene. Technology is at this point where we can have a dramatic impact on our own Earth, and you know what, to the point where we can kill the Earth we all live on. That's scary. We have quite a lot of power. Nuclear bombs. All the emissions from our cars. We are damaging the soil on which our mouths feed on the fruits of.

I believe in the power of people to solve the problems of our time. The goal is to avert an environmental disaster and at the same time, build a way of living that is sustainable. The former is the primary goal, the latter is to be included in our approach. In our TaB trip, we have the goal of learning more about food production, how exactly food comes from the ground and onto our plates, and the path inbetween. We enter the issue of environmental sustainability from the door of food, something common to all people. And we aim to find answers to how we can build a more sustainable world, specific methods to doing so, and organizations and activities we can join and do. On the

trip itself, we will visit nonprofits, talk with those established in the fight of environmental sustainability, and engage in direct and indirect service.

Personally, what initially interested me in the topic of food systems was when I was sitting in my Western Civilization & Sustainability class, Professor Petersen started talking about how the Willamette Valley has some of the most fertile land in the world, yet most of it is used to produce Christmas trees. Why is it that we transport most of our food from faraway lands? Why don't we produce on our lands, locally? And if all our food is coming from other places, what happens if suddenly, it stops coming? Then we would run out of food quite quickly. This scenario is unlikely to happen, but it starts to question what are the costs of importing all our food? And through this question, we get into the world of social justice.

We are not experts. We are students just like yourself. I hope to befriend all of you and with that, I look forward to learning with you all!

Sincerely,
Donald

My fellow environmentalists,

I'm extremely excited to be setting out on this journey of learning and service with you all. My own journey toward interest in food systems emerged slowly from an interest in medicine. Over time, I have become increasingly aware that all diseases must come *from* somewhere, and thus the environment (in the broadest sense of the word) is always a factor in play when we get sick.

You may know that many tropical diseases are spreading as global climates change. The production of plentiful, healthy food is just as much bound up in the environment, and arguably more important to our health as Americans than any infectious disease. All the largest chronic diseases - cancer, heart disease, diabetes, obesity, and multiple mental disease are associated to some extent with diet.

While designing this course, I have placed emphasis on ongoing problems in how food is produced, distributed, and consumed. These problems remain problems, in many cases because there are not simple answers. Even when there are, there are practical barriers to their implementation.

You can expect to finish each reading, leave each class, and complete our adventure in Portland with more questions than answers. The most important thing is that you voice your questions to us and to each other as they arise - any question left unasked is a lost opportunity for learning. Let's make TaB a feast for ravenous minds - an indulgence that, unlike many, does some good for our communities and for the environment.

Sincerely,
Nathan

Chapter 1: Why it All Matters



A Newt Note

Brian Doyle

One time, years ago, I was shuffling with my children through the vast wet moist dripping enormous thicketed webbed muddy epic forest on the Oregon coast, which is a forest from a million years ago, the forest that hatched the biggest creatures that ever lived on this bruised blessed Earth, all due respect to California and its redwood trees but our cedars and firs made them redwoods look like tooth-picks, and my kids and I were in a biggest-creature mood, because we had found slugs waaay longer than bananas, and footprints of elk that must have been gobbling steroids, and a friend had just told us of finding a bear print the size of a dinner plate, and all of us had seen whales in the sea that very morning, and all of us had seen pelicans too which look like flying pup tents, and how *do* they know to all hit cruise control at the same time, does the leader give a hand signal? as my son said, and one of us had seen the two ginormous young eagles who lived somewhere in this forest, so when we found the biggest stump in the history of the world, as my daughter called it, we were not exactly surprised, it was basically totally understandable that suddenly there would be a stump so enormous that it was like someone had dropped a dance floor into the forest, that's the sort of thing that *happens* in this forest, and my kids of course immediately leaped up on it and started shaking their groove thangs, and danc-

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ing themselves silly, and I was snorting with laughter until one kid, the goofiest, why we did not name this kid Goofy when we had the chance in those first few dewy minutes of life I will never know, well, this kid of course shimmed over to the edge and fell off head over teakettle, vanishing into a mat of fern nearly as tall as me, but the reason I tell you this story is that while we were all down in the moist velvet dark of the roots of the ferns, trying to be solicitous about Goofy and see if he was busted anywhere serious but also trying not to laugh and whisper the word “doofus,” one of us found a newt! O my god! dad! check it *out!*

Of course the newt, rattled at the attention, peed on the kid who held it, and of course that led to screeching and hilarity, and of course on the way home we saw damselflies mating, which also led to screeching and hilarity, but the point of this story isn't pee or lust, however excellent a story about pee or lust would be. It's that one day when my kids and I were shuffling through the vast wet moist forest we saw so many wonders and miracles that not one of us ever forgot any of the wonders and miracles we saw, even though we saw only tiny shreds and shards of the ones that are there, and what kind of greedy criminal thug thieves would we be as a people and a species if we didn't spend every iota of our cash and creativity to protect and preserve a world in which kids wander around gaping in wonder and hoping nothing else rubbery and astonishing will pee on them? You know what I mean?

The Universe Story and Planetary Civilization

Mary Evelyn Tucker and Brian Swimme

As we see our present interconnected global challenges of widespread environmental degradation, climate change, crippling poverty, social inequities, and unrestrained militarism, we know that the obstacles to the flourishing of life's ecosystems and to genuine sustainable development are considerable.

In the midst of these formidable challenges, we are being called to the next stage of evolutionary history. This requires a change of

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consciousness and values, an expansion of our worldviews and ethics, for the evolutionary life impulse moves us forward from viewing ourselves as isolated individuals and competing nation-states, to realizing our collective presence as a species with a common origin story and shared destiny. The human community now has the capacity to realize our intrinsic unity in the midst of enormous diversity. Most especially, it has the opportunity to see that this unity arises from the dynamics of the evolutionary process itself. For the first time we have a scientific story of the evolution of the universe and Earth that shows us our profound connectedness to this process. We are still discovering the larger meaning of the story.

Our sense of the whole is emerging in a fresh way as we feel ourselves embraced by the evolutionary powers unfolding over time into forms of ever-greater complexity and consciousness. We are realizing too that evolution moves forward with transitions such as the movement from inorganic matter to organic life and from single-celled organisms to plants and animals, transformations that sweep through the evolutionary unfolding of the universe, the Earth, and the human. All such transitions come at times of crisis. They involve tremendous cost, and they result in new forms of creativity. The central reality of our times is that we are in such a transition moment. This is not an easy moment, as human suffering and environmental loss are already widespread. It is not a guaranteed transition, as it will require tremendous human creativity, emotional intelligence, and spiritual strength.

Surrounding this moment is an awakening to a new consciousness that challenges older paradigms of the human as an isolated being in a random, purposeless universe. Peter Raskin called this the Great Transition, while Joanna Macy named it the Great Turning. From valuing hyperindividualism and independence, our consciousness is shifting to embrace interdependence and kinship on a vast scale. The Enlightenment values of life, liberty, and the pursuit of happiness are being reconfigured. Thus life now includes the larger life of the Earth, individual freedom requires responsibility to community, and happiness involves more than material goods. A sense of a larger common good is emerging—the future of the planet and its fragile biosphere.

In this spirit, we are in a transition from an era dominated by

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competing nation-states to one that is giving birth to a sustainable multicultural planetary civilization. This birth is occurring within the context of our emerging understanding of the universe story.

Over the past century, science has begun to weave together the story of a historical cosmos that emerged some 13.7 billion years ago. The magnitude of this universe story is beginning to dawn on humans as we awaken to a new realization of the vastness and complexity of this unfolding process.

Just as we begin to understand the vast and complex history of the universe, we are becoming conscious of the multidimensional environmental crisis and of the rapid destruction of species and habitat that is taking place around the planet. Just as we are realizing the vast expanse of time that distinguishes the evolution of the universe over some 13.7 billion years, we are recognizing how late is our arrival in this stupendous process. Just as we are becoming conscious that Earth took more than 4 billion years to bring forth this abundance of life, it is dawning on us how quickly we are foreshortening its future flourishing.

We need, then, to step back, to assimilate our cosmological context. If scientific cosmology gives us an understanding of the origins and unfolding of the universe, philosophical reflection on scientific cosmology gives us a sense of our place in the universe. And if we are so radically affecting the story by extinguishing other life-forms and destroying our own nest, what does this imply about our ethical sensibilities or our sense of the sacred? As science reveals to us the particular intricacy of the web of life, we realize we are unraveling it, although in part unwittingly. Only recently have we become fully conscious of the deleterious consequences of our drive toward economic progress and rapid industrialization.

As we begin to glimpse how deeply embedded we are in complex ecosystems and how dependent on other life-forms, we see we are destroying the very basis of our continuity as a species. As biology demonstrates a fuller picture of the unfolding of diverse species in evolution and the distinctive niche of species in ecosystems, we are questioning our own niche in the evolutionary process. As the size and scale of the environmental crisis is more widely grasped, we are

seeing our own connection to this destruction. We have become a planetary presence that is not always benign.

The simultaneous recognition of our cosmological context and our environmental crisis is clearly demonstrated by two major permanent exhibits at the American Museum of Natural History in New York. One is the Rose Center, which houses the Hall of the Universe and the Hall of Planet Earth. The other exhibit is the Hall of Biodiversity.

The Hall of the Universe is architecturally striking. It is housed in a monumental glass cube, in the center of which is a globe containing the planetarium. Suspended in space around the globe are the planets of our solar system. In a fascinating mingling of inner and outer worlds, our solar system is viewed against the backdrop of garden plazas and street scenes visible through the soaring glass panels of the cube. After first passing through a simulation of the originating fireball, visitors move onto a spiral pathway that descends through time, tracing the 12-billion-year cosmic journey, from the great flaring forth in the fireball, through the formation of galaxies, and finally to the emergence of our solar system and planet. It ends with the evolution of life in the Cenozoic period of the last 65 million years. Under a circle of glass, the breadth of a single human hair represents all of human history. The dramatic effect is stunning, as we are called to reimage the human in the midst of such unfathomable immensities.

The Hall of Planet Earth continues this evocation of wonder, revealing the remarkable processes of the birth of Earth, the evolution of the supercontinent Pangaea, the formation of the individual continents, and the eventual emergence of life. It demonstrates the intricacy of plate tectonics, a theory that has been accepted for fewer than fifty years, and it displays geothermal life-forms around deep-sea vents discovered only a decade ago. The exhibit illustrates how new our knowledge of the evolution of the Earth is and how much has been discovered within the last century.

In contrast to the vast scope of evolutionary processes evident in the Hall of the Universe and the Hall of Planet Earth, the Hall of Biodiversity displays the extraordinary range of life-forms that the planet has birthed. A panoply of animals, fish, birds, reptiles, and insects engages the visitor. A plaque in the exhibit observes that we

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are now living in the midst of a sixth extinction period due to the current massive loss of species. It notes that while the five earlier periods of extinction were caused by a variety of factors, including meteor collisions and climate change, the cause of this present spasm of extinction is, in large part, human activity.

This realization calls into question not only our role as a species, but our ultimate viability. Along with those who recognized the enormity of the explosion of the atomic bombs in Japan, we are the first generations of humans to actually imagine our own destruction as a species. And while this may be extreme, some pessimists suggest this may not be such a regrettable price to pay for the survival of other life-forms.

The exhibition notes, however, that we can stem this tide of loss of species and habitat. The visitor walks through an arresting series of pictures and statistics where current destruction is recorded on one side and restoration processes are highlighted on the other. The contrasting displays suggest that the choice is ours—to become a healing or a deleterious presence on the planet.

These powerful exhibits on cosmic evolution and on species extinction illustrate how science is helping us enter into a macro-phase understanding of the universe and of ourselves as a species among other species on a finite planet. As the Rose Center exhibits demonstrate, the evolution of the universe and the Earth is an unfolding story in which humans participate. Indeed, the introductory video to the Hall of the Universe observes that we are “citizens of the universe,” born out of stardust and the evolution of galaxies, and that we are now responsible for its continuity. Humans can assist in stemming the current extinction spasm, the Hall of Biodiversity suggests—a bold position for an “objective” and “unbiased” science-based museum.

Scientists no longer stand completely apart from what they study. They are helping us witness the ineffable beauty and complexity of life and its emergence over billions of years. They point toward a more integrative understanding of the role of the human in the midst of an extinction spasm. Some of this shift in the museum’s perspective arose in the late 1990s, when the curators were searching for an ornithologist. Of the final six candidates, four studied bird species

that vanished into extinction during the course of their research. This alarmed the museum curators, who realized they could not simply stand by with a disinterested objectivity and witness extinction. The Hall of Biodiversity emerged from this realization.

It can be said, then, that the new moment for science involves three intersecting dimensions: to understand the evolution of the universe and the Earth with the best scientific methods, to integrate the evolutionary narrative as a whole (cosmic, Earth, human), and to reflect on the story with a sense of our responsibility for its continuity. From this emerges a new integration of scientific facts, story, and meaning.

Environmental ethicists and scholars of the world's religions are also called to contribute to this understanding of the universe story. The challenge for religion and ethics is both to reenvision our role as citizens of the universe and to reinvent our niche as members of the Earth community. This requires reexamining such cosmological questions as where we have come from and where we are going. In other words, it necessitates rethinking our role as humans within the larger context of universe evolution, as well as in the closer context of natural processes of life on Earth.

What is humankind in relation to 13.7 billion years of universe history? What is our place in the framework of 4.6 billion years of Earth history? How can we foster the stability and integrity of life processes? These are critical questions underlying the new consciousness of the universe story. This is not simply a dynamic narrative of evolution; it is a transformative cosmological story, which engages human energy for a future that is sustaining and sustainable.

The goal of the universe story, then, is to tell the story of cosmic and Earth evolution by drawing on the latest scientific knowledge in a way that makes it both relevant and moving. What emerges is an intensely poetic story that evokes emotions of awe and excitement, fear and joy, belonging and responsibility.

The universe story is a dramatic one. Throughout billions of years of evolution, triumph and disaster have been only a hair's breadth apart. Violence and creativity are pervasive. The ability of matter to organize and reorganize itself is remarkable—from the formation of the first atoms to the emergence of life. Simple hydrogen has become a vibrant living planet, with beings that now are able to investigate

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how this has happened and imagine a life-sustaining future. We are coming to realize that the energy released at the very beginning has finally become capable, in the human, of reflecting on and exploring its own journey of change.

Waking up to our fundamental relationship with the cosmos will be a way to reengage with life. The universe story enables us to connect more deeply with the universe and the Earth of which we are a part. In doing this, we will appreciate the need for a sustainable human presence on the planet.

Thus the integrated story of the origin and development of the universe, of Earth, and of humans could become an inspiring vision for our time. This is because the story gives us a sense of common evolutionary heritage and shared genetic lineage. This new understanding of kinship of humans with each other and with all life could establish the foundations for rediscovering our past and sustaining the future. Carl Anthony, one of the leaders of the environmental justice movement, has said this perspective has been profoundly transforming for his life and work.

We can indeed be inspired by this view of nested interdependence—from galaxies and stars to planets and ecosystems—so that we sense how personally we are woven into the fabric of life. We are part of this ongoing journey. From this perspective, we can see that our current destructive habits toward the environment are unsustainable. In an evolutionary framework the damage we are causing is immense—indeed, cataclysmic. We can thus recognize ecological, economic, and social change as not only necessary but inevitable.

A great transition is indeed upon us. Beyond world wars and the cold war, there beckons the sense of a larger planetary whole—an emerging, multiform, planetary civilization. It is in participating in this transition moment that we will fulfill our role as humans on behalf of future generations. It requires a profound change of consciousness and values—both an expanded worldview of the universe story and a comprehensive global ethics that embraces the Earth community. In this way we will indeed become citizens, not simply of nation-states but of a planet that beckons us with beauty, mystery, and grace.

THE 9 LIMITS OF OUR PLANET ... AND HOW WE'VE RACED PAST 4 OF THEM

Mar 5, 2015 / John Carey



Johan Rockström says humanity has already raced past four of the nine boundaries keeping our planet hospitable to modern life. Writer John Carey digs into the “planetary boundary” theory — and why Rockström says his isn’t, actually, a doomsday message. We’ve been lucky, we humans: For many millennia, we’ve been on a pretty stable — and resilient — planet. As our civilizations developed, we’ve transformed the landscape by cutting down forests and growing crops. We’ve created pollution, and driven plants and animals extinct. Yet our planet has kept spinning along, supporting us, more or less stable and in balance. Going forward, scientists have recently proposed, all we need to do is stay within some limits, nine upper boundaries for bad behavior.

But of course, being human, we haven’t.

In a startling [January 2015 paper in *Science*](#), Johan Rockström says humanity has already raced past four of the nine boundaries keeping our planet hospitable to modern life. The climate is changing too quickly, species are going extinct too fast, we’re adding too many nutrients like nitrogen to our ecosystems, and we keep on cutting down forests and other

natural lands. And we're inching towards crossing the remaining five boundaries (see image).

Rockström (TED Talk: [Let the environment guide our development](#)) is the executive director of the [Stockholm Resilience Centre](#), and his paper is co-authored by 17 colleagues. "The planet has been our best friend by buffering our actions and showing its resilience," Rockström says. "But for the first time ever, we might shift the planet from friend to foe."

Rockström conceived of the idea of planetary boundaries back in 2007, and published his first landmark paper on the topic in 2009. The new paper digs far deeper. A key underlying assumption is that the extraordinary climate stability of the Holocene Epoch, which began when the last Ice Age ended 11,000 years ago, has been crucial to human development. This period of planetary calm enabled our ancestors to emerge from their Paleolithic caves to cultivate wheat, domesticate animals, and launch industrial and communications revolutions. As a result, the world now has 7.2 billion people—and almost that many cell phones.

The 9 planetary boundaries

To keep Earth hospitable, we need to live within 9 specific limits. Here's how we're doing in 2015.

	BOUNDARY	WHERE WE ARE TODAY
1. Climate change	Atmospheric concentrations of carbon dioxide at no more than 350 ppm	Carbon dioxide levels are at 400 ppm and climbing
2. Lost biodiversity as species become extinct	Maintain 90% of biodiversity	Biodiversity has dropped to 84% in parts of the world such as Africa
3. The addition of phosphorus, nitrogen (and other elements) to the world's crops and ecosystems	Worldwide use per year of about 11 teragrams (Tg) of phosphorus and 62 Tg of nitrogen	Up to about 22 Tg per year of phosphorus and 150 Tg of nitrogen
4. Deforestation and other land use changes	Maintain 75% of the planet's original forests	Down to 62%
5. Emission of aerosols (microscopic particles) into the atmosphere that affect climate and living organisms	Global boundary unknown, but regional effects (such as on the South Asian Monsoon) occur when Aerosol Optical Depth (AOD) is more than 0.25	Up to 0.30 AOD over South Asia, but probably well inside (or below) the boundary over most of the globe
6. Stratospheric ozone depletion	Less than 5% below pre-industrial level of about 290 Dobson Units (DU)	Still safely inside the boundary except over Antarctica during spring, when levels drop to 200 DU
7. Ocean acidification	When the oceans become acidic enough that the minerals sea creatures need to make shells, such as aragonite, begin to dissolve	Still within the boundary, which won't be crossed if we can stay within the climate boundary of 350ppm of CO ₂ in the atmosphere
8. Freshwater use	Can use up to 4000km ³ of freshwater a year	We use around 2600 km ³ of freshwater per year
9. Dumping of organic pollutants, radioactive materials, nanomaterials, micro-plastics, and other novel or man-made substances into the world's environment	Unknown	Unknown

But now, this stability is under threat. The paper concludes, for instance, that the “safe” concentration of greenhouse gases in the atmosphere (which cause climate change) is about 350 parts per million. At today’s level of 400 ppm, we’ve already blown by the boundary and risk dangerously high temperatures and sea levels, crippling droughts and floods, and other climate woes. Similarly, Rockström and his team calculate, we’ve already lost 16 percent of the biodiversity in many regions of the planet, more than the “safe” level of about 10 percent.

Crossing those two boundaries — climate change and the health of the planet’s ecosystems — is especially worrisome because doing so “can shove the Earth into completely different states,” says Will Steffen, executive director of the Australian National University’s Climate Change Institute and the new paper’s lead author. Cut down enough tropical forests, and the reminder will flip from rain forest to savannah, for instance, and all the benefits of forests will be lost. Or raise the planet’s temperature enough to cause ice sheets to collapse, and less of the sun’s heat will be reflected back to space, causing the warming to accelerate.

“For the first time, we have a framework for growth, for eradicating poverty and hunger, and for improving health,” Johan Rockström

We’re already close to points of no return, Rockström and many others believe. “What scares me absolutely the most is that we may have crossed a tipping point in the loss of the West Antarctic ice sheet,” he says.

Time to throw up our hands in despair? Not at all, says Rockström. “Ours is a positive — not a doomsday — message,” he insists. The beauty of the planetary boundary analysis is that it charts a path to keeping the planet “safe” for humanity, he believes. For instance, nations can slash their carbon emissions to almost nothing, thus pulling the Earth back across the climate boundary. Similarly, we can triple or quadruple agricultural yields in Africa with no-till water-saving methods, keeping us from the brink on forest and biodiversity loss. “For the first time, we have a framework for growth, for eradicating poverty and hunger, and for improving health,” says Rockström.

Slim and athletic at 50, and a man of boundless energy, Rockström has been taking this message on the road. He’s given talks at [TEDGlobal](#) and at the World Economic Forum in Davos. He’s met with scientists, politicians and executives — and earned accolades like “Sweden’s Person of the Year.” “Johan has incredible skill to be able to work with policy people, business executives, NGOs, and still keep his own research going,” says Steffen.

Even critics of the planetary boundary concept say he’s made a mark. “I can see how he has had a pretty big influence,” says Linus Blomqvist, director of research at the Breakthrough Institute, an ‘eco-modern’ think tank that has been perhaps the idea’s most vocal critic. “He’s brought the questions of global change and human effects to new forums and new debates.”

The boundary idea also is inspiring new scientific questions. Geological history shows that the planet can flip to a dramatically warmer or colder state lasting thousands of years when it crosses the climate boundary. But are there similar tipping points for other boundaries in Rockström's analysis? For instance, if we keep pouring more nitrogen and phosphorus from fertilizers into rivers, lakes and oceans, do we just get a related increase in harmful algal blooms and "dead" zones from the excess nutrients? Or might the whole aquatic system suddenly flip to a new state less conducive to human life?

Another key unanswered question is whether (and how much) crossing one boundary might change the other boundaries. Imagine if a combination of nutrient pollution and ocean acidification killed most of the seas' plankton, dramatically reducing the oceans' ability to pull carbon from the atmosphere. That would accelerate global warming—and require carbon emissions to be cut below today's calculated boundary level. But the details of such connections — and many other possible ones — are unclear. "What frustrates me is that we still don't understand how these boundary points interact," says Rockström, who together with his collaborators is now seeking funding to explore the many possible interconnections.

The research has not been without controversy. Some critics have seen the planetary boundaries idea as the intellectual stepchild of the now discredited 1970's "Limits to Growth" and "Population Bomb" notions that the Earth will inevitably run out of room and resources. "A lot of countries hate the idea of planetary boundaries," says Steffen. To them, it suggests that the planet's available space has all been used up, so that they are unable to follow the path the West has taken to development and prosperity.

Some argue that humans are clever enough to thrive even if the Earth does lurch away from the stability of the Holocene. But why take the risk?

This particular criticism is a fundamental misreading, supporters say. "The planetary boundary research liberates us from limits to growth in a decisive way," Rockström explains. "It says, 'here is a safe operating space where we can have unlimited growth.'" True, the existence of the climate boundary means that developed nations must slash their carbon emissions to near zero in just a few decades. "But there is nothing to hinder solar and wind power and higher efficiency," Rockström says. "The world economy can grow even in a decarbonized space."

Others argue that humans are clever enough to thrive even if the Earth does lurch away from the stability of the Holocene. The planetary boundary concept "ignores the ability of humans to adapt and change, which is the hallmark of civilization," says Ruth DeFries, professor of sustainable development at Columbia University and author of *The Big Ratchet: How Humanity Thrives in the Face of Natural Crisis*.

But why take the risk, especially if humanity can take reasonable steps to stay within the boundaries, Rockström replies. "Is it worth undermining the Earth system to create vast benefits for this generation, assuming the next generation will be more innovative?" he

asks. Plus, adds Steffen, “anyone who says we can cope with a four to five degree warmer world, and a biologically impoverished world, hasn’t thought about it.”

The Breakthrough Institute frets that some boundaries seem arbitrary because they have no known threshold. And since it’s already obvious that the world must cut carbon emissions and boost agricultural yields, “those planetary boundaries kind of seem irrelevant,” says Breakthrough’s Blomqvist.

Not to Rockström. Instead of endlessly arguing with climate skeptics about supposed uncertainties in climate science, he says, it’s possible to show the overwhelming evidence of an acceleration towards the eight other boundaries too — forests, depleting ozone, chemical loading etc. “It creates a more healthy discussion than yes or no on climate change,” he says.

That’s an approach that others find compelling as well. Obviously, we need swift action to fight climate change, says Joe Romm, founding editor of *Climate Progress*, and a former U.S. Energy Department official. “But apparently, however we have been explaining that to people, they don’t get it.”

Will the world get the planetary boundary message? We’d better, Rockström says. “We may have entered the most challenging and exciting decade in the history of the planet,” he says. “We have a responsibility to leave the planet in a state as close to the Holocene as possible.”

Featured image by Reto Stöckli/NASA based on data from NASA and NOAA.

ABOUT THE AUTHOR

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CONNECTING WITH ENVIRONMENTALISTS — GETTING BEYOND WORD GAMES BY DAN DAGGET

MARCH 13, 2016

I've presented a lot of evidence here on Dan Dagget.com (and in plenty of other places including my other blogsite – [The Right Way To Be Green](#)) that grazing livestock on grasslands here in the West, especially when that grazing is done in a way that mimics natural herds of bison, bighorns, or other hoofed critters, can be beneficial to those ecosystem.

I've also given literally hundreds of presentations on that topic to environmentalists and others, and when I give those presentations a majority of people in the audience are usually surprised and impressed by the photos comparing the positive effects of grazing versus the negative effects of protection.

"I had no idea." Some comment. "I changed my mind tonight," said another at a recent presentation.

The problem is, although plenty of enviros appear to get the message, the connection doesn't seem to last very long nor does it go much of anywhere.

"That's nice. So what? Now what?"

A few are impressed in an even less connected way.

"What about overgrazing!?" They sputter. "You can't convince me there isn't overgrazing! Those ranchers are in it to make money not to help the environment! Your information is anecdotal! It's not science!"

That is usually followed by some form of...

"Those places grazed by livestock might look healthy, but they're not natural. They would be just as healthy, actually healthier, if they were protected and, therefore, truly natural."

Recently, when my wife, Trish, heard me wondering out loud about this two-sided response, the lack of connection it made clear, and how to deal with it, she offered...

"You've got to remember, those people think of themselves as environmentalists. You've got to give them some way to make sense of, and to make use of, the

information you're giving them. You've got to give them the right frame of reference."

Frame of reference, I wondered? What is the "frame of reference" of people who call themselves "environmentalists,"

The first thing that came to mind was the definition of "nature."
Environmentalism, of course, is about "nature," specifically about protecting it and restoring it.

Cambridge Dictionaries defines "nature" as: all the animals and plants in the world and all the features, forces, and processes that exist or happen independently of people.

From the Merriam Webster definition "nature" is (T)he physical world and everything in it (such as plants, animals, mountains, oceans, stars, etc.) that is not made by people.

All of my presentations are about humans having a positive impact on the ecosystem, about making it more natural, more healthy, more functional.

Could it be that all the problems people have with the positive examples of humans effecting the environment I present and, beyond that, the endless list of contemporary environmental issues that have to do with protecting the land from humans, are nothing more than this — merely a matter of semantics? Merely about definitions?!

In a very significant way it seems to me the answer is, "Yes." What we call "environmentalism" maintains that the health of any collection of living things and their surroundings is determined by the degree to which that "ecosystem" conforms to the above definition — to the degree to which it "exists or happens independently of people."

I've had a number of experiences that verify that conclusion. One of the most notable was an encounter in one of the "collaborative" groups in which I have participated over the last 30 years. At a gathering of environmentalists, ranchers, agency people and neighbors on a cattle ranch in the grasslands southeast of Tucson, Arizona, the rancher who was our host made an offer to a number of people who had expressed their opposition to cattle ranching in the "desert Southwest" several times during the day.

“Tell me what you would like for this place to be,” he said, “and I’ll set that as my goal and work toward it. Then we can be allies instead of adversaries.”

“There’s only one thing you can do to make this place better,” replied one fellow who had identified himself as a “radical environmentalist.”

“You can leave.”

“Because if you stay, no matter what you do to the land, no matter how good you make it look, it will be unnatural and, therefore, bad. And if you leave, whatever happens to this place, even if it ends up being as bare as a parking lot, will be natural and, therefore, good.”

In other words, if a piece of the planet conforms to the definition of “nature” it is healthy and good no matter what its condition.

A statement like that deserves an illustration (or two).

Here’s an illustration that will be familiar to visitors of this website or readers of one or both of my two books **Beyond the Rangeland Conflict, Toward a West That Works** and **Gardeners of Eden, Rediscovering Our Importance to Nature...**



This is the Drake Exclosure, a U. S. Forest Service study plot near Prescott, Arizona. It is very nearly as bare as a parking lot. However, since it is protected from human use (and has been since 1946) it conforms to the definition of “natural.” For that reason, according to the contemporary environmental frame of reference, it is healthy and good.

The land in the picture below is just outside the Drake Exclosure. (See the sign on the fence.) It has been grazed by livestock since the 1800s. For that reason, it does not conform to the contemporary environmentalist definition of “natural” and, therefore, in need of healing (removing the impacts of humans). Does that mean the goal of contemporary environmentalism is to make it look like the land in the previous picture?



Here's another comparison...



This land, along the Verde River in Arizona, had been protected for 9 years when this photo was taken. During those 9 years it had existed as “independently of human activities” as possible. According to the contemporary environmentalist

frame of reference that means it is “natural” and “healed” or at least on its way to being so. One environmental group involved in the protection of this land states: “We’ve protected more than 119 million acres of land and thousands of miles of rivers worldwide,” That, the group claims, qualifies as a “tremendous record of success” The land in the photo is a portion of those “thousands of miles of rivers” part of that “tremendous record of success” because it conforms to a definition.



On the other hand... The land in the photo above, also along the Verde River in Arizona, is grazed by livestock. (Photos taken roughly at the same time. Yes, most of those plants are natives.) Within the contemporary environmentalist frame of reference this place is “unnatural” and in need of being “restored to nature” or “healed,” The only way to achieve that, according to the definition of “nature” is to protect the land from human activity, turning this “failure” into the “success” illustrated above.

Fortunately for all of us, including environmentalists, there is a much better, much more functional, more accurate and realistic way of interpreting the concept “nature” that can provide a basis for our relationship to the world in which we live. This more functional view of what is “nature” fortunately doesn’t lead to absurdities like the ones just described. It is derived from science and experience rather than from definitions. It is a basis that we can learn about and confirm “on the ground” rather than merely by indulging in word games.

First of all this functional way of relating to our environment resolves one of the main problems with defining nature as: existing or happening “independently of people.” Humans have been a part of nature for as long as any other plant or animal, i. e. for as long as we have lived on this planet. And while we’ve been here, we’ve lived and participated in nature in the same way as those other life forms. We’ve provided input and we’ve harvested output. We’ve been predators and prey; herders and harvesters; cultivators, pollinators, and seed spreaders. We’ve dunged and urinated, lived and reproduced, died, and decomposed just the same as all those other “natural” living things.

From that it seems obvious: an environmentalism based on a dividing line that separates us from everything else on the planet is mistaken and useless. So, If we’re going to come up with a way to understand and practice an effective way of living on planet Earth, whether we call it, “environmentalism” or not, it has to be inclusive. It has to effectively increase our understanding of all those ecological processes we’ve been a part of and continue to be a part of today.

Oddly enough, the best candidate for such an understanding comes to us from the space program and our efforts to visit other planets. In the 1960s, in advance of sending a probe to Mars, NASA decided it might be good idea to know in advance if there is life up there, so they enlisted a number of scientists to come up with a way to tell if there is life on a planet without (or before) visiting it. Among those scientists was James Lovelock, an English chemist known for thinking out of the box,.

Lovelock noted that there are a number of characteristics of our own planet that cannot exist without being sustained in some way (or, in other words, by some thing). For example, there is no way our planet’s atmosphere could stably consist of 20+% oxygen (which it does) if left purely to the vagaries of chemistry. Oxygen is a very reactive gas. That means it would quickly react itself into compounds with other chemicals and trend to zero or nearly so if something wasn’t replacing and sustaining it in its pure or free form. (Venus and Mars, for instance, contain 0.00 percent and 0.13 percent, respectively, of free oxygen.) Here on Earth, plants, both on land and sea, produce oxygen as a byproduct of photosynthesis. In other words, they produce one of the main components of a habitat that will sustain life for life by the process of living.

Something similar happens in the case of the salinity of the oceans. In spite of the fact that every year roughly 500 million tons of mineral salts are eroded and dissolved from the Earth’s dirt and rocks and carried by streams and rivers into the planet’s oceans, the salinity of those waters remains a surprisingly stable 3.4% and has for a very, very long time (millions of years). Lovelock considered it no accident that this is exactly the level of salinity required for the continuing

existence of the forms of life that inhabit the seas. (And we're supposed to worry about a little more carbon dioxide.

To make a long story short (you can read more on your own.) Lovelock hypothesized that living things have developed the conditions that make life possible here on Earth, and they sustain those conditions in a relatively stable form. That means the life forms of Earth (including us) haven't lucked out by being placed on or happening onto a planet with a series of geologic or interplanetary processes that inadvertently make life possible. The living things on Earth have evolved or been created in a way such that they sustain the conditions for life by the very natural act of living. Example? — Bees pollinate flowers as they feed on their nectar, which creates seeds, which create more plants, which create food for bees (and other creatures) along with the oxygen that bees and other creatures breathe, which creates more bees and more other creatures, and more flowers...

And while we're at it, think about those ranchers and cowboys, and cows and grasses, or Indians and bison, and The Great Plains, etc.

Lovelock attached the name "Gaia" (the Greek name for the Earth Goddess) to his hypothesis at the suggestion of an author friend. The name has the unfortunate (in my opinion) effect of making his conclusions susceptible to being co-opted by mystics (for pantheistic purposes) and feminists (for political purposes). In spite of that, the most notable implications of Lovelock's hypothesis are decidedly practical.

Consider those photos we looked at a few paragraphs back. If we interpret them in terms of Lovelock's hypothesis, what seemed like an absurdity at the time (That's healthy?! And that's not?!!) now makes perfectly good sense. The green photo is green because living things, including cattle and humans, have developed the conditions for life and are sustaining them by the act of simply living. Humans are acting as predators, cows are prey, humans are moving and circulating cattle, who are harvesting, recycling, seeding, tilling, and fertilizing. The result is a prosperity that benefits more than cows and humans. It benefits deer, rabbits, mice, fish, birds, bugs, plants, microbes, the list is longer than I have room to include here.

In the other photo, the most significant predators, prey, circulators, harvesters, recyclers, seeders, tillers, and fertilizers have been removed, and where the interaction of living things has been reduced, so have the conditions to support life and, thus, so has life itself.

Translation: protecting the environment from humans performing the functions Lovelock identified as sustaining the conditions for life does no favor for the environment, nor for us, nor for anything, really.

Unless, of course, you live in a world where semantics matter more than results... or more than sustaining the conditions for life.

Source: <http://www.dandagget.com/connecting-with-environmentalists-getting-beyond-word-games/>

Originally read from Gardeners of Eden by Dan Dagget

THOUGHTS AND REFLECTIONS

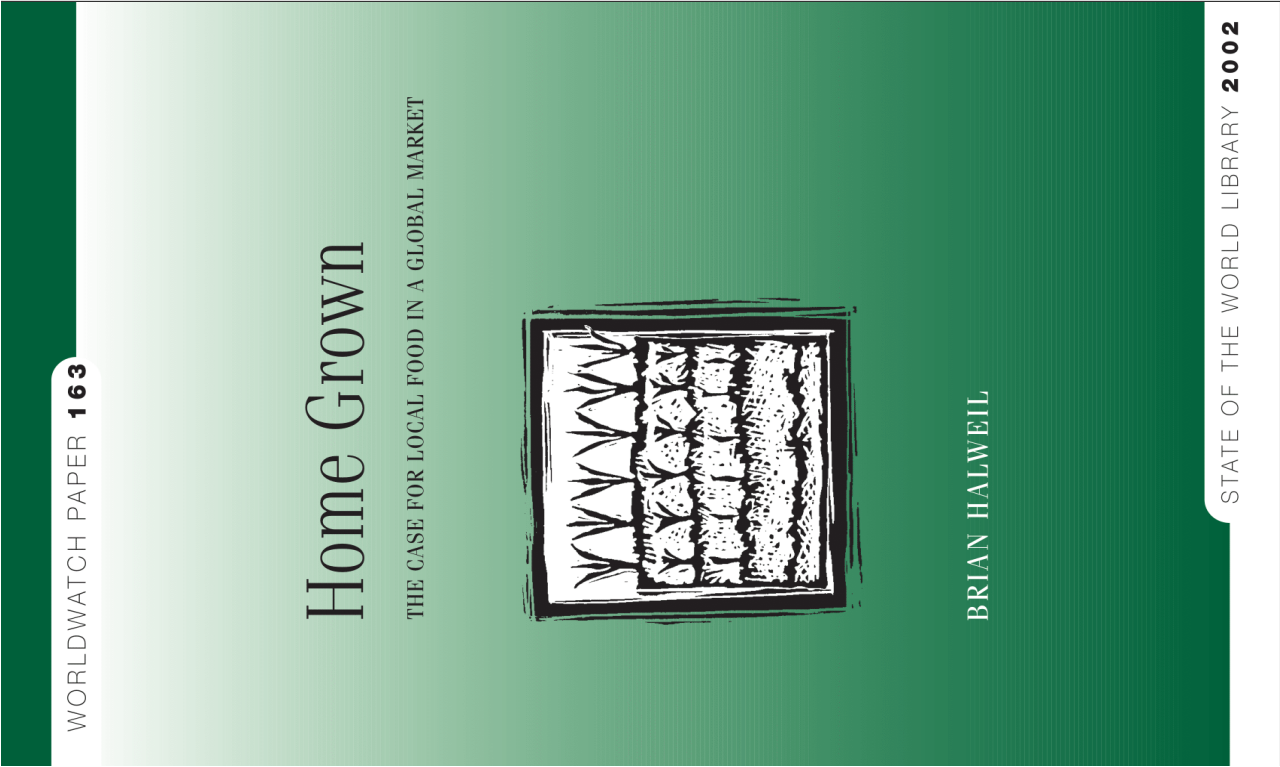
What does the environment/world mean to you?

How did you feel as you were reading these articles?

What are some thoughts lingering on your mind?



Chapter 2: Onto Our Plates



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Summary

People everywhere depend increasingly on food from distant sources. In the last 40 years, the value of international trade in food has tripled, and the tonnage of food shipped between nations has grown fourfold, while population has only doubled. In the United States, food typically travels between 2,500 and 4,000 kilometers from farm to plate, up to 25 percent farther than in 1980. In the United Kingdom, food travels 50 percent farther than it did two decades ago.

The reason is partly demographic: Since more people live in cities, fewer people live near food production centers. Perhaps more importantly, advances in technology that allow longer storage and more distant (and less costly) shipping have encouraged the food system to sprawl. Cheap gasoline and various transportation subsidies also underpin this food traffic, which can require staggering amounts of fuel. A basic diet—some meat, grain, fruits, and vegetables—using imported ingredients can easily gobble four times the energy, and generate four times the greenhouse gas emissions, of an equivalent diet with ingredients from domestic sources.

For those who can afford it, the long-distance food system offers unprecedented and unparalleled choice—any food, anytime, anywhere. But the "global vending machine" often displaces local cuisines, varieties, and agriculture. Products enduring long-term transport and storage depend on preservatives and additives, and encounter endless opportunities for contamination on their long journey from farm to plate. Long-distance food erodes the pleasures of face-to-face inter-

actions around food and the security that comes from knowing what one is eating.

Economists often argue that the long-distance food trade is efficient, because communities and nations can buy their food from the lowest-cost provider. But the loss of local food self-reliance brings a range of unseen costs—to the environment, to the agricultural landscape, and to farm communities.

Instead of selling food to their neighbors, farmers sell into a long and complex marketing chain of which they are a tiny part—and are paid accordingly. Evidence from North America, Asia, and Africa shows that farm communities have not benefited, and have often suffered, as a result of freer trade in agricultural goods. Meanwhile, the supposed efficiencies of the long-distance food chain leave many people malnourished and underserved. Farmers producing for export often go hungry as they sacrifice the use of their land to feed foreign mouths, while poor urbanites in both the First and Third Worlds find themselves living in neighborhoods unable to attract supermarkets, green grocers, and healthy food choices.

Fortunately, the long-distance food habit is slowly beginning to weaken under the influence of a young, but surging, local foods movement. This movement can help restore rural areas, enrich poor nations, return fresh and wholesome food to cities, and reconnect suburbanites with the land by reclaiming lawns, abandoned lots, and golf courses to use as local farms, orchards, and gardens. While a certain amount of food trade is useful, communities that seek to meet their food needs locally as much as possible will realize other benefits as well:

- Rebuilding local foodsheds requires rebuilding the local diversity of crops and food businesses needed to adequately feed the local population. Farmers producing for the local market tend to increase the diversity of their plantings—a shift with advantages for the diets of local people and the ecology of local landscapes.

- Money spent on local produce at farmers' markets, at locally owned shops, or on locally produced foods stays in the community longer, creating jobs, raising incomes, and supporting farmers. Developing nations that emphasize greater

food self-reliance can thereby retain precious foreign exchange and avoid the whims of international markets.

- Local food often costs less than the equivalent food bought on the international market or from a supermarket, because transportation costs are lower and there are fewer middlemen.

The explosive growth in farmers' markets and community supported agriculture (food delivery subscription schemes) is the clearest indication of growing interest in local food. But these sorts of direct marketing arrangements are perhaps the easiest parts of the local food system to rebuild, since they operate under the radar of the conventional food chain—in the niche for fresh, high-quality food connected to a real person—that will never be filled by anonymous supermarkets and multinational food companies.

The food processing and retailing sectors are among the most intensely consolidated links in the food chain. Recapitulating these sectors will not be easy. In many communities, the local packing house, slaughterhouse, dairy, cannery, and commercial kitchen are gone. Nonetheless, success on this front could hold tremendous profit-making potential, by allowing larger growers (too big for farmers' markets) and larger food businesses to tap the interest in local foods and by enabling a broader range of consumers to enjoy local foods.

Seizing these opportunities will require farmers to shift from their current role as mass marketers of generic commodities to a more entrepreneurial approach that is responsive to local consumer demands. Farmers will benefit from coming together in marketing cooperatives—allowing them to share marketing, transportation, and distribution capacity—as well as from linking up with other institutions suffering from food-industry consolidation, including restaurants, consumer co-ops, caterers, school cafeterias, and independent grocers.

One relatively new institution that can help facilitate these linkages is the local food policy council. More than a dozen such institutions exist in North America alone, tracking changes in the local food system, lobbying for farmland protection, pointing citizens towards local food options, creating incen-

tives for local food businesses, and generally making policy more responsive to local food needs.

A more diffuse, but potentially more powerful, actor is the food consumer. Consumers may seek out local food because of the superior taste of products harvested at the peak of ripeness and flavor, and because of the high level of control it gives over the food they eat. Well-publicized food safety concerns—such as mad cow disease and genetically modified foods—have stirred consumers everywhere to determine the origins of their food. This depends heavily on shortening the distance between food producers and consumers.

Entering the Foodshed

In a sprawling series of hangar-sized warehouses in the Maryland town of Upper Marlboro, fruit, vegetables, meat, milk, and other foods destined for kitchen tables along the East Coast of the United States sit in mammoth refrigerators. This is the midatlantic regional distribution center for Safeway supermarkets, and the echo off the rafters and the hum of the machinery gives some sense of the immense scale of infrastructure required to ship food around the planet and ensure that it is still palatable when it arrives.

Think of this place as a pit-stop for travel-weary foods from around the world. “Essentially, all produce that is distributed on the East Coast must go through here for quality control, taste and appearance inspection, inventory,” explains Matthew Hora of the Capital Area Food Bank, who has studied the history of food distribution in the United States. “So if a lettuce farmer outside Atlanta, Georgia, wants to sell lettuce to a Safeway in Atlanta, it must first be shipped 1,000 kilometers to Upper Marlboro for inspection, then be shipped back down to Georgia,” all the while consuming fuel and taking up extra road space—not to mention becoming less fresh.¹

This arrangement may seem absurd. To a supermarket executive or produce wholesaler, this mammoth distribution

center is a state-of-the-art innovation in efficiency. But include the subsidies for gasoline and roads, the effects of smog and global warming, the ecological fallout from the industrial farms that supply the distribution center, and a range of other hidden costs, and the “efficiency” of long-distance food begins to fade away. Because these costs are mostly unaccounted for—not paid directly by the consumer, farmer, or supermarket—the resulting food is artificially cheap.

Food hasn’t always been such a globe-trotter. For example, as recently as the 1950s virtually all of the fruits and vegetables consumed in Washington, D.C., were grown on farms in nearby Maryland. Long-distance shipping was impractical and expensive. But a chain of related events over the next few decades changed that. Refrigerated long-haul trucks were developed, and gasoline prices fell. A federally subsidized interstate highway system spread from coast to coast. Advances in food processing made long-term storage possible. California produce growers began advertising aggressively. Before long, the Midatlantic began to depend on food from all over. Statistics from one wholesale market in Maryland show that the average kilogram of produce traveled at least 2,800 kilometers from farm to plate, as much as 25 percent farther today than in 1980.²

As local farmland declined in importance and profitability in the Midatlantic, thousands of farmers in Virginia, Pennsylvania, and Maryland went under and farm communities dried up, many of them replaced by subdivisions and asphalt. The landscape declined in diversity as the remaining farms specialized in one or two crops to service distant markets rather than provide a range of foods for locals. The economic landscape also declined in diversity as many food businesses—from local grocers and bakers to local canneries and caterers—were replaced by a handful of national conglomerates.³

This system of long-distance food supply has now become the norm in much of the United States and the rest of the world. Apples in Des Moines supermarkets are from China, even though there are apple farmers in Iowa; potatoes in Lima’s supermarkets are from the United States, even though Peru

boasts more varieties of potato than any other country. Today, our food travels farther than ever before, often thousands of kilometers. The value of international trade in food has tripled since 1961, while the tonnage of food shipped between countries has grown fourfold, during a time when the human population only doubled.⁴ (See Figures 1 and 2.)

But, as with many trends that carry serious social and ecological consequences, the long-distance food habit is slowly beginning to weaken, under the influence of a young, but surging, local foods movement in the Midatlantic and elsewhere. Politicians and voters in the counties surrounding Washington, D.C., have supported aggressive measures to protect farmland using tax credits, conservation easements, and greater emphasis on mass transit. Some of this interest is inspired by the desire to preserve the beauty of the countryside, but the campaign to preserve local farmland also rests on the assumption that farmers connected to a community are likely to farm more responsibly. Accokeek Ecosystem Farm, a seven-acre certified organic farm located on the Potomac River in southern Maryland, not only produces food for a weekly food subscription service for almost 90 families (and has started a waiting list because demand is so great), but plays a role in protecting the Chesapeake watershed (farmland holds more water than sprawling subdivisions) and keeping agrochemicals out of the Bay.⁵

Since protecting farmland means little if farmers continue to go out of business, many Midatlantic residents and organizations are bringing back local food markets, which not only help sustain the local farm economy but also build solidarity between farmers and their urban neighbors. This became clear on a recent trip to the bustling FreshFarm Market, staged weekly in a bank parking lot and adjacent side street off Washington's Dupont Circle and hosting about 30 growers from within 250 kilometers of the city. From a distance this farmers' market looks like a human beehive, buzzing with conversation, laughter, music, and talk of food—the social and aesthetic antithesis of the food system symbolized by the Safeway distribution center in Upper Marlboro. (Sociologists esti-

FIGURE 1
Value of World Agricultural Trade, 1961–2000

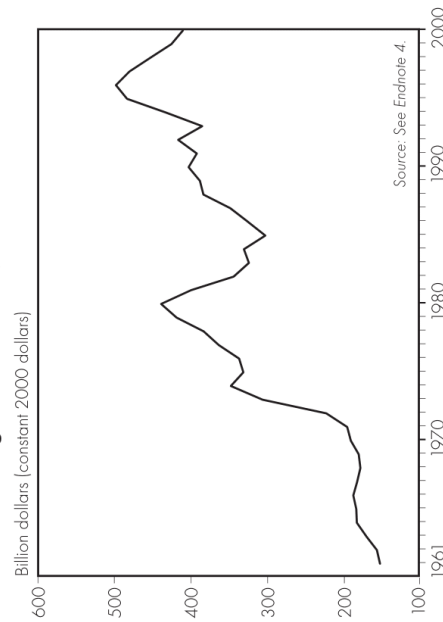
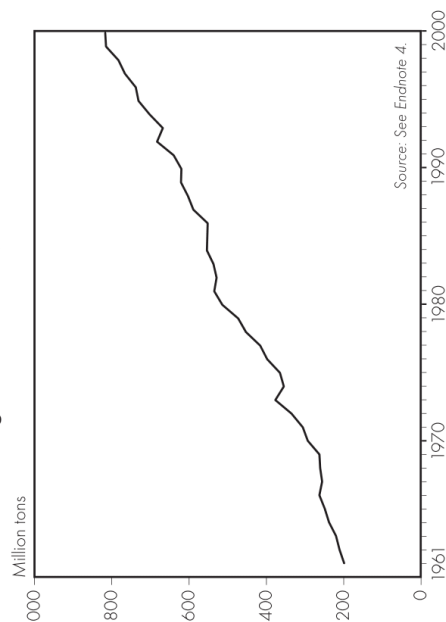


FIGURE 2
Volume of World Agricultural Trade, 1961–2000



mate that people have 10 times as many conversations at farmers' markets than at supermarkets.) Each Sunday, the FreshFarm Market features a different local chef demonstrating how to transform what is currently available at the market into a scrumptious dish—on one August Sunday, how to make a pesto out of garlic and how to can tomato sauce. This is a big draw for market-goers and an easy way to reinforce the possibilities of seasonal cooking. Apart from the tasty fare, "the biggest reason for shopping here," according to market supervisor Bernie Prince, is that in stark contrast to the typical foodchain in which food travels thousands of kilometers and might change hands a dozen times, "a farmers' market allows you to have some firsthand sense of where your food comes from." Such a connection means more to Americans as news reports discuss the possible risks of food irradiation, genetically modified organisms, and bacterial contamination (this last of which recently prompted the second largest meat recall in national history).⁶

Ten other farmers' markets have sprung up around town just in the last year. The farmers' market in Anacostia, the poorest section of Washington, might be the best hope for many residents to get fresh fruits and vegetables—urgently needed in a part of the city crammed with fast food joints but without a supermarket for the last few years. For Anacostia residents, accustomed to conducting food purchases through bullet-proof glass, the market also creates a safe, central public place for people to gather and socialize.⁷

Farmers in the region have banded together in a number of marketing cooperatives in order to sell at farmers' markets, deliver weekly boxes of vegetables to private subscribers, and serve commercial kitchens at hotels, restaurants, and cafeterias. The 14-member Tuscarora Organic Growers Cooperative, for instance, supplies several local grocers, natural food stores, and assorted restaurants. "For a chef concerned with taste, there is no substitute for working with food in-season that has been picked the day before," explains Nora Poullion, whose restaurants buy from Tuscarora. Poullion notes that her restaurants could not offer an array of local meats, grains, fruits, vegeta-

bles, and nuts without the existence of many local farms, including some local growers who have built greenhouses to extend their growing season.⁸

This interest in local food is almost catching. As more farmers raise a variety of crops for local markets, it can quickly become easier and cheaper for school cafeterias, restaurants, government offices, and households to incorporate local foods into their cuisine. The presence of a farmers' market or community garden often inspires neighboring areas to create their own, and the possibilities for start-up food businesses, including bakeries, butchers, green grocers, canneries, and caterers, multiply with the growing availability of local foods.

This is what it looks like to rebuild a local "foodshed"—that sphere of land, people, and businesses that provides a community or region with its food. So many of these activities and arrangements seem intrinsically valuable: chefs using fresher, tastier, and less processed foods; farmers linking up to offer busy consumers a diversity of products in one location; empty downtown parking lots sprouting farmers' markets on the weekends. But such obviously beneficial developments remain a tiny counterweight to the vast agro-industrial food system, a fact that points to the formidable barriers facing local foods: agribusiness monopolies that can squash competition; cheap fossil fuels that encourage long-distance shipping; a stubborn conception of farmers as producers with no need to connect with eaters; and a range of agricultural policies that discourage local farms, farmers' markets, and food cooperatives in favor of factory farms, megamarkets, and long-distance trade.

The long-distance transport of food has become such a defining characteristic of the modern food system that most people accept it as the only way for us to be well-fed. For those who can afford it, the wonder of eating exotic produce grown halfway around the globe in the depths of a rainforest or on some Asian rangeland emerges as one of the clearest benefits of the long-distance food system. Cheap and fast transportation enable cross-cultural experiences, fusion cuisine, and dietary exploration, especially for those living in large metropolitan centers.

But there is an unavoidable tension between the human enjoyment of variety and the global homogenization of food. The long-distance food system offers unprecedented and unparalleled choice to paying consumers—any food, any time, anywhere. But this astounding choice is laden with contradictions. Ecologist and writer Gary Nabhan wonders “what culinary melodies are being drowned out by the noise of that transnational vending machine,” which often runs roughshod over local cuisines, varieties, and agriculture. The choice offered by the global vending machine is often illusory, defined by infinite flavoring, packaging, and marketing reformulations of largely the same raw ingredients. (Consider the hundreds of available breakfast cereals.) The taste of products that are always available, but usually out of season, often leaves something to be desired. And where is the choice when every link in the chain is controlled by a declining number of firms?⁹

Long-distance travel requires more packaging, refrigeration, and fuel, and generates huge amounts of waste and pollution. Products enduring long-distance transport and longterm storage depend on preservatives and additives, and encounter endless opportunities for contamination on their journey from farm to plate. Instead of dealing directly with their neighbors, farmers sell into a long and complex food marketing chain of which they are a tiny part—and are paid accordingly. A whole constellation of relationships within the foodshed—between neighbors, between farmers and local processors, between farmers and consumers—is lost in the process. Farmers producing for export often find themselves hungry as they sacrifice the output of their land to feed foreign mouths, while poor urbanites in both the First and Third Worlds find themselves living in neighborhoods unable to attract most supermarkets and other food shops and thus without healthy food choices. The supposed efficiencies of the long-distance chain leave many malnourished and underserved.

Our food system in many ways reflects what the changing world economic structure means for the environment, our health, and the quality of our lives. The quality, taste, and vitality of our foods are profoundly affected by how and where

they are produced, and how they arrive at our tables. Food touches us so deeply that threats to local food traditions have sometimes provoked strong, even violent, responses. José Bové, the French sheep herder who drove his tractor into a McDonald's to fight what he called “culinary imperialism,” is one of the better known symbols in a nascent global movement to protect and invigorate local foodsheds. It is a movement to restore rural areas, enrich poor nations, return wholesome foods to cities, and reconnect suburbanites with their land by reclaiming lawns, abandoned lots, and golf courses to use as local farms, orchards, and gardens.

Local food is sprouting through the cracks in the long-distance food system: rising fuel and transportation costs; the near extinction of family farms; loss of farmland to spreading suburbs; concerns about the quality and safety of food and the craving for some closer connection to it. Long-distance food erodes the pleasures of face-to-face interactions around food and the security that comes from knowing what one is eating. (Eating local might be the best defense against hazards introduced intentionally or unintentionally in the food supply, including *E. coli* bacteria, genetically modified foods, pesticide residues, and biowarfare agents.) On a more sensual level, locally grown food served fresh and in season has a definite taste advantage—one of the reasons this movement has attracted the attention of chefs, food critics, and discriminating consumers around the globe.

The local alternative also offers huge economic opportunities. In every country, money spent on local produce at farmers' markets and locally owned shops stays in the community, cycling through to create jobs, raise incomes, and support farmers. Developing nations that emphasize greater food self-reliance can thereby retain precious foreign exchange and avoid the whims of international markets. There is strong evidence that local food often costs less than the equivalent food bought on the international market or from a supermarket, because transportation costs are lower and there are fewer middlemen.

But despite its many advantages, the local alternative

nevertheless stands against the daunting tide of agribusiness consolidation, the decline of crop diversity, and the loss of food literacy by the average consumer. Change will not come easily. Control of the food system has been largely lost to a dwindling number of food companies. This is what makes the idea of eating locally so radical—the fact that communities around the world all possess the capacity to regain this control by rebuilding local food institutions, such as farmers' markets and small-scale food processing facilities. The explosion of farmers' markets and community-supported agriculture points to the growing numbers of consumers, farmers, and food businesses that have already shifted their role in the food chain, detaching themselves from long-distance cuisine to live within their foodsheds.

The Transcontinental Lettuce

For the better part of human history, and even as recently as several decades ago, most people obtained their food from local sources. Statistics on how far food travels are not available for most nations. Nonetheless, a survey of trends from a number of nations and regions clearly indicates a growing distance between the fields and pastures where most food is grown and the mouths it feeds.

Food trade, for instance, has grown nearly threefold since 1961. Countries shipped \$417 billion worth of food and agricultural goods around the globe in 2000. As the value of agricultural trade has increased, so has the volume. Today, some 817 million tons of food are shipped around the planet each year—up fourfold from 200 million tons in 1961. (See Figures 1 and 2, page 11.)¹⁰

Surveys of food moving within nations tell the same story. (See Figures 3A and B, pages 18 and 19.) Several surveys from different wholesale markets in the United States show that fruits and vegetables are traveling between 2,500 and 4,000 kilometers from farm to market, an increase of roughly 20 percent

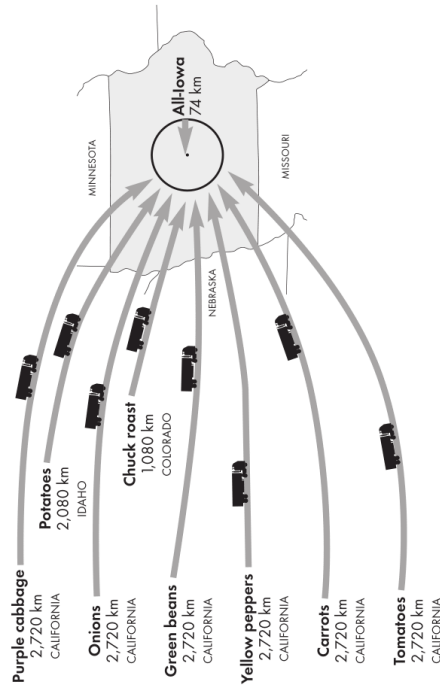
in the last two decades. Food eaten in the United Kingdom travels 50 percent farther on average than two decades ago. Over the same period, imports of fruits and vegetables arriving there by plane more than tripled, to nearly 120,000 tons a year. Trucks moving food now account for nearly 40 percent of all road freight in the United Kingdom.¹¹

Part of the reason we are moving more food around the planet is demographic: there are more people living in cities and fewer living near the centers of food production. Perhaps more importantly, advances in food technology that allow longer storage and more distant (as well as cheaper) shipping helped the food system to sprawl. Even though ice-refrigerated railroad cars allowed perishable food products to be shipped as early as the 1860s, it was major innovations in refrigeration engineering after World War II that gave birth to the frozen food industry. Scientists also developed techniques to control the ripening of fruits, vegetables, and other perishables that further extended shelf-life. Advances in transportation came particularly fast—steamships in the mid-1800s, railroads later in the 19th century, the refrigerated truck in the mid-1900s—and combined with falling oil prices to dramatically reduce the cost of shipping food. It now costs 70 percent less to ship cargo (all items, not just food) by sea, and 50 percent less to ship by air, than it did 20 years ago.¹²

These innovations in food processing and shipping often worked together. For instance, before scientists figured out how to make frozen orange juice concentrate, orange growers could only ship their fruit fresh, and most people in temperate regions enjoyed oranges and orange juice only as a seasonal delicacy. During World War II—partly responding to requests from the U.S. government for an orange juice product that could be shipped to troops overseas—American scientists developed a process for concentrating the orange juice (reducing its bulk and allowing it to be shipped at lower cost), adding a small amount of unconcentrated juice to the mixture (which greatly improved the flavor), vacuum sealing it in cans, and then passing the cans through a freezing tunnel before shipping in refrigerated oceanliners, box cars, and trucks. This

FIGURE 3A

Local Versus Imported Ingredients: Iowa



The foods going into an "All-Iowa" meal traveled an average of 74 kilometers to reach their destination, compared with 2,577 kilometers if they had been shipped from the usual distant sources nationwide. Researchers estimated that local and regionally sourced meals entailed 4 to 17 times less petroleum consumption and 5 to 17 times less carbon dioxide emissions than a meal bought from the conventional food chain.

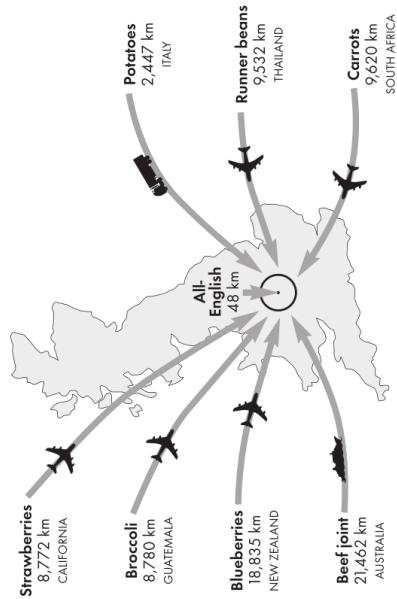
Source: See Endnote 11.

process, still in use, revolutionized the orange growing industry, freeing it from seasonal and geographic constraints, and thereby transformed orange juice into a daily ration for many Americans and Europeans—and turning frozen orange juice into a multibillion-dollar international business.¹³

All this food traffic requires staggering amounts of fuel (and probably wouldn't be feasible without abundant and cheap oil). Among the biggest culprits are those high-value items with relatively low caloric value and high water content, such as cut flowers, fruits, vegetables, and frozen foods. (Nutritionist Joan Gussow of Columbia University describes the

FIGURE 3B

Local Versus Imported Ingredients: England



A "traditional" Sunday meal in England—beef, potatoes, carrots, broccoli, beans, blueberries, and strawberries—made from imported ingredients generates nearly 650 times the transport-related carbon emissions than the same meal made from locally grown ingredients (almost 38 kilograms of carbon dioxide compared with just 58 grams). All the ingredients are available in England for much of the year except the fruits, which can either be stored or preserved to extend their availability.

Source: See Endnote 11.

process as "burning lots of petroleum to ship cold water around.") The transcontinental head of lettuce, grown in the Salinas Valley of California and shipped nearly 5,000 kilometers to Washington, D.C., requires about 36 times as much fossil fuel energy in transport as it provides in food energy when it arrives. By the time this lettuce gets to the United Kingdom, the ratio of fuel energy consumed to calories provided jumps to 127. "Perishables"—as these goods are known in industry jargon—constitute the fastest growing segment (over 4 percent per year) of the food cargo business and are increasingly shipped by refrigerated plane.¹⁴

Most international food trade is by boat, and most food trade within nations is by rail or truck, all relatively energy efficient forms of transportation compared with climate-controlled airplane cargo. And products like grains and beans—which pack a great deal of nutrition for a given unit of weight—and coffee, tea, chocolate, and spices can all be shipped dry, without climate control. Nonetheless, Anika Carlsson-Kanyama of Stockholm University has shown that a basic diet—some meat, grain, fruits, and vegetables—with imported ingredients can easily account for four times the energy and four times the greenhouse gas emissions of an equivalent diet with ingredients from domestic sources. In Britain, food transportation is now among the biggest and fastest growing sources of British greenhouse gas emissions—a pattern emerging in much of the world. (The climate changing implications of a long-distance food system are particularly ironic since food production is one of those human endeavors that is most dependent on a stable climate and will be most affected by climatic spasms.)¹⁵

Much of this shipping seems entirely illogical, as it often involves regions and nations importing food they already have. A recent survey of trade data from the United Kingdom exposed the astonishing reality that the nation imports large amounts of milk, pork, lamb, and other major commodities even as it exports comparable quantities of the same foods, shuttling hundreds of millions of tons of identical food in opposite directions. Analysts explain this “food swap” as an artifact of subsidized transportation, centralized buying by supermarkets and food manufacturers, and trade agreements that set food import quotas even for self-sufficient nations. In the case of milk, British milk purchasers (supermarkets and food manufacturers) prefer to buy a standardized, predictable commodity in large quantities from a few sources—thus forcing British dairy farmers to sell their milk in international markets. These same economic forces also explain why the label on a bottle of Tropicana brand apple juice says it “contains concentrate from Germany, Austria, Italy, Hungary, Argentina, Chile, Turkey, Brazil, China, and the United States.” Apart

from the questionable cost and pollution, a company buying whatever produce is cheapest on the world market can have no allegiance to place, and the drinker can never really be sure what he or she is drinking. (The above list of countries has a wide range of pesticide standards.) And as ecological economist Herman Daly once remarked about this sort of trade, “Americans import Danish sugar cookies, and Danes import American sugar cookies. Exchanging recipes would surely be more efficient.”¹⁶

Meanwhile, as food ends up farther from the soil in which it was grown, waste loops are broken. Jerry Goldstein, the editor of *Biocycle*, a magazine that tracks trends in dealing with organic waste around the world, notes that the long-distance nature of food systems “creates tremendous food waste disposal pressures at one end, while eliminating an ideal source of plant nutrients and soil-building organic matter for agricultural soils, in favor of polluting chemical fertilizers.” (Programs to collect food waste, compost it, and return it to parks, farms, and forest soils have been successfully piloted in supermarkets, restaurants, and residential neighborhoods around the world.) The growth in the distance food travels has also corresponded with an increase in food packaging, as food products are designed for longer journeys and shelf-lives. Food scraps and food packaging now make up a significant share of the waste stream in many cities worldwide. In North American cities, they account for as much as a third of total land-filled waste.¹⁷

The Wal-Mart Effect

The ability to ship foods long distances created a brutal and fierce competition that pitted farmers and food businesses everywhere against each other. Before long, big national and international conglomerates were muscling in on the traditional markets of local farmers and the neighborhood butchers, bakers, and mom-and-pop grocers. These companies typically

offered lower prices and one-stop shopping, had the financial reserves to weather price wars and economic downturns, and often drove the small firms out of business. Among those things lost in this process, which continues today, are the human connections (the butcher who knows your name and favorite cut of meat is replaced by an anonymous employee), some convenience if the supermarket is now farther away than the neighborhood store, and some degree of choice, if you can only buy from one company. Communities also lose some control over their food, since it is harder to influence decision-making in distant corporate offices. Perhaps the biggest loss is the money no longer being recirculated locally, as locally owned businesses, stocking locally made products, are replaced by stores owned by distant corporations and stocked with products from around the globe.

Ken Meter and Jon Rosales, economists at the Crossroads Resource Center in Minneapolis, describe this process in their recent analysis of the economics of farming in southeastern Minnesota, a region emblematic of the American Midwest. Meter and Rosales found that while farmers had sales of \$866 million in farm products in 1997, they spent \$947 million raising this food, primarily as payments for fertilizer, pesticide, and land made to distant suppliers, creditors, or absentee landowners. (If not for federal subsidies, many of these farmers would not be in business.) Meanwhile, residents of the region spent over \$500 million buying food, almost exclusively from producers and companies based outside of the region. In total, Meter and Rosales concluded, the current structure "extract[s] about \$800 million from the region's economy each year."¹⁸

Money, jobs, and food hemorrhaging out of local economies is not a new trend, but it has been a growing one over the last century, as farms become increasingly specialized and more and more services are performed off the farm. As food is shipped long distances, less of the value of that food tends to be retained locally; the shipping, processing, packaging, and retailing of the food assumes greater importance than the food itself. And as more and more of the services once provided

by the farm community are out-sourced to other regions or nations, the community retains a declining share of the ultimate profit. In the United States, the share of the consumer's food dollar that trickles back to the farming community has plunged from over 40 cents in 1910 to just above 7 cents in 1997, while the share going to an ever-shrinking number of processing, shipping, brokerage, advertising, and retailing firms has continued to expand.¹⁹

Think about the business model of Wal-Mart. At a stroke, a new Wal-Mart store can (and does) absorb the business that once flowed into a variety of small, locally owned bakers, grocers, butchers, dairies, farmers' markets, and other outlets. (Wal-Mart, the world's biggest retailer, recently became the world's second largest food retailer.) Any local business is fairly limited in the number of customers it can sell to. But a national or multinational firm can sell to millions of customers in thousands of markets around the world every day. Moreover, consolidation at one link in the chain fuels consolidation at every level of the food business, from the farm to the supermarket retailer. (See Box 1, page 24.) "The relationship between production and marketing is symbiotic," according to Helena Norberg-Hodge of the International Society for Ecology and Culture, a group that studies the impact of globalization on local cultures. "Large-scale, specialized agriculture is best suited to a global and centralized market, and vice versa." It's simply impractical for McDonald's, for example, to source the potatoes for its French fries or the milk for its shakes from thousands of small farms and dairies. (As noted earlier, to keep down transaction costs and to ensure standardized products, exporters and other downstream players prefer to buy from a few large producers.)²⁰

Economists have long argued that consumers, farmers, and food companies would all benefit from greater trade in foodstuffs, both within nations and between nations, and would argue that this is precisely the reason why this food system has become so dominant. But at the national and international levels, policies have long been biased towards large, specialized farms that are not focused on local markets, and

BOX 1**Concentration in Various Layers of Agribusiness**

In 1980, the United Nations Centre on Transnational Corporations published an analysis of the world's 180 most important food and beverage companies, identifying significant levels of market concentration in segments such as dairy, meat, tropical fruits, grain, and tropical beverages. Hope Shand at the ETC Group, based in Canada, recently tried to replicate this study. Shand found that barely a third of the original 180 companies exists today, and that "nearly all of the others have been absorbed into the surviving third." For instance, 65 companies were major competitors in the world pesticide market in 1980. Today, just five companies control 65 percent of the global pesticide market.

Business Sector	Description
Agrochemicals	Five companies control 65 percent of the global pesticide market.
Seeds	The top 10 seed firms control 30 percent of the global seed market; 5 companies control 75 percent of the global vegetable seed market.
Trade	The top five grain trading enterprises control more than 75 percent of the world market for cereals. A handful of transnational companies control about 90 percent of the global trade in coffee, cocoa, and pineapples; about 80 percent of the tea trade; 70 percent of the banana market; and more than 60 percent of the sugar trade.
Meat	One firm controls 60 percent of chicken purchases in Central America. In the United States, four companies control over 80 percent of beef packing, and five companies pack 75 percent of the pork.
Retail	Five retailers control 50 percent or more of all food purchases in France, Germany, and the United Kingdom. Two firms control over 80 percent of Hong Kong's retail market. Between 1994 and 1999, the share of the retail sector in Brazil controlled by the top 10 supermarkets grew from 23 percent to 44 percent. Wal-Mart, the second largest food retailer in the world, recently purchased a major stake in the fifth-largest Japanese food retailer.

Source: See Endnote 20.

against small, diversified farms that are. Subsidies for fossil fuels, roads and other transportation infrastructure, and for commodity production, for instance, all make food shipped round

the world in a refrigerated cargo container, wrapped in layers of plastic, and grown on a highly polluting farm look artificially cheap. Proponents of the current system argue that it has succeeded because it is better and more efficient, but this is only true to the extent that many of the costs are not accounted for—from food safety threats to wasteful burning of fossil fuels to a loss of economic life in farm communities.

In many cases, the shift away from local production has not been entirely voluntary. "The more a nation is constrained—by International Monetary Fund and World Bank loans that require nations to open up markets, by heavily subsidized food imports from the First World which squash local production, by regional and global trade agreements—the less voluntary is that nation's shift towards liberalization," according to David Seddon, a professor of development studies at the University of Norwich in East Anglia. Many developing nations launched export-oriented agricultural strategies in the 1970s as a response to structural adjustment programs that called for reductions in subsidies for staple food crops in favor of exports for export crops.²¹

This pressure from international institutions continued through the 1990s with trade agreements and organizations that covered food, including the North American Free Trade Agreement (NAFTA), MERCOSUR (a South American trade pact), and the World Trade Organization. Some of this pressure came from politicians, economists, and corporations that strongly believed in open borders as the means to prosperity. Opening domestic agricultural markets, economists typically argue, will help reduce hunger and poverty by stimulating investment in developing world agriculture and generating new export revenue through greater access to First-World consumer markets. But in many cases, exports have had completely the opposite effect.²²

Consider the recent experience of Mexico. As a result of its membership in NAFTA and its ongoing integration into the international food market, Mexico is importing more and more of its corn from the United States and elsewhere. Since NAFTA took effect in 1994, imports of corn to Mexico from the

United States have increased 18-fold and now account for one-quarter of Mexican corn. Corn from the United States is less expensive, largely because its production is heavily subsidized by the U.S. government. But the price tag for Mexico includes a mass exodus of corn farmers from the countryside and the loss of the country's corn diversity.²³

"Centuries of experience with global trade show that as soon as you open yourself up to global markets," says David Seddon, "the risks are high." On the one hand, international commodity prices can drop and wipe out a nation's export revenues; on the import side, meanwhile, the value of its currency can drop and cause the price of food imports to soar. If Mexico's currency plunges in value or the dollar gets stronger, or there is some other disruption in the global economy, then the cheap American corn could suddenly jump out of Mexicans' reach. This is precisely what happened in 1996, when world grain prices spiked and starving Mexican *campesinos*, who had been driven off their land by the previous two years of low prices, were forced to loot grain cars for food. An analysis of the NAFTA years has shown that while Mexican corn farmers lost money and market share, the price of corn in Mexico skyrocketed. The original center of corn diversity has now become dependent on other nations for a food which pervades its culture, diet, and economy.²⁴

In her analysis of the fruit and vegetable export industries in Latin America, *Bittersweet Harvest*, Lori Ann Thrupp describes how local communities can suffer as farmers replace fields growing staple crops for local consumption with baby broccoli, carrots, and other export crops for distant mouths. "In many cases, farmers do not make enough money from the venture to purchase food," Thrupp explains, "so their food security suffers when they are enticed into cash crop production." She notes that in most export-oriented agriculture the main beneficiaries are large companies involved in the processing, packaging, and marketing of these crops, including a growing number of international firms. (Even in nations like the United States and Canada, which are strong enough to shape trade agreements to their advantage, liberalization hasn't helped rural commu-

nities. During the NAFTA years, both of these nations have seen commodity prices and farmer incomes plummet, as the companies that trade and process agricultural commodities reaped windfall profits.)²⁵

While the idea of complete food self-sufficiency may be impractical for rich and poor nations alike, greater self-sufficiency can buffer nations against the whims of international markets. In fact, rebuilding local food systems might offer the first genuine economic opportunity in farm country in years, a pressing need in view of the huge amounts of money leaking out of rural communities. To the extent that functions associated with food production and distribution are relocated in the community under local ownership, more money will circulate in the local community to generate more jobs and income. This is particularly true if crops are not only grown locally, but also processed locally or served in local restaurants. A study by the New Economics Foundation in London found that every £10 spent at a local food business is worth £25 for the local area, compared with just £14 when the same amount is spent in a supermarket—that is, a pound (or dollar, peso, or rupee) spent locally generates nearly twice as much income for the local economy.²⁶

This sort of multiplier is perhaps most important in the developing world, where the vast majority of people are still employed in agriculture. In West Africa, for example, each \$1 of new farm income yields an income increase in the local economy ranging from \$1.96 in Niger to \$2.88 in Burkina Faso—increases that do not come when people spend money on imported foods. And the growing prosperity of millions of small farms in Japan, South Korea, and Taiwan following World War II is widely cited as the major stimulus of the dramatic economic boom those countries enjoyed. These "Asian miracles" provide the clearest evidence that alternatives to export-led growth work and have worked before, according to Peter Rosset, director of the Institute for Food and Development Policy. "For this sort of development to work as it did in East Asia," says Rosset, "the money spent on food must circulate within the local economy, rather than leak out by

depending on foreign food sources.”²⁷⁰

This is not to argue that every locale should produce all of its food. A certain amount of food trade is natural and beneficial. (Essayist and farmer Wendell Berry has suggested that communities should not be exporting food before local needs are met and should not be importing foods that can be readily produced at home.) Whether North Americans and Europeans continue to depend on imported oranges is less of a concern than whether communities are developing their capacity to meet as many of their basic food needs as possible. To the extent that they are, thousands or millions of local businesses will capture much of the planet’s food trade instead of a handful of multinationals.²⁸

Making Food Deserts Bloom

The foundation of a local food system is crop diversity. A local population cannot subsist on one or two crops, which is the norm in the midwestern United States or any of the other industrial farming regions of the world. Nor can a local population subsist *economically* on one or two crops. “Crop diversity not only makes a diverse diet possible,” says Katy Mamen of the International Society for Ecology and Culture (ISEC), “but it also guarantees the existence of local farmers and a range of food related businesses.” Mamen has worked in Ladakh, a small mountainous region in the Indian state of Jammu-Kashmir, which produced nearly all of its own food for generations. But money that Ladakhis used to spend buying vegetables grown locally (or barley milled locally or butter churned locally) now fills the coffers of Coca-Cola, Nestle, and other food companies. “Ladakhis have begun to realize that traditional foods and farming skills are incredibly precious,” says Mamen, “and that meeting as many of their basic needs as possible close to home offers a certain freedom from the very unstable flux in the value of their currency.” To reawaken interest in the local food culture, ISEC helped start the Women’s

Alliance of Ladakh, a group that now has 4,000 members, about one-fifth of the adult population. This group has become a vigorous steward of traditional agriculture, initiating a seed saving program to preserve local crop varieties as well as a market for selling and bartering only local crops, including local varieties of mustard, peas, beans, and barley. The crops must be grown locally by women farmers—a sort of procurement standard that keeps money in the local economy.²⁹

Alejandro Argumedo of the Association for Nature Conservation and Sustainable Development (ANDES), a group based in Cuzco, Peru, also knows that efforts to preserve traditional crop varieties are essential for shoring up the local economy. Argumedo explains that polyculture (complex plantings of multiple crops and multiple varieties) requires a highly sophisticated and intimate knowledge of the land—something small-scale, full-time farmers can more readily provide than can the proprietors of large, highly mechanized farms. In the case of the Peruvian Andes, the crop mix often includes dozens of potato varieties, numerous other root crops, and assorted greens, beans, and herbs, all in the same field. ANDES has helped communities set up “Potato Parks,” areas of farmland in which networks of farmers are cataloguing the potato varieties (sometimes as many as 40 per farm) as “pre-patented” under international law. Since Peru is the center of global potato diversity—the stock of seed that potato farmers and breeders around the world depend on for resilience against major pest outbreaks or climatic shifts—preserving this local food economy is also of significant interest to the rest of the planet.³⁰

There is a strong economic argument to be made for preserving this local crop diversity, since it helps to reduce dependence on expensive agrochemicals and other inputs. Studies have shown that diverse organic and ecological farms, which rely less on purchased inputs and more on taking advantage of the ecological processes in the field, cost less to maintain and make more efficient use of land, nutrients, energy, and other inputs, than do chemical-intensive monocultures.³¹

But there is a strong ecological argument for crop diversity as well. When farmers produce for local (rather than

End of reading

“As it pertains to the Willamette Valley, most food products are imported because the agricultural land is devoted to non-edible items such as Christmas trees and grass seed. In Eugene, only 5 percent of food consumed is produced locally (Nelson & Donahue, 2010).”

Binning, V., Bower, A., Burke, E., Hill, B., & Pahlke, G. (2011). Environmental Challenges to the Local Food Movement in the Willamette Valley. *Willamette University*.

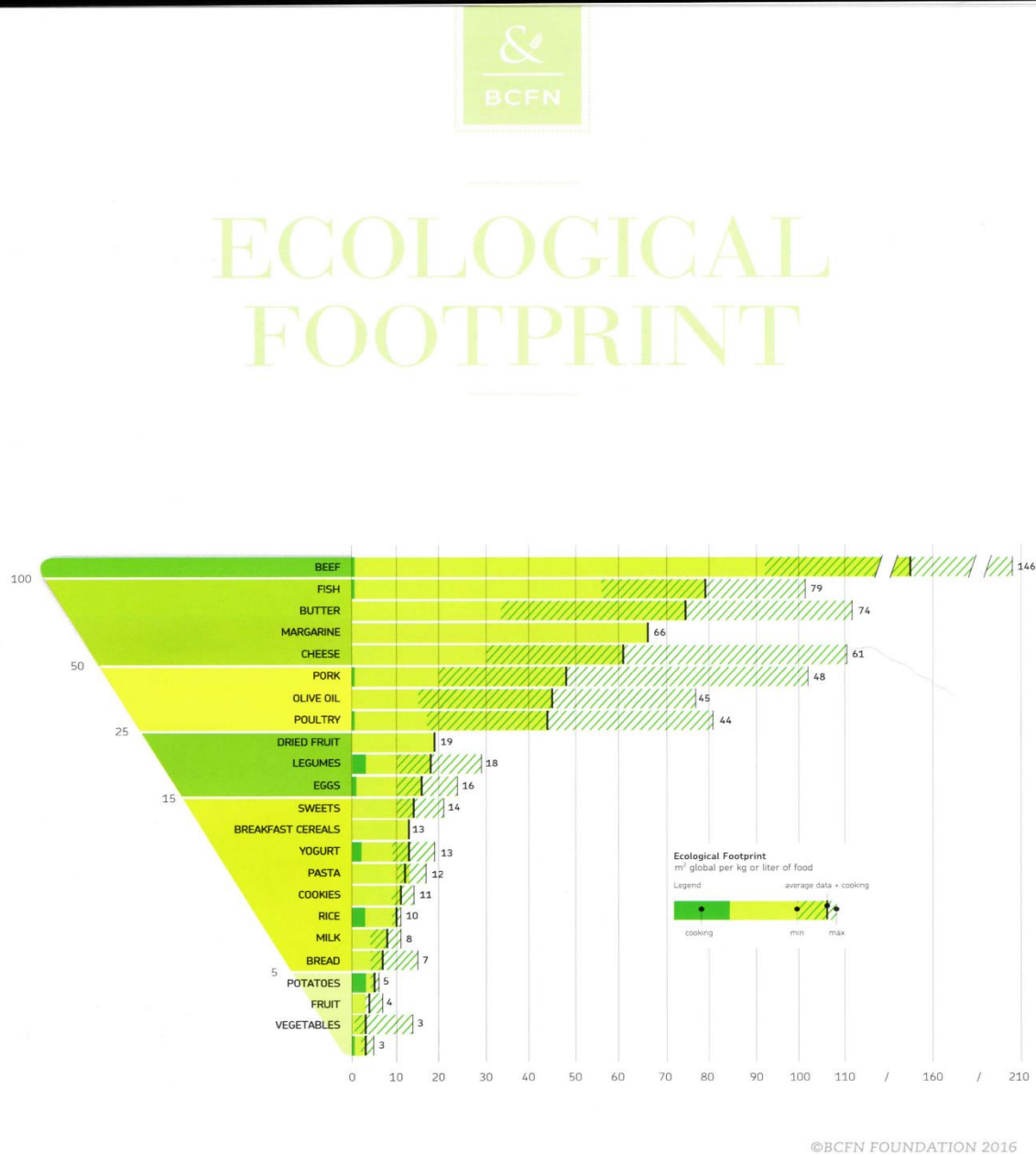
THOUGHTS AND REFLECTIONS

What new things did you learn or what struck you as you were reading?

How did you feel as you were reading the article?

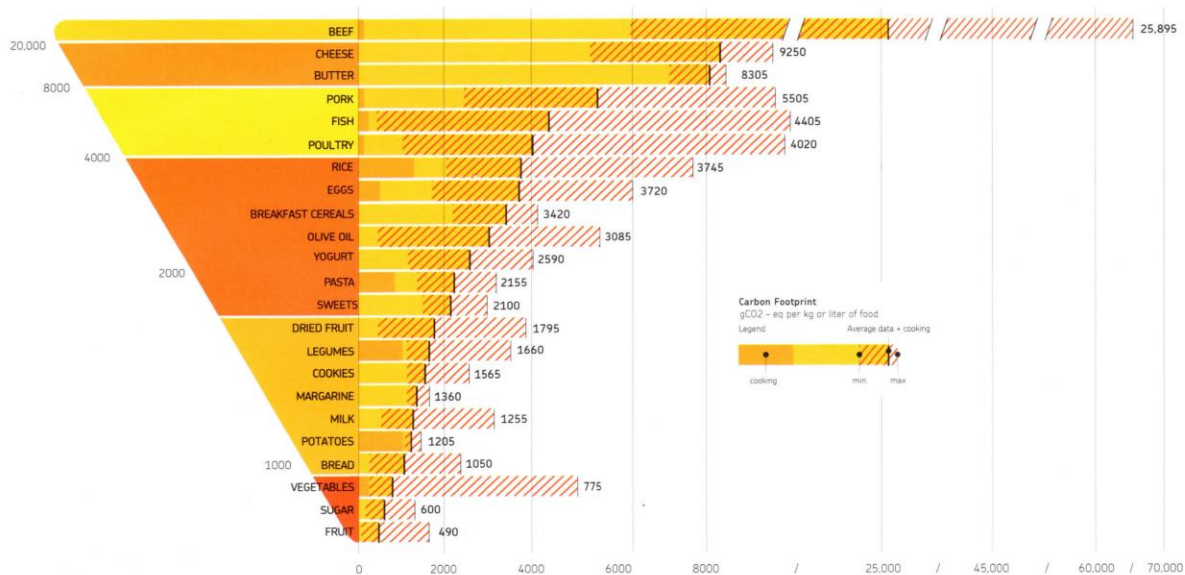
What are some thoughts lingering on your mind?

Chapter 3: Inconvenient Truths of Modern Agriculture



The Ecological Footprint calculates the Earth's capacity to regenerate resources and absorb emissions, and is measured in global square meters per kilogram or liter of food. For each group of foods, the reported value is the average of the various sources used, while the hatched lines mark the distance between the minimum and maximum values. When food is normally cooked, the impact of the cooking is added. The

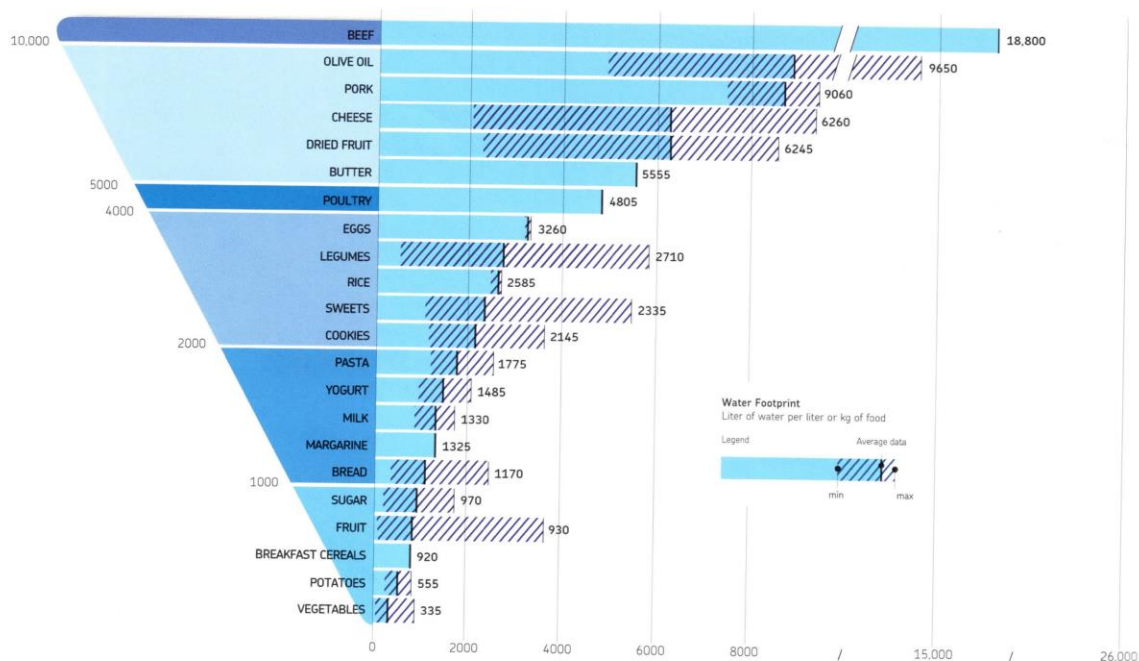
CARBON FOOTPRINT



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The Carbon Footprint measures the greenhouse gas emissions during the entire life cycle of a food and is calculated in grams of CO₂ equivalent (gCO₂ eq) per kilogram or liter of food. For each group of foods, the reported value is the average of the various sources used, while the hatched lines mark the distance between the minimum and maximum values. When a food is normally cooked, the impact of the cooking was added. The average score determines the order of foods from the top (high impact) to

WATER FOOTPRINT



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The Water Footprint quantifies the consumption and mode of use of water resources, and is measured in liters of water per kilogram or liter of food. For each group of foods, the reported value is the average of the various sources used, while the hatched lines mark the distance between the minimum and maximum values. When a food is normally cooked, the impact of the cooking was added. The average score determines the order of foods from the top (high impact) to the bottom (low impact).

Watch this video on food waste:

<https://www.youtube.com/watch?v=w96osGZaS74>

One-third of our greenhouse gas emissions come from agriculture

Natasha Gilbert

31 October 2012

The global food system, from fertilizer manufacture to food storage and packaging, is responsible for up to one-third of all human-caused greenhouse-gas emissions, according to the latest figures from the Consultative Group on International Agricultural Research (CGIAR), a partnership of 15 research centres around the world.



In two reports published today^{1,2}, the CGIAR says that reducing agriculture’s carbon footprint is central to limiting climate change. And to help to ensure food security, farmers across the globe will probably have to switch to cultivating more climate- hardy crops and farming practices.

“The food-related emissions and the impacts of climate change on agriculture and the food system will profoundly alter the way we grow and produce food,” says Sonja Vermeulen, a plant scientist at the University of Copenhagen in Denmark and a co-author of one of the studies, which estimates the emissions footprint of food¹.

Vermeulen and her colleagues examined for the first time the carbon emissions for all stages of the global food system. Previous work has only looked at the contribution of agricultural production to greenhouse-gas emissions, including the release of nitrous oxide from soils from farming techniques such as tilling.

Using estimates from 2005, 2007 and 2008, the researchers found that agricultural production provides the lion’s share of greenhouse-gas emissions from the food system, releasing up to 12,000 megatonnes of carbon dioxide equivalent a year — up to 86% of all food-related anthropogenic greenhouse-gas emissions. Next is fertilizer manufacture, which releases up to 575 megatonnes, followed by refrigeration, which emits 490 megatonnes. The researchers found that the whole food system released 9,800–16,900 megatonnes of carbon dioxide equivalent into the atmosphere in 2008, including indirect emissions from deforestation and land-use changes.

“This is the first time this has been done. It’s a brave paper, considering the huge data limitations — this is why there is such a big range,” said Bruce Campbell, an ecologist and director of the CGIAR research programme on climate change, agriculture and food security.

In high-income countries such as the United Kingdom, post-production — including storage and transport — contributes a large proportion of the food system’s greenhouse-gas emissions, whereas in China, for example, fertilizer manufacture has the biggest role, the researchers found.

Increasing temperatures and the likelihood of flooding will challenge farmers’ ability to safely store and distribute food, boosting the risk of food-borne illnesses and diarrhoeal diseases, they add.

“Food safety will in future be a crucial issue. This is a different take from the usual focus on crop yields and emissions,” says Campbell.

In the second report², Philip Thornton, an agricultural scientist at the International Livestock Research Institute, headquartered in Nairobi, Kenya, examined the potential effects of climate change on 22 of the world’s most important agricultural commodities, including wheat, soya beans and potatoes.

By 2050, climate change could cause irrigated wheat yields in developing countries to drop by 13%, and irrigated rice could fall by 15%. In Africa, maize yields could drop by 10–20% over the same time frame.

For some crops, improvements to heat resistance through conventional and transgenic breeding, for example, will help farmers to adapt. But for others, more radical changes are needed. Thornton says that potato-growing areas, including China and India, are likely to see yields drop significantly as temperatures rise, and he suggests that farmers consider growing crops, such as bananas, that do better in warmer climates.

Campbell says that the CGIAR will use the paper to help set its research agenda for the next decade and “identify which crops and which regions to focus investment on”.

He calls on governments meeting next month at the climate-change conference in Doha, Qatar, to agree on a way forward to tackle the challenges of mitigating and adapting to the effects of climate change on agriculture.

1. Vermeulen, S. J., Campbell, B. M. & Ingram, J. S. I. *Annu. Rev. Environ. Resour.* **37**, 195–222 (2012). [Show context](#)

2. Thornton, P. Recalibrating Food Production in the Developing World: Global Warming Will Change More Than Just the Climate. CCAFS Policy Brief no. 6. (CGIAR Research Program on Climate Change, Agriculture and Food Security, 2012).



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The story of phosphorus: Global food security and food for thought

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ABSTRACT

Food production requires application of fertilizers containing phosphorus, nitrogen and potassium on agricultural fields in order to sustain crop yields. However modern agriculture is dependent on phosphorus derived from phosphate rock, which is a non-renewable resource and current global reserves may be depleted in 50–100 years. While phosphorus demand is projected to increase, the expected global peak in phosphorus production is predicted to occur around 2030. The exact timing of peak phosphorus production might be disputed, however it is widely acknowledged within the fertilizer industry that the quality of remaining phosphate rock is decreasing and production costs are increasing. Yet future access to phosphorus receives little or no international attention. This paper puts forward the case for including long-term phosphorus scarcity on the priority agenda for global food security. Opportunities for recovering phosphorus and reducing demand are also addressed together with institutional challenges.

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1. Introduction

Food production is fundamental to our existence, yet we are using up the world's supply of phosphorus, a critical ingredient in growing food. Today, phosphorus is mostly obtained from mined rock phosphate and is often combined in mineral fertilizers with sulphuric acid, nitrogen, and potassium. Existing rock phosphate reserves could be exhausted in the next 50–100 years (Steen, 1998; Smil, 2000b; Gunther, 2005). The fertilizer industry recognises that the quality of reserves is declining and the cost of extraction, processing and shipping is increasing (Runge-Metzger, 1995; Driver, 1998; Smil, 2000b; EcoSanRes, 2003). Box 1 outlines the key issues.

Common responses to resource scarcity problems include higher prices, more efficient resource use, the introduction of alternatives,

and the recovery of the resource after use. The use of phosphorus is becoming more efficient, especially in Europe. Farmers in Europe and North America are increasingly avoiding over fertilization, and are ploughing straw and animal manure into agricultural soils, partly to recycle phosphorus (European Fertilizer Manufacturers Association, 2000). However, most of the discussion about efficient phosphorus use, and most of the measures to

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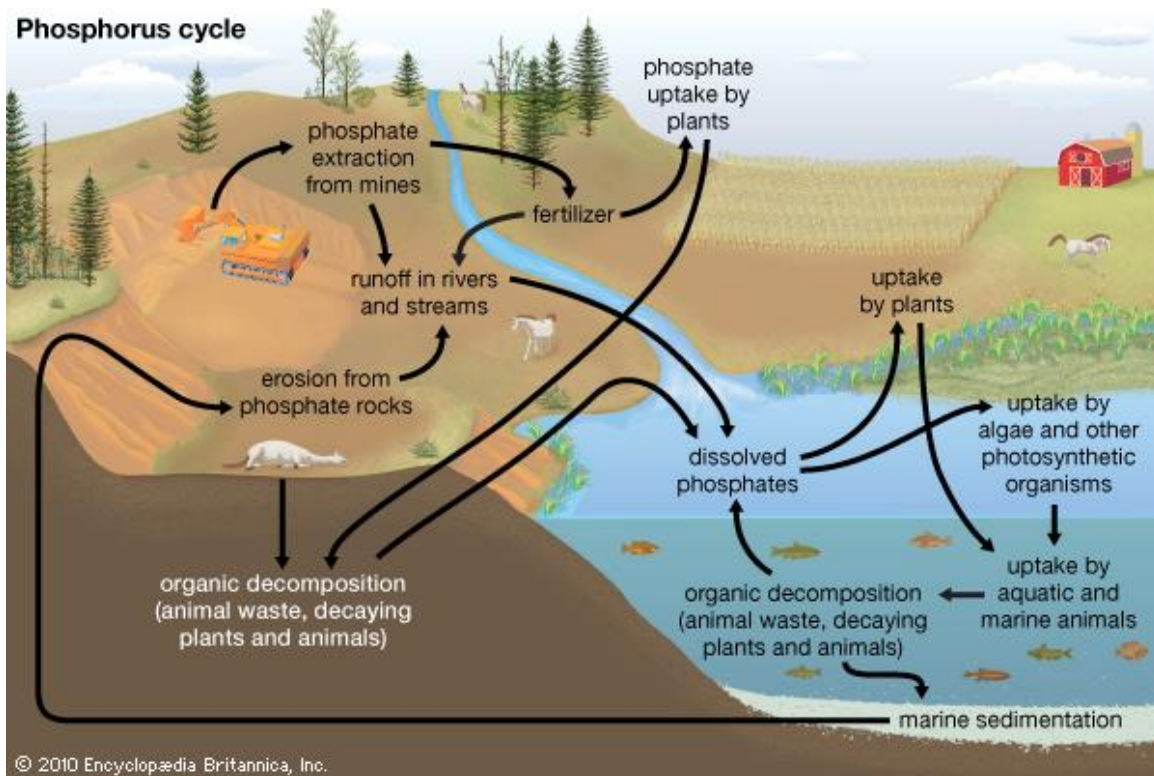
achieve this, have been motivated by concerns about toxic algal blooms caused by the leakage of phosphorus (and nitrogen) from agricultural land (Sharpley et al., 2005). While such measures are essential, they will not by themselves be sufficient to achieve phosphorus sustainability. A more integrated and effective approach to the management of the phosphorus cycle is needed—an approach which addresses future phosphorus scarcity and hence explores synergies that reduce leakage and recover and reuse phosphorus.

The following sections of this paper assess the historical, current and future availability of phosphorus in the context of global food security. Possible options for meeting the world's future phosphorus demand are outlined and institutional opportunities and obstacles are discussed.

2. Humanity's addiction to phosphate rock

Historically, crop production relied on natural levels of soil phosphorus and the addition of locally available organic matter like manure and human excreta (Marrald, 1998). To keep up with increased food demand due to rapid population growth in the 20th century, guano and later rock phosphate were applied extensively to food crops (Brink, 1977; Smil, 2000b). Fig. 1 gives a broad outline of the evolution of phosphorus fertilizer use for food production. The Chinese used human excreta ('night soil') as a fertilizer from the very early stages of their civilization, as did the Japanese from the 12th century onwards (Matsui, 1997). In Europe, soil degradation and recurring famines during the 17th and 18th

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Source: <https://www.britannica.com/science/phosphorus-cycle>

Box 1. Phosphorus (P): A closer look at an emerging crisis.

- Plants require phosphorus to grow. Phosphorus is an element on the periodic table that cannot be substituted and is therefore vital for producing the food we eat (Steen, 1998).
- 90% of global demand for phosphorus is for food production, currently around 148 million tonnes of phosphate rock per year (Smil, 2000a,b; Gunther, 2005).
- The demand for phosphorus is predicted to increase by 50–100% by 2050 with increased global demand for food and changing diets (EFMA, 2000; Steen, 1998).
- Phosphorus is a non-renewable resource, like oil. Studies claim at current rates of extraction, global commercial phosphate reserves will be depleted in 50–100 years (Runge-Metzger, 1995; EcoSanRes, 2003; Steen, 1998). The remaining potential reserves are of lower quality or more costly to extract.
- Phosphate rock reserves are in the control of only a handful of countries (mainly Morocco, China and the US), and thus subject to international political influence. Morocco has a near monopoly on Western Sahara's reserves, China is drastically reducing exports to secure domestic supply, US has less than 30 years left of supplies, while Western Europe and India are totally dependent on imports (Jasinski, 2006; Rosmarin, 2004).

centuries created the need to supplement animal and human excreta with other sources of phosphorus (Mañrald, 1998). In the early 19th century, for instance, England imported large quantities of bones from other European countries. In addition to the application of phosphorus from new sources, improved agricultural techniques enabled European agriculture to recover from the famines of the 18th century (Mañrald, 1998). These improvements included crop rotation, improved handling of manure, and in particular, the introduction of new crops such as clover which could fix nitrogen from the atmosphere.

Liebig formulated his 'mineral theory' in 1840, which replaced the 'humus theory' that plants and animals were given life in a mysterious way from dead or decomposing plants and animals (Liebig, 1840; Mañrald, 1998). Liebig provided a scientific explanation: nutrients such as nitrogen, phosphorus and potassium were elements circulating between dead and living material (Mañrald, 1998). This discovery occurred

during a period of rapid urbanization in Europe, when fertilizer factories were being established around growing cities. Food production was local and the factories manufactured phosphorus fertilizers from locally available organic waste products, such as human excreta, industrial organic waste by-products, animal dung, fish, ash, bones, and other slaughter-house by-products (Mañrald, 1998; Neset et al., 2008).

However, around the mid-to-late 19th century, the use of local organic matter was replaced by phosphorus material from distant sources. The mining of guano (bird droppings deposited over previous millennia) and phosphate-rich rock had begun (Brink, 1977; Smil, 2000b). Guano was discovered on islands off the Peruvian coast and later on islands in the South Pacific. World trade in guano grew rapidly, but it relied on a limited resource which declined by the end of the 19th century (Stewart et al., 2005). Phosphate rock was seen as an unlimited source of concentrated phosphorus and the market for mineral fertilizers developed rapidly. At the same time, the introduction of flush toilets in towns meant that human waste was discharged into water bodies instead of being returned to the soil. There were protests among intellectuals that farmers were being robbed of human manure. Among them was Victor Hugo who wrote in *Les Misérables*:

Science, after having long groped about, now knows that the most fecundating and the most efficacious of fertilizers is human manure. The Chinese, let us confess it to our shame, knew it before us. Not a Chinese peasant – it is Eckberg who says this – goes to town without bringing back with him, at the two extremities of his bamboo pole, two full buckets of what we designate as filth. Thanks to human dung, the earth in China is

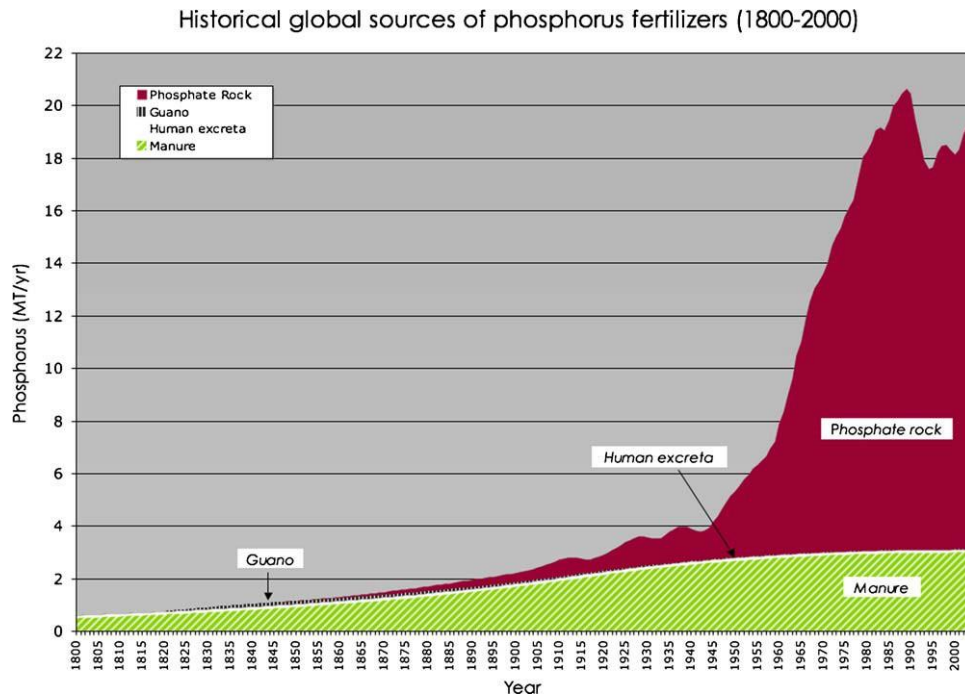


Fig. 1. Historical sources of phosphorus for use as fertilizers, including manure, human excreta, guano and phosphate rock (1800–2000) (Reliability of data sources vary, hence data points for human excreta, guano and manure should be interpreted as indicative rather than precise.). Calculations based on data in Brink (1977), Buckingham and Jasinski (2004), IFA (2006) and Smil (2000b).



Algae blooms, sometimes toxic, are one potentially harmful result of nitrogen and phosphorus runoff from fertilizer
<http://www.sjrwmd.com/algae/>

still as young as in the days of Abraham. Chinese wheat yields a hundredfold of the seed. There is no guano comparable in fertility with the detritus of a capital. A great city is the most mighty of dung-makers. Certain success would attend the experiment of employing the city to manure the plain. If our gold is manure, our manure, on the other hand, is gold (Hugo, 1862).

Trade in food grew steadily with urbanization and colonization, but insufficient amounts of nutrients were returned to the areas of food production to balance off-takes. By the late 19th century, processed mineral phosphorus fertilizer was routinely used in Europe and its use grew substantially in the 20th century (International Fertilizer Industry Association, 2006; Buckingham and Jasinski, 2004). Processed mineral fertilizers such as ordinary superphosphate (OSP) typically contained an order of magnitude greater concentration of phosphorus than did manures (Smil, 2000b). Application of such highly concentrated fertilizers helped rectify the phosphorus deficiency of soils. In the mid-20th century the Green Revolution improved agricultural output in many countries. As well as introducing new crop varieties, the Green Revolution involved the application of chemical fertilizers.¹ This new approach saved millions from starvation and the proportion of the world's population that was undernourished declined despite rapid population growth (IFPRI, 2002a). Today, food could not be produced at current global levels without the use of processed mineral fertilizers. We are effectively addicted to phosphate rock.

3. The current situation

3.1. Demand for food, demand for fertilizers

Following more than half a century of generous application of inorganic high-grade phosphorus and nitrogen fertilizers, agricultural soils in Europe and North

America are now said to have surpassed 'critical' phosphorus levels, and thus only require light applications to replace what is lost in harvest (FAO, 2006; European Fertilizer Manufacturers Association, 2000). Consequently, demand for phosphorus in these regions has stabilized or is decreasing.

However in developing and emerging economies the situation is different. Global demand for phosphorus is forecast to increase by around 3–4% annually until 2010/11 (Maene, 2007; FAO, 2007a), with around two-thirds of this demand coming from Asia (FAO, 2007a), where both absolute and per capita demand for phosphate fertilizers is increasing. There will be an estimated 2–2.5 billion new mouths to feed by 2050 (IWMI, 2006), mainly in urban slums in the developing world. Meat and dairy products, which require higher phosphorus inputs than other foods, are becoming more popular in China and India. According to the International Water Management Institute (Fraiture, 2007) global food production will need to increase by about 70% by 2050 to meet global demand. Under these circumstances, acquiring enough phosphorus to grow food will be a significant challenge for humanity in the future.

In Sub-Saharan Africa, where at least 30% of the population is undernourished, fertilizer application rates are extremely low and 75% of agricultural soils are nutrient deficient,² leading to declining yields (IFDC, 2006; Smaling et al., 2006). The UN and the Alliance for a Green Revolution in Africa has called for a new Green Revolution in Sub-Saharan Africa, including increased access to fertilizers (Blair, 2008; AGRA, 2008) but there has been little discussion of the finiteness of phosphate fertilizer reserves.

In 2007–2008, the same pressures that caused the recent global food crisis led to phosphate rock and fertilizer demand exceeding supply and prices increased by 700% in a 14-month period (Minemakers Limited, 2008). Two significant contributors to the increased demand for phosphorus have been the increasing popularity of meat- and

dairy-based diets, especially in growing economies like China and India, and the expansion of the biofuel industry. Increasing concern about oil scarcity and climate change led to the recent sharp increase in biofuel production. The biofuel industry competes with food production for grains and productive land and also for phosphorus fertilizers. The year 2007 was the first year a clear rise in phosphate rock demand could be attributed to ethanol production (USGS 2007, pers. comm., 5th September).

The International Fertilizer Industry Association expects the fertilizer market to remain tight for at least the next few years (IFA, 2008). It is therefore anticipated that the price of phosphate rock and related fertilizers will remain high in the near future, until new mining projects such as those planned in Saudi Arabia are commissioned (Heffer and Prud'homme, 2007). The sudden spike in the price of fertilizers in 2007–2008 took most of the world's farmers completely by surprise. In India, which is totally dependent on phosphate imports, there have been instances of farmer riots and deaths due to the severe national shortage of fertilizers (Bombay News, 2008). While this short-term crisis is not a direct consequence of the long-term scarcity issues outlined in this paper, the short-term situation can be seen as an indication of what is to come.

3.2. *Global food security and resource scarcity*

The UN's Food and Agricultural Organization (FAO) states that food security “exists when all people, at all times, have

volumes of artificial nitrogenous fertilizers (Brink, 1977).

access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life” (FAO, 2005b, p1). Securing future food security is now considered a global priority (UN, 2000; IFPRI, 2002b). At the turn of the Millennium, 191 nations formalised their commitment to the eight Millennium Development Goals (MDGs), one of which is to decrease poverty and hunger by 50% by 2015 (UN, 2000). Currently, there are over 800 million people without sufficient access to food (SOFI, 2005; UN, 2005). While over 40% of Africans today cannot secure adequate food on a day-to-day basis, many people in both the developed and developing world are suffering from obesity³ (UN Millennium Project, 2005; SIWI-IWMI, 2004; Gardner and Halweil, 2000). Food security is a challenge that can only be met by addressing a number of relevant issues. The FAO's annual State of Food Insecurity (SOFI) reports, the International Food Policy Research Institute's (IFPRI) reports and the UN Millennium Development Project all stress that food insecurity is a consequence of numerous linked factors, including frequent illness, poor sanitation, limited access to safe water and lack of purchasing power (FAO, 2004a; Braun et al., 2004; UN Millennium Project, 2005).

Today it is acknowledged that addressing energy and water issues will be critical for meeting the future nutritional demands of a growing population (Smil, 2000a; Pfeiffer, 2006) but the need to address the issue of limited phosphorus availability has not been widely recognized. Approximately 70% of the world's demand for

² Soil nutrient deficiency is due both to naturally low phosphate soils and to anthropogenic influences like soil mining and low fertilizer application rates w

fresh water is for agriculture (SIWI-IWMI, 2004) and about 90% of worldwide demand for rock phosphate is for food production (Rosmarin, 2004; Smil, 2002). It is predicted that demand for both resources will outstrip supply in the coming decades. Experts suggest that a radical shift in the way we think about and manage water is required (Falkenmark and Rockström, 2002), to deal with the ‘hydroclimatic realities’ of water availability (SIWI-IWMI, 2004). In a similar way, food security faces the ‘geochemical realities’ of limited phosphate reserves.

Global food production is also highly dependent on cheap energy, particularly from fossil fuels like oil. Transporting food all over the world in addition to mining and manufacturing fertilizers is only possible while cheap oil exists. However a peak in global oil production is imminent (Royal Dutch Shell, 2008) and alternatives to fossil-fuel-dependent agricultural systems will be required in the future (Pfeiffer, 2006).

3.3. Global phosphate rock reserves and geopolitics

All modern agriculture is today dependent on regular inputs of phosphate fertilizer derived from mined rock to replenish the phosphorus removed from the soil by the growing and harvesting of crops. However, phosphate rock is a non-renewable resource and approximately 50–100 years remain of current known reserves (Steen, 1998; Smil, 2000b; Gunther, 2005). The world’s remaining phosphate rock reserves are under the control of a handful of countries, including China, the US and Morocco. While China has the largest reported reserves, it has recently imposed a 135% export tariff on phosphate, effectively preventing any exports in order to secure domestic supply (Fertilizer Week, 2008). The US, historically the world’s largest producer, consumer, importer and exporter of phosphate rock and phosphate fertilizers, has approximately 25 years left of domestic reserves (Stewart et al., 2005; Jasinski, 2008). US companies import significant quantities of

phosphate rock from Morocco to feed their phosphate fertilizer factories (Jasinski, 2008). This is geopolitically sensitive as Morocco currently occupies Western Sahara and controls its phosphate rock reserves. The Western Sahara Resource Watch claims that “*extracting and trading with phosphates from Western Sahara are contrary to international law*” (WSRW, 2007) and such trade is highly condemned by the UN (Corell, 2002). Several Scandinavian firms have boycotted this trade in recent years (The Norwegian Support Committee for Western Sahara, 2007).

Together, Moroccan and Western Saharan reserves represent more than a third of the world’s supply of high-quality phosphate rock (IFA, 2006). Ironically, the African continent is simultaneously the world’s largest exporter of phosphate rock and the continent with the largest food shortage (FAO, 2006; Jasinski, 2006) (see Fig. 2). This highlights the importance of phosphorus *accessibility*, in addition to physical (and political) scarcity. Indeed, the average sub-Saharan farmer has less purchasing power to access fertilizer markets, yet phosphate fertilizers can cost an African farmer 2–6 times more than they cost a European farmer due to higher transport and storage costs (Runge-Metzger, 1995; Fresco, 2003).

3.4. Quantifying today’s phosphorus flows through the food system

A systems approach to understanding the phosphorus cycle, particularly in global food production and consumption, can help in locating and quantifying losses and inefficiencies and thus assist in identifying potential recovery points. A modification of the Substance Flows Analysis (SFA) tool from Industrial Ecology has been applied to track global phosphorus flows. SFA quantifies the material inputs and outputs from processes and stocks within a system to better understand pollution loads on a given environment, and determine places to intervene in a system to increase its efficiency, or reduce

Wastage and pollution (Brunner and Rechberg, 2004). The simplified SFA in Fig. 3 traces phosphorus through the global food production and consumption system, from the mine through to consumption, and identifies losses throughout the system. Unlike water (SIWI-IWMI, 2004; Lundqvist et al., 2007), carbon (GCP, 2008) and nitrogen (UNEP, 2007), there are no comprehensive studies analysing anthropogenic global flows of phosphorus.⁴

The inner white area termed the 'Anthroposphere' defines the human-activity system (in this case, food-related human activity), while the outer area termed 'Natural Environment' represents the 'natural' phosphorus biogeochemical system (in which the human activity system is embedded). The dotted arrows in the natural biogeochemical system occur at a rate of millions of years (for example, natural weathering and erosion of phosphate-bearing rock). The solid arrows within the human activity system indicate the approximate quantities of phosphorus (in millions of metric tonnes of phosphorus per year, MT P per year) in each key stage (the boxes) in the food production and consumption process. These stages are: mining, fertilizer production, the application of fertilizers to agricultural soils, the harvesting of crops, food and feed processing, consumption of food by animals and humans, excretion and leakage from the system to either the natural environment or recirculation back to the food system.

Mineral phosphorus in rock phosphate was formed 10–15 million years ago (White, 2000). Since the end of World War II, global extraction of phosphate rock has tripled to meet industrial agriculture's demand for NPK fertilizers (UNEP, 2005). Approximately 90% of society's use of phosphorus is for food production (including fertilizers, feed and food additives) (Smil, 2000b; European Fertilizer Manufacturers

Association, 2000). Currently, phosphorus fertilizers sourced from mined phosphate rock accounts for around 15 MT P per year (Jasinski, 2006; Gumbo and Savenije, 2001; Rosmarin, 2004; Gumbo, 2005). Modern agricultural systems require annual applications of phosphorus-rich fertilizer. However, unlike the natural biochemical cycle, which recycles phosphorus back to the soil 'in situ' via dead plant matter, modern agriculture harvests crops prior to their decay phase, transporting them all over the world to food manufacturers and to consumers.

Because phosphate rock and phosphate fertilizers are both commodities on the international market, international data exists for mining, fertilizer production and application. However after fertilizer application, there is very little accurate data available for use in a global analysis. This is particularly true of sources of organic phosphorus, such as manure, crop residues and household organic waste, which are re-circulated or lost from the food system (FAO, 2006). These organic phosphorus sources are typically not commodities, but are applied informally and on an ad hoc basis, and so there is no formal tracking of their use and losses. Data that does exist is typically compiled at a farm or local level. The use of organic phosphorus sources is often not quantified in investigations of phosphorus flows in the food production and consumption process as researchers are presently more interested in losses to water bodies causing eutrophication. Calculations based on Smil (2000a, 2002) suggest the total phosphorus content in annual global agricultural harvests is approximately 12 MT P, of which 7 MT P is processed for feed and food and fibre, while 40% of the remaining 5 MT P of crop residues is returned to the land.⁵

Studies on post-harvest losses of food and embodied water from the global food production and consumption chain (Smil,

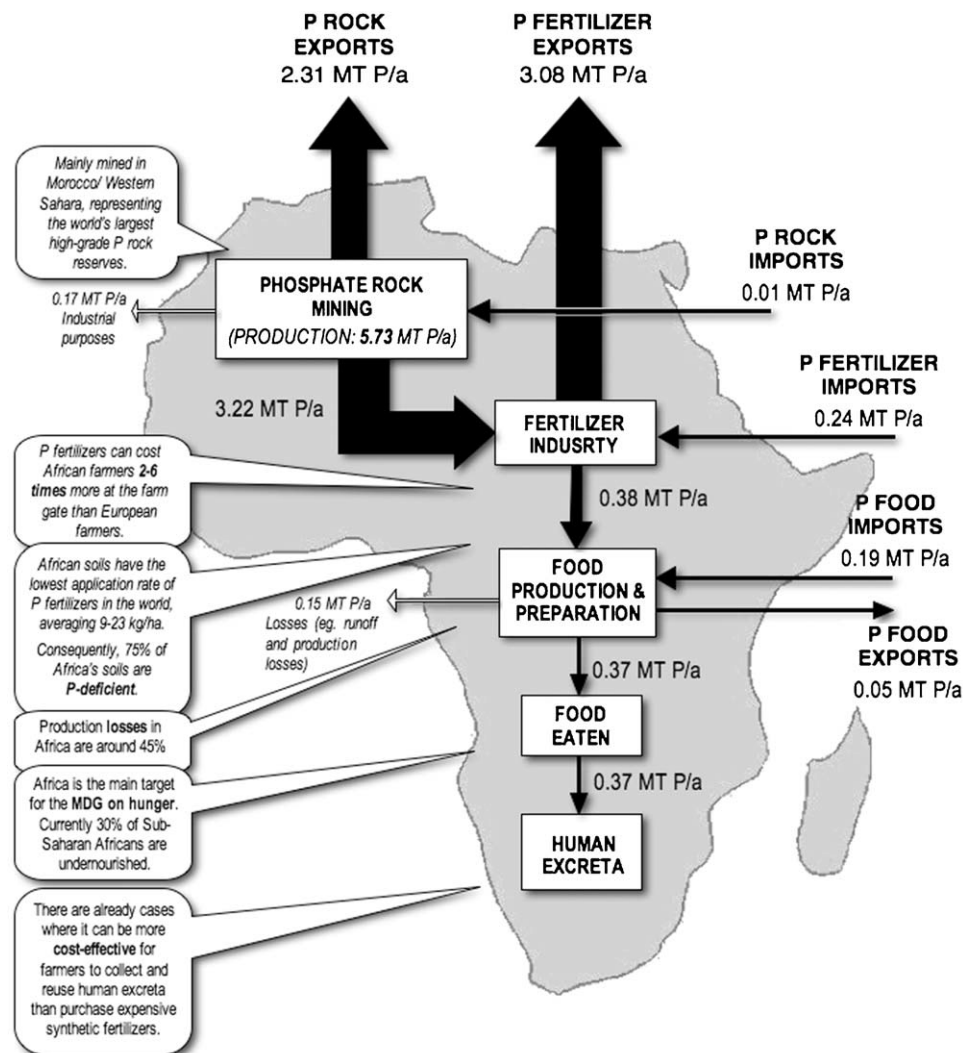


Fig. 2. Major phosphorus flows in the production and trade of phosphorus commodities in Africa, including phosphate rock, phosphorus fertilizers and food commodities. Calculations based on data in Gumbo (2005), Stockholm Environment Institute (2005), IFDC (2005) and IFA (2006) (Best available data for 2005 has been used for phosphate rock and fertilizer flows, while 2000–2003 data has been used for food flows.) (Flows are indicative and not intended to add up in all instances due lack of available data. Flows not presented in this diagram, including recirculation of organics (such as manure and crop residues) are not included due to lack of available and reliable data; a small amount of phosphate rock is used in direct application on the field; intermediate phosphate commodities, such as phosphoric acid are included as ‘fertilizers’ for simplicity and due to lack of complete data set. Care has been taken to avoid double counting, as phosphoric acid is used to produce most fertilizers.).

2000a; SIWI et al., 2008), can be used as a basis for estimating phosphorus losses. This suggests that approximately 55% of phosphorus in food is lost between ‘farm and fork’. Smil (2000a) estimates that around 50% of the phosphorus consumed and hence excreted by livestock is returned to agriculture globally. However there are significant regional imbalances, such as an oversupply of manure in regions where a

critical soil phosphorus level has already been surpassed (such as The Netherlands and parts of North America), and a lack of manure in regions where soils are most phosphorus-deficient (such as Sub-Saharan Africa or Australia) (Runge-Metzger, 1995; Smaling,

2005).

Close to 100% of phosphorus eaten in food is excreted (Jonsson et al., 2004). Working backwards using a mass balance, we can calculate that humans physically consume approximately 3 MT P globally.⁶ Every year, the global population excretes around 3 million tonnes of phosphorus in urine and faeces. Given that more than half the world’s population now lives in urban centres,

⁶ Human bodies require roughly 1.2 g/(person day) of phosphorus for healthy functions, which equates to approximately 3 MT P globally.

and urbanization is set to increase (FAO, 2007b), cities are becoming phosphorus ‘hotspots’ and urine is the largest single source of phosphorus emerging from cities. While nutrient flows from food via human excreta typically found their way back to land in the past, today they more often end up in waterways via wastewater from urban centres or as sludge in landfills. Overfertilization of agricultural soils has been a common practice in the northern hemisphere, and contributes to excess discharge into water bodies and environmental problems like eutrophication. Rosmarin (2004) estimates that close to 25% of the 1 billion tonnes of phosphorus mined since 1950 has ended up in water bodies, or is buried in landfills. It is estimated that on average, around 10% of human excreta is currently recirculated, either intentionally or unintentionally, back to agriculture or aquaculture. Examples of how this occurs include poor urban farmers in Pakistan diverting the city’s untreated wastewater to irrigate and fertilize the crops (Ensink et al., 2004), and pit or composting toilets in rural China, Africa and other parts of the world (Esrey et al., 2001). Recirculating urban nutrients such as urine back to agriculture therefore presents an enormous opportunity for the future (see Section 5 for examples).

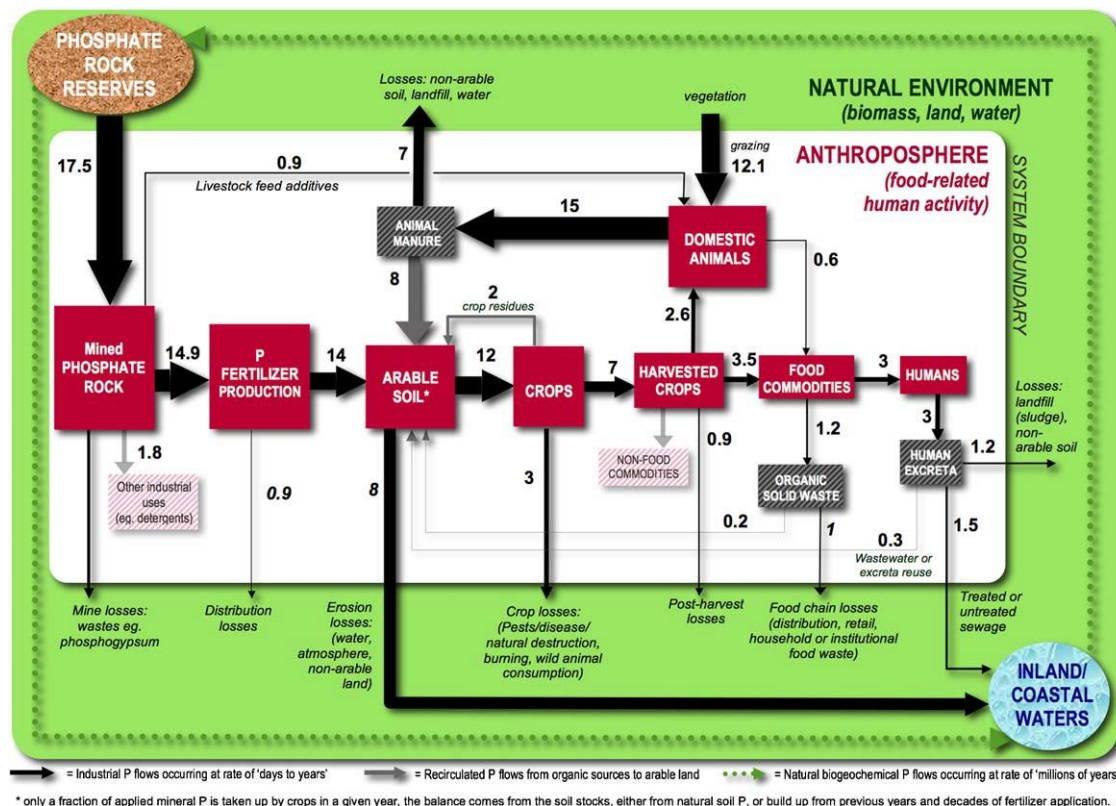


Fig. 3. Key phosphorus flows through the global food production and consumption system, indicating phosphorus usage, losses and recovery at each key stage of the process. Units are in Million Tonnes per year (Only significant flows are shown here, relevant to modern food production and consumption systems.). Calculations based on data in IFA (2006) and Smil (2000a,b).

In addition to analysing the global use of phosphorus based on an average diet, it is also informative to analyse different scenarios of phosphorus demand by assessing likely phosphorus losses in the various phases of the food chain. By working backwards from human excreta to the field, we can calculate the required amount of phosphate rock for vegetarian and meat-based diets. Table 1 provides an example of such a calculation with stated assumptions. A vegetarian excretes some 0.3 kg/(P year) (WHO, 2006), and if one-third of the phosphorus in a vegetarian's food is lost during food preparation, one can assume that the post-harvest material contained 0.45 kg P. Assuming that three quarters of the harvested crop ends up as organic waste, the average per capita annual harvest for a vegetarian would have contained 1.8 kg P originally. If one-third of the phosphorus taken up by plants is from mineral phosphate fertilizer and soil phosphorus provides the remaining two thirds, then 0.6 kg of mineral phosphate

fertilizer is required annually for a vegetarian. It takes 4.2 kg of rock phosphate to produce 0.6 kg of phosphorus. If equivalent assumptions are made for meat production, it can be concluded that meat-eaters require some 11.8 kg of rock phosphate (for meat eaters, it is assumed that one-fifth of phosphorus uptake is from mineral phosphate fertilizer and four-fifths is from soil phosphorus).

This simple calculation using phosphorus losses in each phase highlights two things. Firstly, that a vegetarian diet demands significantly less phosphate fertilizer than a meat-based diet. And secondly, that returning biomass from plants to the soil is by far the most important measure to retain soil phosphorus in a meat-based diet. This also requires no transport back to the field. For the vegetarian diet, the use of human excreta is the most important recovery measure but this involves collection and transport back to the field.

Data from two recent material flow analyses

Table 1
Phosphorus fertilizer demand in a meat-based and vegetarian diet. Magnitudes of phosphorus in kg per person and year (kg/(P year)) (Current data availability in the literature is minimal, hence this table is an indication of what can be done at

Consumption type	P in human excreta (most in urine)	P in post-harvest food preparation	P in harvested crops	Total extracted ^a
Vegetable-based diet	0.3 kg/(P year)	0.45 kg/(P year) [if 2/3 eaten and 1/3 is organic waste]	1.8 kg/(P year) [if 1/4 becomes food and 3/4 organic waste]	0.6 kg/(P year), or 4.2 kg of phosphate rock [plant uptake of P comprise 1/3 from rock P and 2/3 from soil P]
Meat-based diet	0.6 kg/(P year) ^b	0.8 kg/(P year) [if 3/4 eaten and 1/4 is organic waste]	8.0 kg/(P year) [if 1/10 becomes food and 9/10 organic waste]	1.6 kg/(P year), or 11.8 kg of phosphate rock [plant uptake of P comprise 1/5 from rock P and 4/5 from soil P]

the local level where the relevant data are available.) (SEPA, 1995).

^a 7 kg of phosphate rock contains approximately 1 kg of P.

^b SEPA (1995).

(MFA) of phosphorus through urban centres in Sydney, Australia (Tangsubkul et al., 2005) and in Linköping, Sweden (Schmid-Neset et al., 2005) suggest that a change from the average western diet to a vegetarian diet could decrease phosphorus demand of fertilizers by at least 20–45%. Tangsubkul et al. (2005) further suggest a change in Sydney residents' current diet to one with no excess phosphorus consumption (i.e. recommended daily intake per person) could decrease the city's total phosphorus demand by 70%. On the other hand, a switch in the current Indian diet to meat would increase India's demand for phosphorus three-fold.

From the analysis in Fig. 3, we can infer that significant losses occur throughout the system—from mine to field to fork. Globally, we are mining five times the amount of phosphorus that humans are actually consuming in food. This analysis tells us that to simultaneously address phosphate scarcity and water pollution due to phosphorus leakage, an integrated approach must be taken that considers:

- minimizing phosphorus losses from the farm (estimated at around 8 MT P),
- minimizing losses in the food commodity chain (losses estimated at 2 MT P),
- alternative renewable phosphorus sources, like manure (around 15 MT P), human excreta (3 MT P) and food residues (1.2 MT P),
- other important mechanisms to reduce overall demand (such as optimizing soil carbon to improve phosphate availability and influencing diets).

These options are covered further in Section 5.

3.5. The environmental costs of the phosphate rock industry

As well as the problem of eutrophication

due to the leakage of excess phosphorus into waterways, the production of fertilizers from rock phosphate involves significant carbon emissions, radioactive by-products and heavy metal pollutants.

Processing and transporting phosphate fertilizers from the mine to the farm gate, which up to now have relied on cheap fossil fuels, involve an ever-increasing energy cost. Phosphate rock is one of the most highly traded commodities on the international market. Each year around 30 million tonnes of phosphate rock and fertilizers are transported across the globe (IFA, 2006). With growing concern about oil scarcity and climate change, there is a need to reconsider the current production and use of phosphorus, particularly with respect to energy use and other environmental impacts. Each tonne of phosphate processed from phosphate rock generates 5 tonnes of phosphogypsum, a toxic by-product of phosphate rock mining. Phosphogypsum cannot be used in most countries due to unacceptably high radiation levels (USGS, 1999). Global phosphogypsum stockpiles are growing by over 110 million tonnes each year and there is a risk of leakage to groundwater (Wissa, 2003). Phosphate rock naturally contains radionuclides of Uranium and Thorium, most of which end up in the phosphogypsum by-product and to a lesser extent in the processed phosphate fertilizers (Kratz and Schnug, 2006; Saueia et al., 2005). If crushed phosphate rock is applied

directly to soils, radionuclides of the decay series are distributed to agricultural soils, risking overexposure to farmers and phosphate industry workers (Saueia et al., 2005). While radiation levels can vary above and below acceptable radiation limits, there are no standard procedures for measuring soil radioactivity due to applied phosphate rock (or phosphate fertilizers) (Saueia et al., 2005). Despite this, crushed rock phosphate is currently permitted as a fertilizer in organic agriculture in at least the European Union (EU, 2007), India (Department of Commerce, 2005) and Australia (Organic Federation of Australia, 2005). Similarly, associated heavy metals like cadmium can also be present in phosphate rock at levels which are either too toxic for soils or too costly and energy intensive to remove (Steen, 1998; Driver, 1998).

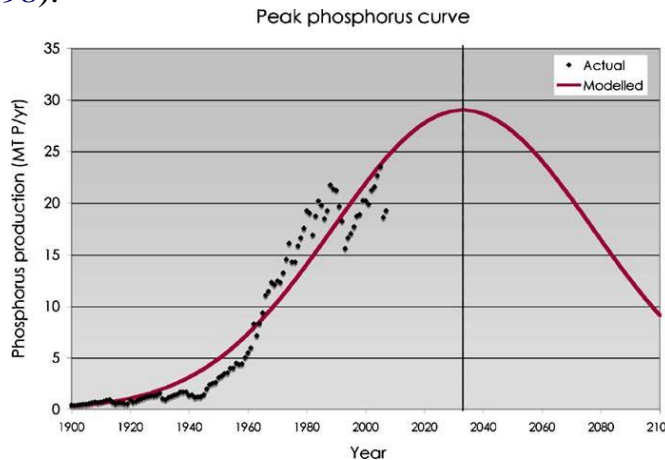


Fig. 4. Indicative peak phosphorus curve, illustrating that, in a similar way to oil, global phosphorus reserves are also likely to peak after which production will be significantly reduced (Jasinski, 2006; European Fertilizer Manufacturers Association, 2000).

4. Peak phosphorus—a sequel to peak oil?

As first highlighted by Hubbert in 1949 (Hubbert, 1949), production of oil reserves will at some time reach a maximum rate or ‘peak’ based on the finite nature of non-renewable resources, after which point production will decline. In a similar way, the rate of global production of high-grade phosphate rock will eventually reach a maximum or peak. Hubbert and later others argue that the important period is not when 100% of the reserve is depleted, but rather

when the high quality, highly accessible reserves have been depleted. At this point, production reaches its maximum. After this point, the quality of remaining reserves is lower and they are harder to access, making them uneconomical to mine and process. Therefore while demand continues to increase, supply decreases year upon year. A conservative analysis using industry data suggests that the peak in global phosphorus production could occur by 2033 (Fig. 4). This analysis of peak phosphorus is based on estimated P⁷ content in remaining world phosphate rock reserves (approximately 2358 MT P⁸) and cumulative production between 1900 and 2007 (totaling 882 MT P) based on US Geological Survey data (Buckingham and Jasinski, 2006; Jasinski, 2007, 2008), data from the European Fertilizer Manufacturers Association (2000) and the International Fertilizer Industry Association (2006). The area under the Hubbert curve is set equal to the depleted plus current reserves, totaling approximately 3240 MT P.

The data for annual production is fitted using a Gaussian distribution (Laherrere, 2000), based on the depleted plus current reserves estimate of 3240 MT P, and a least squares optimization which results in a production at peak of 29 MT P/a and a peak year of 2033. However the actual timing may vary due to changes in production costs (such as the price of raw materials like oil), data reliability and changes in demand and supply.

The concept of the ‘peak’ production of non-renewable resources such as oil or phosphorus is the subject of limited

⁷ Units of phosphorus are presented as elemental P, rather than P₂O₅ (containing 44% P) or phosphate rock (containing 29–34% P₂O₅) as commonly used by industry.
⁸ Estimated from 18 000 MT phosphate rock (Jasinski, 2008).

Table 2

Supply and demand-side factors influencing uncertainty of lifetime of global phosphate reserves and hence the timeline of peak phosphorus.

	Supply-side	Demand-side
Factors indicating peak P production could occur sooner	Some scientists (e.g. Ward, 2008 ; Michael Lardelli pers comm 9 August 2008) suggest USGS phosphate rock reserve data (on which the peak P estimate in Fig. 4 is based) is likely to represent an over-estimate, as has been the case with reported oil reserves (Pazik, 1976), hence the real peak phosphorus is likely to occur much sooner than 2033.	Sustained demand for non-food crops like biofuel crops, and changing diets, could increase phosphate fertilizer demand at rates faster than previously projected, thus depleting reserves sooner.
	China's reported reserves doubled following joining WTO in 2003–2004, however there are no 3a party analyses that can confirm the size of these reserves (Rosmarin, 2004 ; Arno Rosmarin, pers. comm., 5th September 2007).	Increased demand for fertiliser in regions that have historically used limited amounts (e.g. Asia, Africa).
Factors indicating peak P production could occur later	USGS reserve estimates for China are based on official government data, which excludes production/reserve data from smaller mines (Jasinski, 2008). This means China could have more reserves than officially reported.	Increased oil prices can reduce economic feasibility of phosphate reserves as mining and production rely on oil.
	According to USGS staff, Moroccan and Western Saharan reserves, which account for a significant proportion of today's global production, are currently being mined at a relatively constant rate that is less than the maximum production capacity (USGS 2007, pers. comm., 5th September).	The collapse of the Soviet Union in 1991 resulted in dramatically lower fertilizer demand from this region, thus contributing to the decline following the mini-peak around this time (Prud'homme, 2006 ; Smil, 2000a,b).
	Smil (2000a,b) and Steen (1998) note that while annual production averaged 140 MT of phosphate rock in the late 1990's (following the mini-peak production year of 1989), the capacity at this time was over 190 MT phosphate rock.	Demand for phosphate fertilizers decreased in the 1990's in North America and Western Europe following increased awareness of soil saturation (i.e. after decades of over-application, there was a sufficient soil P stock so that applications rates could be reduced) (EFMA, 2000). Awareness of eutrophication problems has also reduced phosphate demand in the developed world to reduce leakage to waterways (EFMA, 2000 , FAO, 2008a,b). The increasing number of dead zones globally is likely to further drive the efficient use of P fertilizers, thus reducing future demand (World Resources Institute, 2008).

dispute today, but the exact timeline for the peak in production is debated. According to [De'ry and Anderson \(De'ry and Anderson, 2007\)](#), global phosphorus reserves peaked around 1989.⁹ However it is likely that this observed peak was not a true maximum production peak, and was instead a consequence of political factors such as the collapse of the Soviet Union (formerly a significant phosphate rock consumer) and decreased fertilizer demand from Western Europe and North America. Indeed, data from the International Fertilizer Association indicates that the 2004–2005 production exceeded the 1989–1990 production ([IFA, 2006](#)). [Table 2](#) outlines both supply- and demand-side factors leading to potential over- or under-estimates of phosphate rock reserves and the timeline of peak phosphorus.

While the timing of the production peak may be uncertain, the fertilizer industry recognises that the quality of existing phosphate rock is declining, and cheap fertilizers will soon become a thing of the past.

The average grade of phosphate rock has declined from 15% P in 1970s to less than 13% P in 1996 ([Stewart et al., 2005](#); [IFA, 2006](#); [Smil, 2002](#)).

While some scientists (such as [Stewart et al., 2005](#)) suggest market forces will stimulate new technologies to improve the efficiency of phosphate rock extraction and beneficiation in the future, there are no known alternatives to phosphate rock on the market today that could replace it on any significant scale. While small-scale trials of phosphorus recovery from excreta and other waste streams exist ([CEEP, 2008](#)), commercialisation and implementation on a global scale could take decades to develop. Significant adjustments in institutional arrangements will also be required to support these infrastructure changes.

⁹ If production is assumed to have been at maximum capacity in the period to about 1990, this would suggest that peak production would have occurred at about that time ([De'ry and Anderson, 2007](#)), but that reserves are approximately half of the amount estimated by the USGS.

While it is understood that phosphate rock, like oil and other key non-renewable curve, peak oil and peak phosphorus differ in at least two key ways. Firstly, while oil can be replaced with other forms of energy once it becomes too scarce, there is no substitute for phosphorus in food production. Phosphorus is an element and cannot be produced or synthesized in a laboratory. Secondly, oil is unavailable once it is used, while phosphorus can be recovered from the food production and consumption chain and reused within economic and technical limits. Shifting from importing phosphate rock to domestic production of renewable phosphorus fertilizers (such as human excreta and biomass) can increase countries' phosphorus security and reduce the reliance on increasingly inaccessible phosphate fertilizer markets.

5. Options for sustainable phosphorus use and management

There is no single 'quick fix' solution to current dependence on phosphate rock for phosphorus fertilizers. However there are a number of technologies and policy options that exist today at various stages of development – from research to demonstration and implementation – that together could meet future phosphate fertilizer needs for global food production. Implementing these measures will inevitably require an integrated approach that looks beyond the current focus on reducing agricultural phosphorus leakage into waterways. Such an approach, incorporating a combination of supply- and demand-side measures, is described below. Conventional supply-side approaches look for solutions similar to those of the past 150 years, such as further exploration and more intensive exploitation of existing phosphate rock resources, including off-shore and/or lower grade deposits. Some advocates of

resources, will follow a peak production

conventional processed fertilizer production argue these potential reserves will become economically viable once all high-grade reserves have been depleted and prices have increased (FAO, 2004b; Stewart et al., 2005). However, this approach fails to address several key issues, including the finiteness of phosphate rock reserves in the long term; poor farmers' limited access to globalised fertilizer markets, the energy intensity of the current production and use system, and the accumulation of phosphorus and associated toxic wastes in soils and waterways.

As discussed in Section 3, phosphorus can be recovered from the food production and consumption system and reused as a fertilizer either directly or after intermediate processing. These recovery measures include: ploughing crop residues back into the soil; composting food waste from households, food processing plants and food retailers; and using human and animal excreta. Such sources are renewable and are typically available locally. However, due to their lower phosphorus concentrations, they are also bulkier than fertilizers processed from phosphate rock. Leading-edge research and development on phosphorus recovery is increasingly focusing on recovery of struvite (ammonium magnesium phosphate crystals high in phosphorus) from both urban and livestock wastewater (Reindl, 2007; SCOPE, 2004). Struvite crystallisation and recovery is a promising technological process that has the potential to both remove phosphorus from wastewater byproducts more efficiently, and, provide an alternative source of phosphate fertilizer (Jaffer et al., 2002).

The International Fertilizer Industry Association (IFA) indicates it is committed to a sustainable fertilizer industry and while the industry does not explicitly advocate the reuse of human excreta as a potential

³⁰⁰ alternative to mined phosphate rock, the European Fertilizer Manufacturers Association does state:

Two major opportunities for increasing the life expectancy of the world's phosphorus resources lie in recycling by recovery from municipal and other waste products and in the efficient use in agriculture of both phosphatic mineral fertilizer and animal manure (European Fertilizer Manufacturers Association, 2000, p.9).

Already in some urban areas in Pakistan and elsewhere in Asia, more than 25% of urban vegetables are being fertilized with wastewater from cities (Ensink et al., 2004). The International Water Management Institute estimates that 200 million farmers worldwide use treated or untreated wastewater to irrigate crops (Raschid-Sally and Jayakody, 2008). Currently 67% of global yields of farmed fish are fertilized by wastewater (World Bank, 2005) because wastewater is a cheap and reliable source of water and nutrients for poor farmers. However it is essential that farmers and those working with wastewater take precautionary measures to avert associated health risks. The World Health Organization has recently developed comprehensive guidelines on the safe reuse of wastewater in agriculture (WHO, 2006). Another drawback is that wastewater-fed agriculture and aquaculture rely on water-borne sanitation systems, rather than on systems such as dry or ultra-low flow toilets. Reuse is safer if sanitation service providers and urban planners avoid infrastructure that mixes human excreta with other wastewater streams, such as industrial wastewater. Industrial and non-residential wastewater may contain heavy metals and other toxic wastes. Moreover, if urine is not mixed with faecal matter in the toilet, the urine can be

used safely through simple storage (WHO, 2006). Urine is essentially sterile and could provide more than half the phosphorus required to fertilize cereal crops (Drangert, 1998; WHO, 2006; Esrey et al., 2001). In Sweden for example, two municipalities have mandated that all new toilets must be urine-diverting (Kvarnström et al., 2006; Tanums Kommun, 2002). While there are numerous practical ways urine can be collected, stored, transported and reused, the typical arrangement in these Swedish cases involves either a dry or flush urine-diverting toilet to collect the urine (see Fig. 5). The urine is then piped and stored in a simple 1–3 kl storage tank under the house or piped to a communal urine storage tank. Local farmers then collect the urine approximately once a year for use as liquid fertilizer (see Kvarnström et al., 2006 for further details). Sanitized faecal matter can also be used as a soil conditioner (WHO, 2006).

There are numerous documented practical examples of ecological sanitation around the world in places such as Southern Africa, India, China, Vietnam, Mexico (Gumbo and Savenije, 2001; Drangert, 1998; Stockholm Environment Institute, 2004). According to the Stockholm Environment Institute (2005), the cost of such ecological sanitation systems globally could be offset by the commercial value of the phosphorus (and nitrogen) they yield. Most of the projected 2 billion new mouths to feed in the coming decades are expected to reside in peri-urban areas of mega-cities in developing countries (FAO, 1999). Urban and peri-urban agriculture involves growing crops and raising livestock within urban areas and bordering urban settlements (FAO, 2007b). Fertilizing urban agriculture with phosphorus recovered from organic urban waste could be a significant step towards reaching the Millennium Development Goals on

³⁰⁰eradicating hunger and poverty, and providing access to safe sanitation. While this opportunity has been largely neglected at the global level to date (Cordell, 2007), a preliminary examination of the relationship between the land area required for food intake, the quantities of nutrients in human excreta, the capacity of the soil to absorb urine, crops' requirements for nutrients and population densities in peri-urban areas is outlined in Drangert (1998). Gumbo (2005) further studied the potential of reusing human excreta in urban Zimbabwe to 'short-cut' the urban phosphorus cycle. Gumbo found that the fertilizer value of the urine produced by urban dwellers in the case study catchment could sustain the agricultural activities in the surrounding area.

There is still significant scope to further explore the individual and combined potential for recovering organic urban waste products such as human excreta, food waste, garden waste, and manure. Bone meal, ash, and aquatic vegetation such as algae and seaweed are also potential sources of phosphorus.

Options aimed at reducing the demand for phosphorus in food production vary widely and can include: increasing agricultural efficiency to increase phosphorus uptake from the soil, reducing organic losses throughout the food chain and encouraging diets which contain fewer phosphorus-intensive foods.

Approaches to fertilizer efficiency range from high-tech solutions such as precision agriculture (FAO, 2000, 2008a; Johnston, 2000) through to organic farming techniques that seek to optimize soil conditions to increase soil phosphorus availability for plants (FAO, 2006, 2007c). Other approaches focus on the addition of microbial inoculants to increase soil phosphorus availability. The fertilizer

industry, governmental institutes and research organizations have been actively supporting more efficient fertilizer application practices for over a decade (International Fertilizer Industry Association, 2006; European Fertilizer Manufacturers Association, 2000; Food21, 2005; FAO, 2006). Such initiatives have mainly been triggered by concerns about nutrient leakage to waterways causing eutrophication. However, much agricultural land is still subject to an over-application of phosphorus, resulting in unnecessary accumulation in soils in addition to runoff to water bodies (Steen, 1998; Gunther, 1997). Indeed, only 15–30% of applied phosphorus fertilizer is actually taken up by harvested crops¹⁰ (FAO, 2006). At the same time, agricultural land in other regions are phosphorus-deficient due to naturally low soil phosphorus levels and fertilizer applications at rates which are far lower than would be required to replace the phosphorus lost through agriculture (Smaling et al., 2006).

Smil (2007) suggests that shifting to a 'smart vegetarian' diet, combined with reducing over-consumption, would be one of the most cost-effective measures to reduce agricultural resource inputs (including water, energy, land and fertilizers) and would also minimize greenhouse gas emissions and other forms of pollution. Food preferences are generally more strongly correlated with taste, advertisements and price than they are with nutritional value (SIWI-IWMI, 2004).

Therefore, potential strategies to reduce the demand for phosphorus include encouraging the move to foods which require the input of less phosphorus, water and energy. This could be done through appropriate communication strategies or economic incentives in both the developed and developing worlds. In areas where there is a move away from vegetarian diets,

³⁰⁰communication strategies to combat this trend could be employed. No analyses have yet been done that integrate such supply- and demand-side options in the same framework and assess the implications for global phosphate security. There is also a need to systematically assess potential options according to criteria¹¹ such as: economic cost; life cycle energy consumption; other environmental impacts; synergies between phosphorus and other resources (such as water, energy); logistics and technical feasibility, and cultural values and preferences.

1. Institutional and attitudinal barriers and opportunities

Since a global phosphorus scarcity crisis is imminent, as we have demonstrated in the sections above, why is it not being discussed in relation to global food security or global environmental change? What are the current barriers to addressing a phosphorus ‘crisis’ and what are the underlying reasons for the lack of attention to nutrient recirculation options such as urine reuse?¹²

Despite increasing global demand for non-renewable phosphate rock, and phosphate rock’s critical role in food production, global phosphate scarcity is missing from the dominant debates on global food security and global environmental change. For example, phosphorus scarcity has not received any explicit mention within official reports of the UN’s Food and Agricultural Organization (FAO, 2005a, 2006, 2007a), the International Food Policy Research Institute (IFPRI, 2002b, 2005), the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, 2005), the Global Environmental Change and Food Systems programme (GECAFS, 2006), the International Assessment of

Agricultural Knowledge, Science and Technology for Development (IAASTD, 2008) or the recent High-level Conference on World Food Security hosted by the FAO (FAO, 2008b). The implications of declining global phosphate availability and accessibility have been mentioned in a limited number of discussions by a few concerned scientists.¹³

We are entering a new and unprecedented era of global environmental change. As we are learning from climate change and global water scarcity, a long-term time frame is required to address phosphate scarcity. Decision-makers need to consider the next 50–100 years, rather than just the next 5–10 years. Young et al. (IDGEC, 2006) suggest that some global environmental problems occur due to the ‘lack of fit between ecosystems and institutions’ (IHDP, 2002). In the case of phosphorus, existing international institutional arrangements are inconsistent with the natural phosphorus cycle. This is most evident in the divide between the agricultural sector, where phosphorus is perceived as a fertilizer commodity, and the water and sanitation sector, where phosphorus is perceived as a pollutant in wastewater. This may hinder opportunities to find integrated solutions to the scarcity problem, since it is necessary for several sectors to be involved. In the case of phosphorus scarcity, part of the alternative resources and strategies are located in the sanitation sector (e.g. reuse of nutrients), whilst others are located in the household sector (e.g. the reduction of food waste, the reduction of meat and dairy consumption, etc.).

The recycling of urine is a socio-technical process that has no institutional or organizational home (Cordell, 2006; Livingston et al., 2005). Rather, a lack of institutional fit means it is seen as peripheral by all stakeholders and sectors (such as water service providers, town planners and

farmers) and is not currently perceived as important enough for any single stakeholder group to make it a priority. Drangert suggests a ‘urine-blindness’ has prevented modern societies from tapping into this abundant source of plant nutrients in urine (Drangert, 1998). Both the professionals managing urban water and sanitation systems and residents using these systems avoid thinking about the character of individual fractions within wastewater and instead adhere to the routine of ‘flush and discharge’ (p157).

There are some significant similarities in the way in which the contemporaneous issues of climate change, water scarcity and phosphorus scarcity manifest themselves and can be addressed as potential solutions emerge. Climate change mitigation comprises a wide range of measures, and the same goes for water scarcity. World leaders have embraced the concept that limited water availability and accessibility is threatening food security, and discussions on solutions have followed. For example, it has been argued that reducing wastage in the entire food production and consumption chain will also reduce significantly the amount of water used to produce food (Lundqvist et al., 2008). The good news is that climate change, water and phosphorus scarcity can all be ameliorated with a concerted effort by the global community. In the extreme scenario where all wasted phosphorus would be recovered and recirculated back to agriculture, no additional phosphate rock inputs would be required. Scarcity of phosphate rock would then be of little concern. The crucial task however is to reduce the demand for phosphorus in addition to harnessing the measures needed to recirculate wasted phosphorus back to food production before it is dispersed into water bodies and non-agriculture soils. At present, there is a scarcity of management of phosphorus

resources, rather than simply a physical scarcity of phosphate rock. With this in mind, institutional and other constraints can be better addressed.

The recent price spike in phosphate rock is likely to trigger further innovations in and adoption of phosphorus recovery and efficiency measures. However, the current market system alone is not adequate to manage phosphorus in a sustainable, equitable and timely manner in the longer term.

Opportunities also exist for integrating phosphorus management into existing discussions. For example, the issue of phosphorus scarcity could be given a higher profile in leading interdisciplinary international networks such as the Earth System Science Partnership (ESSP) which is addressing other important global biogeochemical cycles (GCP, 2008). The ESSP Global Environmental Change and Food Systems (GECAPS) program is an obvious place where this could occur.

The emergence of peak oil, the likelihood of a global emissions trading scheme for carbon, and the associated increases in energy costs will increase the cost of phosphate rock mining. This will provide an incentive for recirculating phosphorus found in organic sources, which will become more cost-effective relative to mining, processing and shipping rock phosphate. The energy required to produce mineral phosphate fertilizers is greater than that of organic phosphate fertilizers. The Earth Policy Institute reports that fertilizer production (including phosphorus) accounts for 29% of farm energy use in the US, excluding transporting chemicals to the field (Earth Policy Institute, 2005). A British study (Shepherd, 2003) indicated that organic agriculture uses less energy per crop output than industrial agriculture, mainly due to the significant amounts of energy required to produce mineral fertilizers. Johansson

³⁰⁹(2001) note that urine can be transported up to 100 km by truck and remain more energy-efficient than conventional systems of mineral fertilizer production, transportation and application.

Another incentive for increasing the reuse of phosphorus in this way is the avoidance of the environmental and financial costs associated with the discharge of phosphorus to waterways. The environmental cost of phosphate pollution of waterways is deemed unacceptable in many parts of the world and thus high levels of phosphorus must be removed from wastewater. Collecting urine, excreta and manure at the source will reduce phosphorus entering the wastewater treatment plant and thereby can achieve removal targets using less energy and at lower costs (Huang et al., 2007).

Sustainability initiatives in other sectors, such as materials manufacturing, can also be applied to the use of phosphorus. For example, concepts of ‘design for the environment’ and ‘extended producer responsibility’ involve capturing and reprocessing valuable substances directly after use, for reuse in production and manufacturing processes (OECD, 2001). Examples range from recovery and reuse of copper piping (Giurco and Petrie, 2007), to reusing vehicle parts under the European Union Directive for End-of-Life Vehicles (European Commission, 2000). In the case of nutrients, residents, local councils or entrepreneurs could be involved in recovering phosphorus from urban waste streams. Small and medium-scale examples already exist in sites around the world, including West Africa (Kvarnström et al., 2006), Inner Mongolia (EcoSanRes, 2008), and Stockholm (Kvarnström et al., 2006). There are clear synergies with sustainable sanitation strategies, which aim to decrease the mixing of water, faeces and urine in order

to better contain, sanitise and reuse the water and nutrients. The World Health Organization is active in rethinking approaches to sanitation and has recently issued guidelines for the use of grey water, urine and faecal matter in agriculture (WHO, 2006). These guidelines map out ways that nutrients and water can be recovered, treated and reused. This is likely to play an important role in ‘legitimizing’ the use of human excreta among authorities and contribute to our understanding of the role of urban sanitation in the global nutrient and water cycles. For example, Sweden has recently proposed that 60% of phosphorus in sewage should be returned to land by 2015 (Swedish Environmental Objectives Council, 2007).¹⁴

2. Conclusions

This paper outlines how humanity became addicted to phosphate rock, and examines the current and future implications of this dependence on a non-renewable resource. Global demand for crops will continue to rise over the next half century, increasing the demand for phosphate fertilizers. However, modern agriculture is currently relying on a non-renewable resource and future phosphate rock is likely to yield lower quality phosphorus at a higher price.

If significant physical and institutional changes are not made to the way we currently use and source phosphorus, agricultural yields will be severely compromised in the future. This will impact poor farmers and poor households first. However, there are opportunities to recover used phosphorus throughout the food production and consumption chain. Reducing losses in the food chain and increasing agricultural efficiency are also likely to contribute significantly to averting a future phosphate crisis.

Despite the depletion of global reserves and potential geopolitical tensions, future

³⁰⁰ phosphate scarcity and reduced accessibility to farmers is not yet considered a significant problem by those who decide national or international policy. There are currently no international organizations or intentional governance structures to ensure the long-term, equitable use and management of phosphorus resources in the global food system. In order to avoid a future food-related crisis, phosphorus scarcity needs to be recognized and addressed in contemporary discussions on global environmental change and food security, alongside water, energy and nitrogen.



Understanding the Food Choices of Low Income Families

The Food Stamp Program is designed to safeguard the health and well-being of low-income Americans by providing them access to a healthy, nutritious diet. Benefits are awarded to participating families in a manner designed to ensure that families have the resources to purchase an adequate supply of nutritious foods. Specifically, food stamp benefit amounts are the difference between 30 percent of a household's net income and the Thrifty Food Plan (TFP) amount for its household size. The TFP is a low-cost food plan designed to provide a nutritionally adequate diet for most households, while conforming as much as possible to the usual diets of low-income households.

The Food and Consumer Service (FCS) administers the Food Stamp Program at the federal level. Among its other responsibilities, FCS seeks to provide program participants with information that will help them achieve the program's goal of providing their families a nutritionally sound diet. FCS is exploring whether and how the techniques of social marketing can be used to formulate messages that will reach people participating in the Food Stamp Program. Social marketing applies marketing techniques developed in the commercial sector to social problems whose solutions require behavioral change. The goal of FCS is to help Food Stamp Program participants bring their food choices and food preparation practices more in line with broadly accepted recommendations for healthful eating. An important first step in the use of social marketing is understanding the target audience. This report presents the findings of a study sponsored by FCS that examined the food-choice behavior of low-income families. FCS undertook the study to better understand the food-purchasing and food choice decisions of the population the program serves. The study pursued two broad goals. First, it examined the characteristics of and foods used by those low-income households in which the foods met goals for healthful eating and food costs were within the TFP budget. This part of the study was designed to identify whether some groups of low-income households were more likely to achieve the objective of acquiring a healthful and low-cost diet and, if so, how they accomplished this. Such information might be helpful in developing nutrition guidance strategies and in determining whether it might be appropriate to design different messages for different segments of the low-income population. Second, it sought information on the attitudes, perceptions, and beliefs about food choices and healthy eating from a group of low-income families.

USDA Nutrition Goals...

The mission of the
Food and
Consumer Service is

"to ensure access
to nutritious, healthy diets
for all Americans.
Its food assistance
and nutrition education
programs provide a
healthful diet for
needy Americans.
Assistance and
education efforts
encourage consumers
to make healthful
food choices."

Study Design

Lisboa Associates, Inc., and its subcontractor, Technical Assessment Systems, Inc., conducted two complementary lines of investigation that corresponded to these two goals. To examine the characteristics of households in which foods met goals for healthy eating and were within the TFP budget, the study team analyzed data from recent surveys sponsored by FCS to identify:

- ❖ Households in which the value of food used from home food supplies was no more than the TFP amount
- ❖ Households in which the value of foods used from home food supplies provided at least the Recommended Dietary Allowance (RDA) for key marker nutrients (calcium, iron, vitamin C) and at least the Recommended Energy Intake
- ❖ Households in which the foods used from home food supplies provided no more than 30 percent of food energy from total fat and less than 10 percent from saturated fat

Analysts then compared the household characteristics, dietary knowledge, and types of foods used by households in which the foods used were both within the TFP budget and met goals for healthful eating with those of households in which spending exceeded the TFP budget or goals for healthful eating were not met. The study used data from the following surveys:

- ❖ 1987 to 1988 Nationwide Food Consumption Survey (NFCS) Basic Survey
- ❖ 1987 to 1988 NFCS Low-Income Survey
- ❖ Alabama Food Stamp Cash-Out Survey
- ❖ San Diego Food Stamp Cash-Out Survey
- ❖ 1989 to 1991 Survey of Food Intake by Individuals (CSFII) and its follow up, the Diet and Health Knowledge Survey (DHKS)

Because each of these surveys has important limitations for describing food choices of low-income households, sole reliance on any one of them is unwise.¹ However, similar patterns observed in different surveys indicate important empirical relationships.

Survey data can reveal broad differences across population groups, and these differences might help to target nutrition messages. This type of data, however, is not capable of providing insights on the diverse attitudes, beliefs, and perceptions that shape food stamp participants' actual shopping behaviors and food choices. To better understand low-income shoppers' attitudes and perceptions, the study conducted focus groups with FSP participants across the country. The focus group discussions covered perceptions and attitudes about food shopping and food selection, meal preparation practices, and family eating practices. A total of 28 focus groups

¹The 1987–1988 NFCS was selected to be a nationally representative sample. However, the low survey response rates placed in question the representativeness of the sample interviewed. The Alabama and San Diego Cash-Out Surveys were representative of Food Stamp Program participants in two regions, the state of Alabama and San Diego, California. The CSFII does not include food expenditure information and does not cover food used by the entire household.

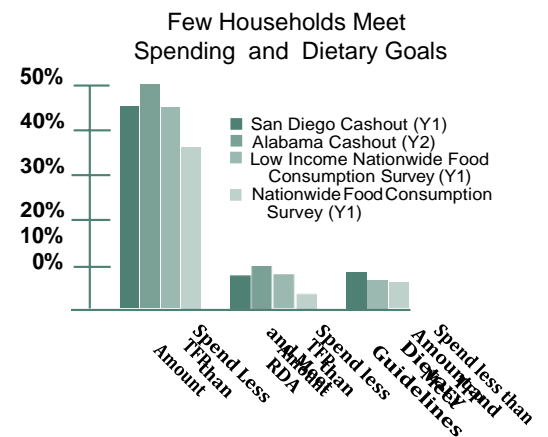
were held in six cities: New York, NY; Miami, FL; Birmingham, AL; Dallas, TX; Detroit, MI; and Los Angeles, CA. Each group included members of only one ethnic group (white non-Hispanics, African Americans, or Hispanics), but the study design ensured ethnic as well as regional diversity. Of the 28 groups, 9 were made up of white non-Hispanic Food Stamp Program participants, 11 of African Americans, and 8 of Hispanics. Focus group members were primarily women with children who received food stamps, although some of the Hispanic groups also included men. The groups were designed to include people who work outside the home and people who do not, as well as people from both urban and suburban settings.

Findings from the Analysis of Survey Data

Few low-income households meet the twin objectives of using foods that provide a healthful diet and spending less than the TFP amount. Approximately half of low-income households spend less than the TFP amount on food for home consumption. The estimated percentage who spend less than the TFP amount ranges from 36 to 50 percent, depending on the survey. Similarly, approximately half of low-income households use foods that provide an ample supply of key nutrients. Very few low-income households, however, use foods from home food supplies that meet *Dietary Guidelines for Americans* recommendations for total fat and saturated fat.

Few households spend less than the TFP and have available an adequate supply of key nutrients--the percentage varies from 4 to 10 percent, depending on the survey. Similarly, very few low-income households spend less than the TFP amount and acquire foods that meet the *Dietary Guidelines for Americans* recommendations for fat--the percentage varies from three to eight percent.

Characteristics, such as household size and ethnicity, are not related to the likelihood that a household meets the twin objectives of spending less than the TFP amount and having available foods that provide a healthful diet. Small and large households are equally likely to be successful along both dimensions, although large households are more likely to keep within the TFP amount but not provide the RDA of the marker nutrients. Similarly, white non-Hispanic, African American, and Hispanic households were about equally likely to keep within the TFP budget and to use foods that provide the



RDA for marker nutrients. Members of other ethnic groups, however, were somewhat more likely than white non-Hispanic households to keep within the TFP budget while using foods that provide less than the RDA for marker nutrients. No differences were evident for groups defined by education level or gender of the household head.

Food use patterns of households that both kept within the TFP budget and provided at least the RDA were quite different from the food use patterns of other households. In broad categories of foods, this small group spent a larger share of its food dollar on grains, fruit, vegetables, and milk and a smaller share on meat and the “other foods” category (which includes sweets, fats, soft drinks, and alcoholic beverages). The most notable differences are that the successful group spent more of its food dollar on whole and low-fat fluid milk, flour, white bread, cake, cookies, and cooked and ready-to-eat cereals and spent less on soft drinks, alcoholic beverages, fish, beef other than ground, and pork (NFCS Low-Income Survey).

Most low-income meal preparers are aware of some but not all key relationships between diet and health. For example, more than three-fourths of low-income women are aware of health problems related to overweight and excess salt intake, according to the 1989 - 1991 DHKS. Between two-thirds and three-fourths are aware of health problems related to fat intake and cholesterol. Half or less, however, said they knew about health problems relating to insufficient fiber, calcium, iron, or excess saturated fats. Higher-income women (those with incomes above 130 percent of poverty) were better informed than low-income women about the relationships between dietary components and health. Women with lower education levels are also less well informed about diet and health relationships than those with more education.

Among low-income households, knowledge and attitudes concerning the relationship between diet and health are not related to the likelihood that a household spends more or less than the TFP amount. Across a broad range of knowledge measures gathered in the 1989 - 1991 CSFII, knowledge was very similar among low-income people whose expenditures for food at home were less than the TFP amount and those whose food expenditures exceeded the TFP amount. For example, both self-reported awareness of diet and health relationships and the importance attributed to nutrition guidelines were similar. These data suggest that attitudes toward and awareness of diet and health relationships are not major factors influencing whether a low-income household purchases a low-cost or higher-cost diet.

More than Two-Thirds of FSP Households said, YES, they had heard of health problems related to

“how much salt or sodium a person eats,”

“how much cholesterol a person eats,”

“how much sugar a person eats,”

and

“being overweight.”

Less than 40 % expressed awareness of health relationships for fiber and iron in the diet.

Key Findings from Focus Group Discussions with Food Stamp Participants

The findings from the analysis of survey data show that personal and family characteristics and dietary knowledge, as measured by surveys, do not identify groups that are able to purchase low-cost, healthful supplies of food. The focus groups provided a way to investigate other less readily observable and quantifiable factors that might shape food-purchasing patterns and food choices.

As a whole, food stamp recipients are savvy shoppers. The focus group discussions show that they are attentive food shoppers who have developed preferred and economically sound methods of shopping, and who follow a specific shopping routine. They often make shopping lists or work from longstanding “mental” lists, check newspaper advertisements and store circulars to compare food prices, and shop at several stores to obtain the best food prices for various food items. Many also arrange for child care while shopping, to conduct their shopping without interference from children.

The frequency of food shopping varies across different ethnic groups. African American focus group participants were most likely to report doing their major shopping once a month at major supermarkets, usually right after receiving their food stamp allotment. They go to the store between major trips only to replace perishable food items. Hispanic and white non-Hispanic respondents shop more frequently. Many respondents who are employed, particularly white females, mentioned they do not plan meals more than a day or two ahead and will shop several times a week.

Respondents in all groups reported food price as the most important consideration in making food choices. Focus group participants use many strategies to reduce the food cost for the household. They clip and use both store and manufacturers’ coupons and often mentioned shopping in large chain stores offering double coupon redemption and “two-for-one” specials. They often purchase items in large quantities and store them, especially more expensive items (such as meat). They reported purchasing generic products, or the least expensive name brands, if these are adequate and there is not a discernible difference in quality.

Food stamp recipients with a large number of children said that, to make sure there is enough food in the home to satisfy all family members, they often purchase less expensive foods in bulk amounts. Many food stamp recipients spoke about food quantity, with a large number remarking that the most important factor in choosing and preparing foods is to ensure that no one will complain they are still hungry. To this end, they are willing to make concessions regarding food texture and flavor.

“It takes at least
two days to shop
if you check for sales,
use coupons, and
go to different stores.”

“I’m a nut for coupons. It’s
just free money.”

“If you don’t shop
for the month,
9 out of 10 times your
stamps
won’t carry you.”



“On food stamp day the
food prices go up.”

“It seems like they put
out all the sales
when nobody ain’t got
no stamps left .”



“If you’re feeling
really tired after
re turning from work you
don’t want to fix a meal
that takes
thirty pans. You just
want some thing
quick and easy and as
simple as possible.”

“I look for
anything that I can
stick in the
micro wave.”



“I make sure my
kids eat right, even
if I don’t”

“You cater to your kid.
If it’s some thing
they don’t care f or, it
will just sit.”

“Kids are the
biggest influence on
what is bought and
cooked.”

“It’s hard to look a t your
kids and not buy
what they want”



The time of month food stamp recipients choose to shop, the frequency of their shopping, and their use of “convenience” foods limit their ability to purchase a low-cost diet. Focus group participants in different geographic regions often reported that they felt supermarkets maintain their highest food prices during the time immediately after food stamps are distributed. The best food prices, according to focus group participants, occur shortly after the middle of the month. While some have been able to alter their shopping to take advantage of these lower prices, others are “locked into” a buying cycle in which they must purchase food immediately after receiving their stamp allotment, to ensure food will be available at home.

As noted, white food stamp recipients reported more frequent trips to the supermarket, while African American recipients shop less frequently, often completing most of their monthly food purchases in a single shopping trip. These data suggest frequent shopping may lead to impulse buying and higher food expenditures. Information from the survey data indicated that African American food stamp recipients are more able than their white counterparts to keep food expenditures at or below the TFP.

Focus group participants, particularly those who are employed, often purchase convenience foods because they can be prepared quickly and easily. These foods often are more expensive than other food items that have greater nutritional value and require only slightly more preparation time. Participants acknowledge that convenience foods are more expensive. They insist that these foods are advantageous, however, because of their ease of preparation and their taste appeal to family members. Interestingly, when asked how they would alter their food purchases if their stamp allotment was cut by 20 percent, focus group participants often said they would purchase fewer convenience food items.

Focus group respondents reported that their families often do not have regular meals together. Often, dinner is the only meal prepared by the family’s main meal preparer. Some food stamp recipients said they prepared dinner only on weekdays and viewed the weekends as “time off” from meal preparation responsibilities. Others, especially those who are employed, do little cooking during the week and rely heavily on easy-to-prepare convenience foods for weekday dinners, preferring to prepare larger, multicourse dinners on the weekend. Many focus group respondents said that family members do not routinely eat the dinner meal together, but may eat in different locations in the house or at different times. In most homes, family members are expected to prepare food for themselves at breakfast and lunch. Focus group participants rely heavily on their children’s food preferences and their “special” food requests in choosing foods. Respondents were adamant about the role children have in selecting foods for the household. Respondents in all ethnic groups agreed it does not make sense to purchase food that children will not eat. Many said they will purchase certain more expensive name

brand products if the children want them. Other focus group members commented that, when children like the food choices in the home, they are more likely to express appreciation, satisfaction, and caring toward their parents. This, in turn, reinforces the parents' feelings of self-worth and satisfies their "need to be needed." Respondents also acknowledged, however, that children's requests influenced them to purchase "junk foods," which are expensive and provide salt, sugar, and fat but fewer nutrients. Married female Hispanic respondents noted that their food choices are dictated by husband and children. Female respondents in all groups said their own taste and product preferences had less influence on food choices than those of other family members.

Ethnic and cultural traditions are strong factors in food choice and meal preparation, particularly for African American and Hispanic food stamp recipients. Many focus group participants in these two ethnic groups said that they learned how to shop and cook from their mothers while growing up. They continue to buy and prepare culturally familiar foods and take great pride in their cooking skills. They also remarked that family members enjoy traditional meals and often react negatively when new foods or cooking methods are introduced to the household.

For the most part, Hispanic women express a tremendous amount of joy, satisfaction, and pride in their cooking. They value the importance of their cultural tradition in food choices and meal preparation, often indicating that they cook the same foods their mothers and grandmothers cooked. They report that their spouses and children often react to their cooking with great enthusiasm.

Cultural tradition and the preferences of family members influence food stamp participants to continue serving high-fat meat products and other traditional foods. Focus group members reported spending a large percentage of their food stamp allotment on meat, although meat often is high in cholesterol, high in fat, and expensive. These reports confirm a pattern found in the survey data that shows that low-income families devote just over one-third of their food expenditures to meat. Food stamp recipients in all ethnic groups emphasized the importance of serving meat as a part of dinner. They indicate that meat is essential for dinner, that it is the food they "grew up with," and that it implies success and status. African American food stamp recipients in particular emphasized the need to have meat as a staple for all dinners. Survey data confirm the importance of meat to African American families: over 40 percent of food spending among African Americans is devoted to meat, compared with about one-third for other ethnic groups. Some African Americans said that eliminating meat is not an option, stating that meat is the essential component of dinner in an African American household. They associate purchasing and serving meat with pleasant meal memories, affluence, tradition, and feeding their families the "right" way. Some African American respondents suggested that, while white people can eat meatless meals and be satisfied, this is not true in African American households.

**"Nothing comes
before my meat.**

**I t's more filling
t hen anything else."**

**"I was raised here
eating red meat.**

**It's gone on for
generations. If you're
sitting down for a meal,
red meat is it "**

**"When you plan a meal you
start with the meat. I never
had a meal without meat
while I was
growing up."**

**" 60 - 75 % o f my food
budget goes for meat ."**



Members of all ethnic groups frequently mentioned steaks, beef roasts, and seafood as preferred foods; however, they purchased these items infrequently because of their high price. If they purchase these items at all, it is most often shortly after receiving their monthly allotment of stamps.

In Hispanic households, traditional food choices also have special significance. Hispanic focus group participants often said that they are reluctant to depart from traditional food choices and recipes and that they encounter family resistance if they attempt to change their food choices or preparation.

Many focus group participants said they are aware of current guidelines for healthy eating, uncertain about the healthfulness of their own diet, and open to trying new ways to feed their families healthier meals. Yet many said they believe these changes are difficult.

Some focus group participants indicated that their food purchases have been influenced by media attention, physician advice, and increased knowledge about the relationship of diet to obesity and disease. Many spoke about trying to purchase low-calorie foods and more low-fat, low-sugar, high-fiber foods. Some participants said they have tried some new ideas in their cooking. These individuals are reading food labels, experimenting with ingredient substitutions, and trying to prepare more healthful meals for their families. Often, they are not supported in their efforts; many report that children and other family members complain about recipe changes or new foods.


Others said they are aware of the need to serve more low-fat, high-fiber foods but are uncertain how this translates to specific food choices. Many also believe that healthy eating costs more money, and this presents a major obstacle because of their very limited budgets. In addition, while some respondents said they use the nutritional information on food labels, others said they do not understand the information on the labels or know how to use it. Many participants said they would like help with menu planning and using information on nutrition labels, with the focus on planning appealing, nutritious meals at low cost. Others said their cooking was “in a rut” and they would benefit from information on how to plan low-cost meals that will appeal to their ethnic/cultural group.

For many of the focus group participants, a tension was apparent between what they believe they “should” do--as revealed in their expressed intention to purchase more nutritious foods--and their food preferences and actual food choices. This tension was most obvious in their choice of snack foods for their children, which they described as “junk foods” that the children want. This tension was also apparent when discussions about the importance of preparing healthier meals turned into discussions of favorite foods consisting of high-fat, high-salt meat items.



Summary

About half of low-income households spend within the TFP amount for foods at home, less than half used foods which provide the RDA for key nutrients, and even fewer meet *Dietary Guidelines for Americans* recommendations for fat and saturated fat. Thus the percentage spending less than the TFP and meeting recommendations for healthful eating is very small. Household characteristics (ethnicity, household size, and education or gender of the household head) and knowledge of relationships between diet and disease do not enable us to identify groups of households whose food supply will meet health recommendations and cost less than the TFP amount. The analysis thus suggests that factors other than these broad household characteristics may be more useful for targeting nutrition education messages.



Focus groups revealed that food stamp participants are savvy shoppers who take care to get the most for their food dollar. Even so, time pressures lead these shoppers to purchase convenience foods. Time pressures also limit the ability of working women to prepare family meals every day. Budgeting constraints lock many into frequent shopping trips or major trips at times of the month when many report prices are higher. Ethnic traditions and the preferences of family members, especially children, exert a large influence on households' food choices. Both the survey data and the focus groups show that many low-income households are aware of key dietary guidance. Yet many women perceive that their ethnic traditions, preferences of family members, and lack of time limit their ability to provide healthier, lower-cost meals to their families. Indeed, many expressed uncertainty about specific steps to modify food choices and food preparation in ways that would be both more healthful for and acceptable to their families.

Together, these findings suggest that initiatives aimed at assisting low-income meal preparers to adapt culturally familiar foods and initiatives aimed at educating children may be especially fruitful avenues for providing nutritional guidance to low-income families.

Reference



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THOUGHTS AND REFLECTIONS

Which issues in food production and distribution seem the most pressing to you, and why?

Brainstorm ways to convince people to make healthier choices for themselves and for the planet

How important do you think cost, healthiness, and tradition each are in your own food choices? What other factors affect them?

Chapter 4: Debates Surrounding Biotechnology

Watch this TED talk by a plant biologist:

<https://www.youtube.com/watch?v=wZ2TF8-PGQ4>

Over 80 percent of Americans Support “Mandatory Labels on Foods Containing DNA”

A [recent survey](#) by the Oklahoma State University Department of Agricultural Economics finds that over 80 percent of Americans support “mandatory labels on foods containing DNA,” about the same number as support mandatory labeling of GMO foods “produced with genetic engineering.” Oklahoma State economist Jayson Lusk has [some additional details on the survey](#). If the government does impose mandatory labeling on foods containing DNA, perhaps the label might look something like this:

WARNING: This product contains deoxyribonucleic acid (DNA). The Surgeon General has determined that DNA is linked to a variety of diseases in both animals and humans. In some configurations, it is a risk factor for cancer and heart disease. Pregnant women are at very high risk of passing on DNA to their children.

The Oklahoma State survey result is probably an example of the intersection between scientific ignorance and political ignorance, both of which are widespread. The most obvious explanation for the data is that most of these people don’t really understand what DNA is, and don’t realize that it is contained in almost all food. When they read that a strange substance called “DNA” might be included in their food, they might suspect that this is some dangerous chemical inserted by greedy corporations for their own nefarious purposes.

Polls repeatedly show that much of the public is often ignorant of both [basic scientific facts](#), and [basic facts about government and public policy](#). Just before the 2014 elections, which determined control of Congress, [only 38 percent realized that the Republicans controlled the House of Representatives before the election, and the same number knew that the Democrats control the Senate](#). The public’s scientific knowledge isn’t much

better. A 2012 National Science Foundation survey even [found that about 25% of Americans don't know that the Earth revolves around the sun rather than vice versa](#). Issues like food labeling bring together political and scientific knowledge, and it is not surprising that public opinion on these subjects is very poorly informed.

It would be a mistake to assume that widespread political and scientific ignorance are the result of [“the stupidity of the American voter,”](#) as Obamacare architect Jonathan Gruber put it. Political ignorance [is not primarily the result of stupidity](#). For most people, it is [a rational reaction to the enormous size and complexity of government and the reality that the chance that their vote will have an impact on electoral outcomes is extremely low](#). The same is true of much scientific ignorance. For many people, there is little benefit to understanding much about genetics or DNA. Most Americans can even go about their daily business perfectly well without knowing that the Earth revolves around the sun. Even the smartest people are inevitably ignorant of the vast majority of information out there. We all have to focus our time and energy on learning that information which is most likely to be instrumentally useful, or at least provide entertainment value. For large numbers of people, much basic political and scientific information doesn't make the cut. Unfortunately, this is a case where [individually rational behavior leads to potentially dangerous collective outcomes](#). While it doesn't much matter whether any individual voter is ignorant about science or public policy, when a majority (or even a large minority) of the electorate is ignorant in these ways, it can lead to the adoption of dangerous and counterproductive government policies. In this case, [excessive and unnecessary warning labels on food products could confuse consumers](#), and divert their limited attention from real dangers.

Although Jonathan Gruber was wrong to believe that American voters are necessarily stupid, he was [right about the pervasiveness of public ignorance](#), and the dangers it poses.



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Viewpoint

Biotechnology or organic? Extensive or intensive? Global or local? A critical review of potential pathways to resolve the global food crisis

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abstract

While experts agree that poverty, population, energy prices, climate change, and socio-political dynamics undermine global food security, there is no agreement on effective strategies to meet this challenge. For example, some promote “high tech” solutions (e.g. biotechnology) designed to boost yield while others prefer local food systems. To better understand these debates, this article explores four perspectives from the literature: (1) technology to increase food production; (2) equitable food distribution; (3) policies to reduce pollution and waste; and (4) community action to promote sovereign food systems. The paper concludes with recommendations on how food scientists can navigate these controversies to help research and policy making.

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1. Introduction e the global food crisis

Many academics and policymakers interested in global food security are concerned that humanity faces a major crisis over the next generation (Foley et al. 2011; Godfray et al. 2010a). Population growth and economic inequality are shaping new global demands for food, while climate change, volatile energy prices, soil erosion, and water scarcity threaten to make food more difficult and more expensive to produce. Meanwhile, technological innovation offers the promise of boosting productivity and ameliorating some of these challenges. Because of these factors, many experts are worried that we face a “perfect storm” of problems; unless we use

technology to increase food production, while at the same time decreasing

agriculture's impact on the environment, the world may become hungrier, more violent, and more disease-ridden (Beddington, 2009). But while there is a broad consensus that developing food systems capable of sustainably feeding at least 9 billion people represents a major challenge, there is no agreement as to the best strategies to meet this challenge. For instance, and as will be outlined in detail below, some argue that we need technology, and in particular enhanced biotechnologies, to boost yields and ensure the earth produces enough food for future generations (e.g. Cassman, Grassini, & van

Wart, 2010; Fedoroff et al. 2010; Jaggard, Qi, & Ober, 2010).

However, many argue that poverty and a lack of political power are more important in terms of causing hunger and malnutrition than the ability of a region to produce food. In other words, the fact that some people lack that ability to demand food from the market is a larger determinant of food security than harvest or yield (e.g. Sen, 1981). Supporting these arguments are data that show there is enough food on the planet for everyone: after accounting for food waste and crops used for bioenergy, there are approximately 2850 dietary calories available on the planet per person per day (FAO, 2015a,b). Nevertheless, approximately 800 million go hungry (FAO, 2015a,b). Even if we assumed that food production remained constant, while our population grows to 9 billion, by 2050 there would still be 2200 dietary calories available per person per day, which is enough for us all to have adequate nutrition (Nb. the situation is the same if you examine calories, grams of protein, or grams of fats). In addition, at least 10% of global corn production that could be used for human consumption is used for bioenergy production (Graham-Rowe, 2011) and approximately 1/3 of the food currently produced globally is wasted before it is consumed (FAO, 2011). Overall, therefore, global data suggest that distributional problems are significant and these will not be rectified by simply increasing production. Finally, critics sometimes argue that the development of agricultural technologies, such as high-yielding seed varieties or other agri-inputs, typically benefit a small number of rich corporations and provide little in the way of meaningful progress towards reducing food insecurity (Tomlinson, 2013).

In light of these conflicting accounts and data, the purpose of this viewpoint article is to review the academic literature on topics relating to “solutions to the global food crisis”. This is important because food scientists often find themselves inadvertently thrust into the heart of

this acrimonious and volatile debate. For instance, in 2012 the UK government approved genetically modified (GM) wheat trials at Rothamsted Research. The scientists explained that their work is important for improving the sustainability of the food system: “Growing wheat has an environmental toll of extensive insecticide use to control aphid pests. The research, which is non-commercial, is investigating how to reduce that by getting the plants to repel aphids with a natural pheromone.” (See more at: (Sense about Science, 2012)). But protestors disagreed, and one group called “Take Back Our Flour” wrote a series of letters to the *Guardian* newspaper where they declared that even doing research on GM may harm the integrity and sustainability of our food:

Our vision is for an agro-ecology based farming involving using appropriate technology available to even the poorest farmers ... [For] a food system that is not contaminated by GM or pesticides

.... Empirical evidence shows that GM crops simply cannot coexist with non-GM crops, so the choices we are making now have vital implications for future generations (Manchester Guardian, 2012).

In the hopes that a better understanding of these debates may be useful to scientists working on related topics, the purpose of this viewpoint review is to summarize some of the most prevalent themes in the food security literature. We aim to review the arguments for and against each position, and in doing so help food scientists understand some of the larger context of their research.¹

2. Overview of key themes in the food security literature

Our reading of the literature suggests that there are at least four key pathways presented by scholars to solve “the global food crisis”. These are:

1. **Technology for Production.** Arguments made under this theme stress the role of technological innovation to increase total production. Strategies proposed include using plant breeding and GM techniques to create disease or drought resistant varieties of plants, and bio-fortifying food crops.
2. **Equity and Distribution.** Arguments made in this theme stress the need for more equitable food distribution. Proposed strategies

- 80 include poverty reduction, reducing global meat consumption, reducing the amount of grain used for bio-energy production, as well as changes to social welfare and trade regimes.
3. **Local Food Sovereignty.** Arguments made in this theme stress the need for communities to come together and promote more local and sovereign food systems. In wealthier countries these ideas are normally associated with “local food movements” while in the Global South e but increasingly in North America and Europe as well e these ideas are clustered around the notion of “food sovereignty”.
 4. **Market Failures, Policy and Regulation.** This theme stresses the Arguments over the most sustainable ways of feeding the world's population are not limited to disputes between environmental activists and bioengineers (Tscharrntke et al. 2012). For instance, Badgley and Perfecto's (2007) article “Can organic agriculture feed the world?” concluded small farms that use crop rotation and avoid chemical inputs have the potential to address global food needs (See also: Badgley et al. 2007). Their article provoked a swift counter argument from Connor (2008) in a paper entitled: “Organic Agriculture Cannot Feed the World.” Similarly, Seufert et al.'s (2012) meta-analysis in *Nature* found yields on organic farms were lower than those on conventional systems. This paper also launched a series of debates e both in the academy, and on social media e on the food production models best suited to meet global food security needs while protecting ecosystem services (Montenegro, Carlisle, Shattuck, & Kremen, 2012).

These illustrative debates e just two of many controversies related to the global food supply (i.e. food cloning, rBST, farmed salmon ...) e show how researchers sometimes find themselves at the centre of polarized arguments that become entrenched around very distinctive technological, social, and ideological perspectives. These themes are illustrated in Table 1 and the key arguments for/against each theme are summarized in the paragraphs below.

¹ *Methodological Note.* To explore debates on solutions to global food security, this viewpoint review article is based on the results of a systematic review of the scholarly literature. First, the research team created a database of scientific papers by querying the search engine “Web of Science” using the term “food security”, restricting the range to articles published between 1993 and 2013. This generated 24,624 publications. The initial sample was narrowed down to only those articles that were published in highly cited international journals such as *Nature*, *Science*,

The Proceedings of the National Academy, *The Philosophical Transactions of the Royal Society*, and subject-specific journals published by *Elsevier* and *Springer*. The research team systematically read through the sample, analysing the literature to identify recurrent themes until the point of theoretical saturation was reached. In this, we used an approach similar to that described by Braun and Clarke as a thematic content analysis (Braun & Clarke, 2006). Once we reached this point of theoretical saturation, eight senior scholars on the research team (two crop scientists, a food scientist, a global change modeller, a rural sociologist, and three human geographers who specialize on rural or food related topics) added supplementary readings and provided expert advice based on their disciplinary background. This led to a second round of critical reading where we reflected on, and confirmed the themes from, the

need for policies and regulations to correct for perverse incentives that undermine the sustainability and security of our food systems. In particular, market failures and inappropriate subsidies result in pollution, waste, and excessive input, as well as leading to a proliferation of foods with large amounts of high-fructose corn syrup. Strategies proposed to correct market failures include incentives to reduce food waste, reducing distorting subsidies, and paying farmers for providing environmental benefits like carbon sequestration.

first level of analysis. The critical reading process culminated in the development of a short (~1000 word) description of each theme, citing illustrative publications from the sample. These narratives were shared with the whole research team and edited in three rounds of revisions. The vast majority of the papers reviewed in this assessment were published between 1993 and 2013.

Table 1
Key themes, representative quotes, and key strategies that summarize current debates on global food security.

Theme	Representative quotes	Key strategies and illustrative references
Technology for	<ul style="list-style-type: none"> • Low yields occur because of technical constraints that prevent local food producers 	<ul style="list-style-type: none"> • Conventional plant breeding to develop F₁ hybrid varieties
Production	<ul style="list-style-type: none"> • from increasing productivity, or for economic reasons arising from market conditions." (Godfray et al. 2010b) • "To survive the droughts, wars and other major causes of famine, Africa must embrace technologies that enable it to produce more, better food with less effort." (Juma, 2011) 	<ul style="list-style-type: none"> • and disease-resistant varieties (Godfray et al. 2010a) • Genetic modification of crops for pest resistance or bio-fortification (Tester & Langridge, 2010) • Reduce political and cultural barriers preventing widespread adoption of molecular crop improvement (Fedoroff, 2013) • Market-led investment in agriculture (Parfitt et al., 2010) • Reducing the consumption of meat (Godfray et al. 2010a)
Equity and	<ul style="list-style-type: none"> • "But availability does not assure access, and enough calories do not assure a healthy 	
Distribution	<ul style="list-style-type: none"> • and nutritional diet. The distribution of the available food is critical." (Pinstrup-Andersen, 2009) • "If one person in eight starves regularly in the world, this is seen as the result of his inability to establish entitlement to enough food; the question of the physical availability of the food is not directly involved" (Sen, 1981) 	<ul style="list-style-type: none"> • Reducing the use of food crops for non-edible purposes (Thompson, 2012) • Improving of global distribution infrastructure (Lappe, 1971; Lappe, 2012) • Creating government food reserves (Devereux, 2002)
Local Food	<ul style="list-style-type: none"> • "Localizing and re-localizing food systems do not readily create enormous progressive 	<ul style="list-style-type: none"> • Developing biologically diverse farms (Kloppenburg et al. 2007)
Sovereignty	<ul style="list-style-type: none"> • societal changes. However, they do represent modest socio-economic, cultural and environmental shifts in encouraging directions." (Hinrichs, 2003) • "Food sovereignty movements politicize the current trade regime, revealing the complicity of states in incorporating agriculture into the reproduction of capital, rather than sustaining it as a site of social and ecological reproduction." (McMichael, 2009) 	<ul style="list-style-type: none"> • Empowering producers and consumers in local food systems (Patel & McMichael, 2009) • Reducing corporate control of the food system (Wittman, 2009)
Market Failure,	<ul style="list-style-type: none"> • "While attempts to shift consumer behaviour may result in reduction in food waste in 	<ul style="list-style-type: none"> • Policies or technologies to reduce waste (FAO, 2011)
Policy, and	<ul style="list-style-type: none"> • developed countries, changes in legislation and business behaviour towards more sustainable food production and consumption will be necessary to reduce waste from its current high levels." (Parfitt et al. 2010) • "In the meantime, a more fair and efficient use of these public resources would be 	<ul style="list-style-type: none"> • Policies to internalize externalized costs (Pretty et al. 2001) • Government measures for environmental protection (Pretty, 1999)
Regulation	<ul style="list-style-type: none"> • achieved if policy sought more explicitly to internalize these external costs." (Pretty et al. 2000) 	<ul style="list-style-type: none"> • Policies to reward farmers for environmental goods and services (Redford & Adams, 2009) • Reducing energy and agrochemical inputs (Kloppenburg et al. 2007)

3. Pathway 1: technology for production

3.1. Summary of main arguments in support of the technology for production pathway

Arguments that support using technology to boost yields are typically predicated on global models that project rising demand for food due to population growth and rising affluence. The most commonly quoted statistic is that food production must double by 2050 to both address current food insecurity and meet this demand (Godfray et al. 2010a,b). Proponents of this pathway argue that biotechnologies, and in particular genetic engineering, are needed to create productive crops that are increasingly climate and pest resistant, to reduce pesticide use, and to improve the efficiency with which crops use nutrients and inputs. This narrative suggests that the regulatory burden placed on scientists (and companies) should be reduced in order to allow them to bring novel technologies, such as a new type of seed or input, to market faster (Edgerton, 2009; Fedoroff et al. 2010). Such advances would be critical in parts of

the world where farmers only produce a fraction of their theoretical maximum, and scholars working on these topics often argue that closing these "yield gaps" represents an important scientific priority (Cassman et al. 2010; Foley et al. 2011; Jaggard et al. 2010; Juma, 2010; Peltonen-Sainio, Jauhiainen, & Laurila, 2009). For example, in many rice-growing regions, a lack of phosphorus limits yield. Farmers and scientists in India have long been aware that a traditional variety of rice called *Kasalath* is able to grow well in low phosphorus conditions due to the plant's ability to use phosphorus more efficiently than other varieties. In 2012, a group of scientists identified the gene responsible for this trait and are now working on using a mixture of biotechnologies and traditional plant breeding methods to develop locally adapted rice varieties with the enhanced ability to use phosphorus (Heuer et al. 2012). If developed, these new rice varieties have the potential to increase

rice yields in parts of the world where access to phosphorus is limited. This pathway is summarized by Juma (2011) who writes: “to survive the droughts, wars and other major causes of famine, Africa must embrace technologies that enable it to produce more, better food with less effort.”

32. *Summary of main arguments challenging the technology for production pathway*

Arguments that challenge the “technology for production” pathway fall into several broad categories. First is the “world already has enough food” argument, which cites global caloric production (in excess of 2850 dietary calories/person/day available in 2013 according to: FAO, 2015a,b) and analyses that suggest one third of the world's food is wasted before it is consumed (FAO, 2011). Also falling into this category are those authors who point out that about 40% of the corn in the USA is used for biofuel, while most of the remainder is used as animal feed and a source of high fructose corn syrup and corn oil, both of which are major inputs in fried and processed foods (Graham-Rowe, 2011). A second commonly expressed criticism of the technology for production theme is related to a perceived lack of equity in terms of ownership over agricultural biotechnologies (Tomlinson, 2013). Third, the most commonly used trans-genetic crops are herbicide-resistant corn, soy, and cotton, and varieties of corn and cotton that produce their own insecticide. The benefits of these crops are increasingly challenged by the emergence of insects and weeds that are tolerant to these pesticides (Powles, 2008; Shaner, 2000). For example, in parts of the USA, many weeds are becoming resistant to glyphosate, the main herbicide that GM crops can tolerate (Andrews, 2013; Benbrook, 2012). Similarly, the benefits of the *Bacillus thuringiensis* (Bt) crops, which were engineered to produce insecticidal toxins, have been reduced given the evolving resistance by the target pest corn rootworm (Gassmann et al. 2014). This highlights the fact that single

gene traits are not robust long-term solutions to agronomic challenges as noted by Lee and Tollenaar (2007) and supports the idea that the benefits of technology (including GM technology) will be most fully realized in the context of (or when they aid in) the development and adoption of diverse and integrated farming systems (Russelle, Entz, & Franzluebbers, 2007).

Finally, many argue that “high-tech” crops, such as transgenic crops, will simply reinforce today's large-scale industrial food system that is already criticized for its impact on the environment (Feenstra, 2002; Weis, 2010), water quality (Xie, Xiong, Xing, Sun, & Zhu, 2007) and quantity (Hoeppner, Entz, McConkey, Zentner, & Nagy, 2006; Pimentel & Pimentel, 2008), animal welfare (Fraser, 2008), and its over-use of inputs such as energy and antibiotics (Silbergeld, Graham, & Price, 2008). Taken together, therefore, the critics of science and technology as the primary pathway to food security argue that technological solutions are likely to make the food system less sustainable, more energy intensive, and less equitable (Altieri & Rosset, 2002; Kimbrell, 2002; Patel, 2007; Sage, 2013; Shiva, 1993).

4. Pathway 2: Equity and distribution

41. *Summary of main arguments in favour of the equity and distribution pathway*

As already noted, many scholars have pointed out that food is unevenly distributed, and about 800 million people suffer chronic hunger while an additional 1.3 billion individuals are overweight/obese (Pinstrup-Andersen, 2009; Popkin, Adair, & Ng, 2012). Compounding the issue is the use of food crops for uses that are questionable in terms of nutrition (e.g. production of excessive sugars and fats) and crops grown for non-edible uses, highlighted by the US bioethanol industry that uses about 40% of the US maize harvests and has created a situation where grain that could be used to combat hunger is instead used for fuel (Searchinger et al. 2008; Tenenbaum, 2008; Thompson, 2012; Zhang, Lohr, Escalante, & Wetzstein, 2010). Hence, many argue that food security has less to do with the earth's capacity to produce calories than

the ability of those most in need to obtain these calories (Elobeid & Hart, 2007; Zhang et al. 2010). Arguments about distribution date back at least to the early 1980s when Amartya Sen published the groundbreaking *Poverty and Famines* (Sen, 1981). In this book, Sen argued that food insecurity and famine are not caused by a lack of food as much as by a lack of economic and political power that would allow impoverished citizens to demand food in a highly inequitable world market (see also: Davis, 2002). Sen's book set the stage for three decades of development work based on the "sustainable livelihoods approach" to reduce poverty and food insecurity (Bebbington, 1999; Chambers & Conway, 1992; Scoones, 1998). The sustainable livelihoods approach works to assess and enhance the types of assets (both individual and communal) poor families can access in times of need (Morse & McNamara, 2013). Proponents of a livelihoods approach to food security suggest that poverty reduction, income redistribution, gender equality, and education (and specifically educational programs focused on girls) are all more effective measures to address food security than research to improve the productivity of seeds or the efficiency of farms (Fraser, 2007; Fraser, Simelton, Termansen, Gosling, & South, 2012; Nally, 2010; Simelton, Fraser, Termansen, Forster, & Dougill, 2009; Simelton et al. 2012). While reducing poverty and improving gender equality may indirectly stimulate food redistribution, others advocate for more specific strategies to ensure more equitable distribution. In particular, there are at least three broad strategies that are often discussed: First, we can reduce the use of edible grains for bio-ethanol. Second, we have the option of increasing direct distribution through food aid. Third, a shift in diet towards more plant based nutrition will free up land currently devoted to animal agriculture that could be used for human consumption. Each of these topics is discussed below.

One often-described way of improving food distribution is to reduce the amount of grains that are used for bioenergy production. In the media, this issue is sometimes referred to as the "food versus fuel" debate and was highlighted in late 2012 when a number of US governors requested the Environmental Protection Agency waive the requirement to blend ethanol from corn with gasoline (EPA, 2012). The politicians argued that this would help bring food prices down, thus ensuring more of America's grain would be available for human consumption (Haugen, 2012). But, as pointed out by Graham-Rowe (2011), the role of bioenergy policy on food prices is extremely complex. In particular, Grahame Rowe shows:

- (1) Food prices are driven by much more than just the bioenergy industry (this conclusion is supported by recent data in a FAO study that shows that oil prices are to blame for high food prices (see FAO, 2015a,b));
- (2) Biofuels are increasingly using non-edible crops or wastes and second-generation biofuel shares went from 3% of total renewable fuels in 2010 to 13% in 2015 based on US production data (EPA, 2014) and are projected to exceed first-generation production by 2022 (Renewable Fuels Association, No date). Note: under certain market conditions biofuels may be still grown on land that could be used for edible crops (e.g. Sanscartier et al. 2014);
- (3) Even if biofuels are based on corn, once the sugars are removed from the corn for ethanol, a range of protein-rich by-products remain to be used as animal feed. So it is not as if these grains, the majority of which would have been used for livestock feed anyway, have been taken out of the food system. In fact, the amount of US corn available for export and other uses has remained fairly constant even as biofuel production has increased (in NCGA report but based on USDA statistics see: NCGA, 2012; NCGA, 2013; USDA, 2015a), largely due to higher yields and more land under corn production (USDA, 2015b).

Such arguments, therefore, lead many to question whether a reduction in the USA's use of corn for bioenergy would ensure more food availability or better food distribution (Thompson, 2012).

Second, experts argue that since some parts of the world have too much food, while others have too little, food could be re-distributed as food aid. Despite the intuitively appealing logic, the history of food aid, defined as food given as charitable donations between nations, suggests that strategies used to distribute food are fraught with challenges. In particular, the whole notion of food aid is now questioned as an effective long-term

strategy to address hunger and deprivation (Singer, 1987). For instance, a range of scholars have shown that food aid can be disastrous for local markets and cause a drop on farm incomes in recipient regions (Awokuse, 2011; Maxwell & Singer, 1979; Schultz, 1960). As a consequence, most development agencies today have moved away from using food aid except as a tool in short-term humanitarian relief efforts (World Food Program, 2010).

Third, another proposed way of improving food distribution is if rich consumers eat less meat, or only ate meat that came from grass fed systems of animal husbandry thus freeing up the grain that currently feeds livestock for human consumption (Rimas & Fraser, 2008; Smil, 2013). This approach was popularized by the vegetarian cookbook *Diet for a Small Planet* (Lappe, 1971), which implicitly argues there would be enough food for all if only the rich consumed less meat and dairy. This position has been taken up by Foley et al. (2011) and Godfray et al. (2010a) both of whom argue that one solution for the global food crisis is to eat less meat, and in particular, meat that comes from resource intensive “factory” farms. A problem remains: meat and dairy consumption is rising quickly at the global scale (Weis, 2013) and few policies or strategies seem effective at altering this trend (De Bakker & Dagevos, 2012). Educating consumers about the dangers of diets high in saturated fats is one approach. However, the challenge of dietary reform is highlighted by Smil (2011) who writes, “Obviously, even relatively small reductions in average meat consumption would have notable effects ... But in the absence of higher meat costs, or lower average incomes, this is not a popular course to follow ...” (p. 13).

43. Summary of main arguments in favour of the local food sovereignty pathway

A third theme in the global food security literature centres on the development of local and sovereign food systems involving alternative, diverse, local, and often organic farms (Blay-

Palmer, 2011; Renting, Marsden, & Banks, 2003). In this literature, it is not so much the scale that makes local systems preferable, rather it is the content of the agenda within the local scale that drives sustainability or justice (Born & Purcell, 2006). A general conclusion presented by authors writing in this literature is that a community's health and long-term sustainability are enhanced through developing local food systems (Allen, FitzSimmons, Goodman, & Warner, 2003; Born & Purcell, 2006; Connelly, Markey, & Roseland, 2011; ; Feenstra, 2002; Hinrichs, 2003). This is accomplished by biologically diverse “alternative” farming systems that require low fossil energy and agrochemical inputs, and situations where the actors who produce, process, and consume food are linked through social ties in a specific locality (Feenstra, 1993; Kloppenburg, Lezberg, De Master, Stevenson, & Hendrickson, 2007). Such alternative food systems are argued to offer a greater degree of equity, democracy, and sovereignty for all members of the community, improve the economic viability of farmers, and help protect the environment (Blay-Palmer, 2008; Hinrichs, 2000; Martinez et al. 2010). Food sovereignty refers to a collection of ideas that centre around the notion that to be food secure, consumers and producers both need to have the political, economic, or social power to be able to shape the food system they depend on (Torrez, 2010; Wittman, 2009). Proponents of this approach argue that local and sovereign food systems help poor and economically marginalized producers and consumers assert some control over the food systems on which they depend (Altieri, 1999; Patel & McMichael, 2009). Hence, arguments for developing local food systems are often closely aligned with both the environmental movement and also the anti-globalization movement (Altieri & Rosset, 2002; Lang & Heasman, 2004). Today, this position is often articulated by those who promote the 100-mile diet (Smith & Mackinnon, 2007) and rural studies scholarship that focuses on the transnational peasant movement, *La Via Campesina* (Desmarais, 2002, 2012).

Many question whether local and sovereign food systems, based on low-input agriculture, and close links between consumers and farmers, can provide a viable food security strategy for the future. In particular, criticisms centre on two key areas: yield and scale. With regards to yield, some research suggests that biologically diverse farms may not be able to produce enough food to ensure global food security. For instance, [Green, Cornell, Scharlemann, and Balmford \(2005\)](#), [Benton, Dougill, Fraser, and Howlett \(2011\)](#) and [Seufert, Ramankutty, and Foley \(2012\)](#) all argue that farms using “alternative” methods (such as biodynamic or organic) tend to have lower yields when compared to conventional farms, (for example a hectare of organic wheat has a lower yield than a similar hectare of conventional wheat). It is important to note, however, that estimates vary on how much lower “alternative” yields are and some argue that mixed farms are better for food security ([KC et al., 2015](#)) and offer more stable farm income ([Abson, Fraser, & Benton, 2013](#)) even if the yields of specific crops are lower. Finally, while [Seufert's \(2012\)](#) analysis suggests that organic fields are, on average, ~25% less productive than conventional ones, [Seufert's work](#), as well as [Ponisio et al. \(2015\)](#)'s study, also show considerable variation, suggesting considerable scope for increasing yields on organic farms in some localities and for some kinds of foods. There is also huge regional variation and one of [Benton et al.'s \(2011\)](#) key conclusions is that in regions where the landscape is naturally heterogeneous and yields are low, there is ample scope for a range of so-called “alternative agricultural” approaches to result in major increases in crop productivity without environmental challenges. Similarly, [Benton et al. \(2011\)](#) conclude that there is enormous scope for “greening” conventional farming systems to ensure that conventional farmers reduce their environmental impact while maintaining high yields. Hence, [Benton et al.'s](#) paper confirms [Pretty's](#) survey of “sustainable” agriculture projects in Africa that show promise

for boosting productivity while enhancing the environment ([Pretty, 1999](#)).

A second common criticism against the promoters of alternative food systems is that for as long as alternative food enterprises, such as community supported agriculture or farmers markets, remain small they are often laborious, inconvenient and require consumers invest considerable time and energy. For instance, [CoDyre, Fraser, and Landman \(2015\)](#) point out that unless urban gardeners are extremely skilled and dedicated, then urban gardening is an extremely inefficient way of obtaining food ([CoDyre et al. 2015](#)). By contrast, whenever “alternative food enterprises” grow in scale they end up taking on many of the traits of conventional systems. For instance, critics argue that both fair trade and organic certification programs have been “watered down” in their attempt to access mainstream markets and that large-scale organic and fair trade farms cause many of the same problems as conventional ones ([Dolan, 2010](#); [Edward & Tallontire, 2009](#); [Jaffee & Howard, 2010](#); [Tallontire, 2009](#)). As a consequence, a growing body of literature is now tackling the issue of how alternative food enterprises may (or may not) be able to scale up without losing the intrinsic characteristics and intended benefits that defined them as alternative in the first place ([Mount, 2012](#)). At present, there does not seem to be a strong consensus emerging in the literature as to whether this is possible. Furthermore, this debate reveals serious tensions within the organic movement between those who are more closely aligned with ideals related to social justice, seem likely to be opposed to large-scale organic and focus on creating an alternative family-farm-centric food system. This approach contrasts with large-scale producers who benefit from how organic has been defined by the US Dept. of Agriculture that focuses narrowly on a small number of management practices and inputs. Many of the organic farmers who either explicitly or implicitly subscribe to the more philosophical approach to organic farming are deeply concerned with how large scale farming

systems have been certified as organic (please see chapter nine in [Fraser & Rimas, 2010](#))

45. *Summary of main arguments in favour of the market failure, policy, and regulation pathway*

A fourth distinct theme present in the literature on the global food crisis deals with “negative externalities” in the food system that are not captured by market prices or are caused by perverse incentives such as inappropriate subsidies ([Panayotou, 1993](#)). For farming, negative externalities include polluting farming practices ([Pretty et al. 2001](#)) the high energy and carbon footprint of the food system ([Garnett, 2011](#)), food poisoning ([Pretty et al. 2000](#)), food waste ([Parfitt, Barthel, & Macnaughton, 2010](#); [FAO, 2011](#); [Kummu et al. 2012](#)), obesity ([Popkin et al. 2012](#)), and global warming from fossil fuel use ([Connelly et al. 2011](#); [Smil, 2001](#)). For instance, [Pretty et al. \(2000\)](#) attempted to calculate the “total cost” of UK agriculture, concluding that drinking water contamination, damaged habitat, soil erosion, and food poisoning imposed £2343 million of hidden costs on UK society in 1996. This pathway suggests that if consumers were obliged to pay the full cost of producing food, our systems would adjust and become more ecologically efficient ([Benton et al. 2011](#); [Connor & Mínguez, 2012](#); [Tscharntke et al. 2012](#)). Similarly, corn subsidies that reduce the cost of processed food high in sugar represents a policy where the health consequences of our diets are not reflected in the price consumers pay. In this literature, these ideas are sometimes linked with the notion of “ecological intensification”, which is defined as the “... maximization of primary production per unit area without compromising the ability of the system to sustain its productive capacity”(Cassman, 1999; [Firbank, 2005](#); [Food and Agricultural Organisation, 2009](#); [Green et al. 2005](#); [Rudel et al. 2009](#); See also: [Benton et al. 2011](#); [Connor & Mínguez, 2012](#)). Policies to address this include pollution taxes and payment for ecosystem services, each of which try to create financial incentives to reduce the impact of farming on the environment. Similar policies are

used to address social market failures as well.

46. *Summary of main arguments challenging the policy and regulation pathway*

Many scholars criticize the notion that it is possible to establish regulatory frameworks to reduce the negative externalities in our current system. Some authors argue that regulations rarely make farming more ecologically efficient and usually only serve to stifle innovation ([Burton, Kuczera, & Schwarz, 2008](#); [Tamilia & Charlebois, 2007](#)). Hence, a large body of literature questions whether environmental legislation does anything more than increase the costs associated with producing food, thus penalizing innovative farmers ([Fedoroff et al. 2010](#); [Miller & Conko, 2000](#); [Wu, 2006](#)). For instance, in a widely cited study on the effectiveness of EU schemes designed to promote biodiversity conservation in agricultural landscapes, [Kleijn and Sutherland \(2003\)](#) conclude that despite having spent 25.3 billion Euros on agri-environmental schemes up to 2003, it was impossible to ascertain whether these policies had any measurable effect on improving biodiversity. A follow-up study from 2006 was only slightly more positive and showed that these schemes had “marginal” and “moderately positive” effects ([Kleijn et al. 2006](#)). In terms of policies to reduce food waste, the research is somewhat more positive. It has been suggested that innovative technology, particularly in packaging, which extends the shelf life of perishable foods and semi-prepared meals, could potentially reduce food waste in developed countries ([Parfitt et al. 2010](#)). In developing and emerging economies, “market-led large-scale investment in agricultural infrastructure, technological skills and knowledge, storage, transport and distribution” hold

great potential for waste reduction ([Parfitt et al. 2010](#)). But even here the debate surrounding the need to internalize the full costs of the food system exposes ironies and tensions. If an underlying cause of food waste in the developed world is that food is so inexpensive that it is easily wasted, then a proposed solution must be to enact policies to make the consumer bear the full cost of food production and distribution. But while such policies should make food too valuable to waste, these same policies could lead to worse food insecurity and malnutrition in poorer communities.

5. Discussion

We would like to conclude this viewpoint article by picking up on three key points.

- First, in our observation, each of the four pathways described above has a particular set of stakeholders behind it that represent different constituents, each of which has different expectations and demands. In the past, because proponents of each paradigm came from different positions, debates about the most appropriate solutions to food security have resulted in acrimony and, in many cases, a policy stalemate (see below).
- Second, it is our view that no single solution will work in every instance and so food security experts need to be looking to develop a “blended portfolio” of strategies rather than maintaining their allegiance to only one type of strategy.
- Finally, developing inclusive and participatory decision making processes to decide on specific policies, technologies or management practices may be more important than focusing narrowly on any specific tool (such as biotechnology or local food systems).

With regard to the first of these three points, it is clear from the literature that debates between proponents of the four pathways identified above have, in the past, resulted in what can only be described as a “policy stalemate”. For instance, the introduction of this paper alluded to acrimonious debates between environmental activists and food scientists working on GM crops. Perhaps the most extreme example of how arguments over food security can derail policy-making occurred during the writing of the global report for *The International Assessment of Agricultural Knowledge, Science and Technology for Development* (IAASTD). IAASTD was convened by the United Nations following the Johannesburg Summit on

Sustainable Development in 2002. It was designed to act in a similar capacity as The Intergovernmental Panel on Climate Change (IPCC) in that it was to establish a multi-stakeholder group of experts who would assess and review the state of scientific knowledge pertaining to agriculture and food security. According to [Edwards \(2012\)](#) despite the fact that IAASTD was launched with high-level political support and an impressive array of scientific contributors, “almost everything that could go wrong did” (p. 70). Edwards describes the situation:

Civil society representatives clashed with agronomists over the value of physical science vs. traditional knowledge. Business delegates clashed with civil society representatives over the merits of large-scale agribusiness vs. small-scale village farming systems. State delegates and civil society representatives clashed over who could legitimately speak for peasant farmers: their governments or international NGOs working directly with farmers. (p. 75)

In the end, the only real point of agreement was to terminate IAASTD after the first synthesis report was published. But even this report was rejected by the governments of Canada, the US, and Australia. At least two academic papers have been published on the IAASTD. In one, [Edwards \(2012\)](#) concludes that it was disagreements between proponents of local food sovereignty and proponents of technology that caused this rift; similar conclusions are reached by [Scoones \(2009\)](#). In particular, Edwards argues that there were serious epistemological differences between these camps that became politicized and entrenched. As a result, meetings of contributing scholars that were supposed to discuss data and science dissolved into arguments over the role of agribusiness, globalization, traditional versus scientific knowledge, and whether biotechnology can play a meaningful role in promoting food security. Therefore, both Edwards and Scoones treat the failure of the IAASTD process as a cautionary tale that illustrates how debates over

global food security can derail well-meaning policy and scientific discussions. Incidentally, Hulme highlights similar tensions in his study over why people disagree over climate change. In particular, Hulme concludes that it is critical to explore the discordant voices and multifarious knowledge claims in order to help identify the ideas different people in diverse places and times have about the issue at stake (Hulme, 2008, 2009).

Building on this lesson, one of the key conclusions that the authors of this viewpoint paper would like to make is that no single pathway will work in every situation. There are many situations when the unthinking promotion of a specific tool ended up undermining food security. For instance, Scott's (1985) study shows how Western development experts tried to reduce food insecurity in Asia by promoting labour-saving tools such as rice combine harvesters. All this equipment did was increase rural unemployment and consequently the tool was unsuited to the local environment and rejected by the people who were supposed to benefit from it. Therefore, what is needed is a sort of "blended portfolio" of food security strategies where the strengths and weaknesses of different approaches are balanced. Furthermore, such an approach could be explicitly based on core objectives such as equity, sustainability and nutrition.

But while promoting such a blended portfolio of food security strategies is a nice theoretical aspiration, the critical question remains: what guidance is there to allow policy makers, scientists, farmers or business leaders to actually achieve this goal? To answer this question, we would like to turn to the literature that pertains to participatory environmental management. Briefly, a key insight from this body of work is that decision making can be improved if scientists and policy makers (so-called "experts") work in greater partnership with farmers, concerned citizens, and other "non-experts." This requires that less powerful stakeholders gain access to resources (such as access to legal advice or technical expertise) and the goal is to ensure that

there is a clear, fair and transparent process to identify problems, decide on locally relevant solutions, and develop accountable evaluation frameworks to ascertain whether or not strategies have been effective (e.g. see: Dougill et al. 2006; Fraser, Dougill, Mabey, Reed, & McAlpine, 2006; Reed, Fraser, & Dougill, 2006; Stringer et al. 2006).

One of the most high-profile examples of this sort of process is the World Commission on Dams that established a multi-stakeholder and participatory process for planning, implementing and decommissioning large-scale water and energy projects (World Commission on Dams, 2010a). The World Commission on Dams posits that decision-making must be underpinned by the need for demonstrated multi-stakeholder acceptance, as well as free, prior and informed consent (World Commission on Dams, 2010b). While the World Commission on Dams provides us with a starting point in thinking about how to conduct a participatory process, problems remain. For instance, when compared with agriculture and development projects, it is relatively easy to identify relevant stakeholders in large-scale hydro-electric projects, so we acknowledge that capturing an appropriate social network with whom to engage with is extremely challenging. One way of overcoming such hurdles is to use an approach called "mediated modelling" that provides a structure to identify relevant stakeholders (Reed et al. 2006) and can be used to help scientists and other stakeholders build a shared understanding of the drivers of food security (or other topics) in a region. Mediated modelling, which starts by mapping the relevant social network and then provides tools to help identify drivers, feedbacks and intervention points represents one way of bringing different perspectives together to explore how proposed strategies may cause unintended consequences. Dougill, Fraser, and Reed (2010), for instance, applied this process to identify how different policies changed livelihood and food security strategies in Botswana (see also Fraser et al., 2011 for an introduction to a special issue of the journal *Ecology and Society* on this topic and

Dougill et al. 2006 for an application of this approach to land management in rural UK). While mediated modelling provides one process-based tool that tries to combine the benefits of “bottom-up” participation and “top down” expert advice (Fraser et al. 2006), our core message is that developing such a deliberative process is crucial to developing solutions to the global food crisis.

6. Conclusion

When considering food security, policy makers, scientists, and activists must carefully consider each of the four pathways outlined in this paper. To do so, however, requires a large degree of collective coordination at local through to international scales. A major concern is that today the intellectual debate on food security risks descending into a policy stalemate with the hungry paying the highest cost. Therefore, the authors of this paper hope that this viewpoint article provides some clarification of these issues and, along with our attempt to highlight the key points of convergence and contestation, we hope to have provided a helpful distillation of core tenets surrounding the challenges and solutions to solving the global food crisis.

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Evaluating the Economic and Environmental Impacts of a Global GMO Ban

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Abstract

The objective of this research is to assess the global economic and greenhouse gas emission impacts of banning GMO crops. This is done by modeling two counterfactual scenarios and evaluating them apart and in combination using a well-known Computable General Equilibrium (CGE) model, GTAP-BIO. The first scenario models the impact of a global GMO ban. The second scenario models the impact of increased GMO penetration. The focus is on the price and welfare impacts, and land use change greenhouse gas (GHG) emissions associated with GMO technologies. Much of the prior work on the economic impacts of GMO technology has relied on a combination of partial equilibrium analysis and econometric techniques. However, CGE modelling is a way of analyzing economy-wide impacts that take into account the linkages in the global economy. Here the goal is to contribute to the literature on the benefits of GMO technology by estimating the impacts on price, supply and welfare. Food price impacts range from an increase of 0.27% to 2.2%, depending on the region. Total welfare losses associated with loss of GMO technology total up to \$9.75 billion. The loss of GMO traits as an intensification technology has not only economic impacts, but also environmental ones. The full environmental analysis of GMO is not undertaken here. Rather we model the land use change owing to the loss of GMO traits and calculate the associated increase in GHG emissions. We predict a substantial increase in GHG emissions if GMO technology is banned.

1. Results

The results of this work are divided into three sections. We begin by examining the results of the first scenario—that is, the simulation in which we model the disappearance of GMO technology. This is followed by a similar

summary of the second scenario (higher GMO penetration). The third section presents the combination of the outcomes from the two scenarios. The full results of the simulation cover a wide range of outcomes. In the following we present selected economic and environmental impacts. Each section covers global outcomes, United States' outcomes, and outcomes for the rest of the world.

4.3. Combination of Scenarios 1 and 2

4.3.1. Economic Impacts

Lastly, we consider the scenarios together. We recall that the previous results have all been understood relative to the actual world. Scenario 1 considers the world in the absence of GMO technology; scenario 2 considers the world with increased GMO penetration. Having considered these scenarios separately, we now take them together. Here our goal is not to compare counterfactual worlds to the actual world, but rather to consider the future. One way of thinking about this is to consider this as an estimation of the cost of banning GMO crops. Instead of comparing the ban to the current world, which assumes that the penetration of GMO crops will remain static, we compare the outcomes in the case of a ban to the outcomes in the case of a likely future scenario. In this case, we understand scenario 2 as the plausible alternative outcome. Based on the rising penetration of GMOs worldwide, it is not unreasonable to assume that penetration will reach the levels it has attained in the United States. In fact, it would not be unreasonable to assume that GMO penetration far exceeds the penetration we model here. That being said, given the number of unknown variables, this seems a reasonable way to conservatively estimate of the future costs of a GMO ban (or the future benefits of GMOs).

In considering the scenarios relative to each other, we consider the welfare effects and land use/emissions effects. Clearly the commodity price impacts and food cost impacts would be higher, but it is not possible to directly combine those results.

In order to compare the welfare costs of a future GMO ban, we take the welfare results from scenario 1 and subtract the welfare impacts from scenario 2. This gives the welfare impact of a GMO ban given the welfare impacts of the increased GMO penetration from scenario 2. Global welfare loss is \$9.8 billion. China is especially hard hit, with welfare losses accounting for more than 40% of global welfare loss. The third column of **Table 5** gives the difference in welfare impact by region.

Here the winners and losers of the GMO ban are made even clearer than in either scenario taken alone. Besides China, India and the Middle East and North Africa are the hardest hit, with Brazil and the United States reaping significant rewards. Given the regulatory approaches of the various regions represented here, the results are somewhat surprising. On the whole, as GMO penetration increases in GMO using countries, a GMO ban hurts low GMO penetration regions more and more. Export heavy regions are also the regions

with the most significant penetration of GMO crops. Importers in turn rely on the marginal production of these GMO using producers. When the GMO varieties disappear, it is the importers who must meet their demand with higher prices that are adversely impacted the most.

4.3.2. Land Use Change

A similar procedure allows us to determine the land use effects of a future GMO ban. The third block of **Table 6** summarizes the land use impacts of the future GMO ban. From the first column of this table, it is clear that much of the conversion of forest to crop is occurring in either the developing world or in places with at-risk forests to begin with. Sub Saharan Africa has the largest forest loss, losing about 0.3 million hectares of forest. India also loses significant forested area (also around 0.3 million hectares).

4.3.3. Land USE Emissions

The global emissions outcomes combining scenario 2 and scenario 1 is approximately

1.1 billion tons of CO₂ equivalent (see the last column of **Table 7**). It is clear from these results that GMOs are a significant factor in the “greening” of agriculture. After energy production, agriculture is the largest source of greenhouse gas emissions. This level of emissions is about three times the land use change emissions from the entire US ethanol program. The emission reduction impact of GMO varieties is rarely mentioned in the GMO debate.

2. Conclusions

The objective of this paper was to quantify the economic and environmental impacts of banning GMO crops. Using a well-known CGE model (GTAP-BIO), two counterfactual scenarios were examined to reach these goals. The first is a GMO ban, while the second is an increase in total GMO penetration. The economic impacts include welfare, price, and supply impacts. The environmental impacts focus on land use change and associated emissions change.

As GMO finds wider and wider usage, there is a corresponding growth in the popular hysteria surrounding the technology. Environmental activists push for GMO bans, without adequately considering the impacts such bans might have. The losses associated with a global ban would be twofold: the losses actually realized and the potential losses when compared to an alternative adoption schema. These losses are also not merely economic. To frame the debate as environmentalists on one side, and capitalists (and purveyors of capitalist apologetics) on the other, a more complex issue is oversimplified. There are environmental gains associated with GMO technology, and while the welfare effects of GMO technology are not, as it turns out, especially substantial at the global level, the environmental effects are. Both sides of the GMO debate are done

a disservice if these effects are ignored.

While the welfare impacts are not substantial at the global level, there are economic effects worth noting. In particular, the supply price and food price increases are extremely region specific. While the United States does not even experience a 1% food increase, countries like India and other South Asian nations do see their food prices increase more noticeably (2.2% and 1.3%). These are parts of the world where food and beverage expenditure is already a greater share of total household consumption, and so the effect of the food price increase is in fact amplified. It is a luxury to be relatively unaffected by a GMO ban, or at least to have your pocketbook hit less hard. Interestingly, the welfare and supply effects suggest that in the case of a GMO ban, the world becomes more dependent on US agriculture. This might not be a desirable outcome for nations other than the United States. Indeed, the United States is the country that benefits most from a GMO ban, either present or future.

The welfare impacts are in line with the impacts estimated in the rest of the literature [17]. Because they are the results of a global GMO ban of all three main crops, they are slightly greater than studies which have focused on one region, or one crop's benefits. However, the overall economic impacts of GMO crops have been discussed at great length, both at the micro and macro level.

What have been more sparsely covered in the literature are the land use change impacts. Indeed Barrows *et al.* [56] in their examination on land use change and GMO point to the need for a full general equilibrium analysis to assess the impacts of land use change on price, supply but also on greenhouse gas emissions. Our findings suggest that avoided land use change (and thus avoided increases in emissions) is one of the most important benefits associated with GMO technology. Following the completion of the latest talks in Paris, countries have expressed a willingness to lower overall emissions, and GMO technology is one of the ways that agriculture can help this aim. Agriculture would have to find alternative approaches to lowering emissions, and these are not immediately obvious without fundamentally altering the agricultural landscape (e.g. banning meat).

This work is among the first to use the updated 2011 data from GTAP. Thus it is run using the most recent global economic information. Undertaking to model a global GMO ban requires that global data be used, and preferably the best global data available—this allows this work to provide a fuller picture of the world impacts.

THOUGHTS AND REFLECTIONS

What role should GMOs have in creating a more sustainable food system, and how should they be evaluated?

How should we navigate the vast variety of perspectives on how to achieve agricultural sustainability?

Why might so many Americans feel opposed DNA in their food, when DNA is in all living things?

Chapter 5: What We Can Do



Watch this video
on shellfish
aquaculture and
bioremediation:



<https://www.youtube.com/watch?v=99kWyfTQwXo>

Transparency is an important part of improving our food system. Check out this explanatory video by a company that is blazing a new trail toward transparency:

<https://www.labelinsight.com/about>

THE AQUAPONICS CYCLE

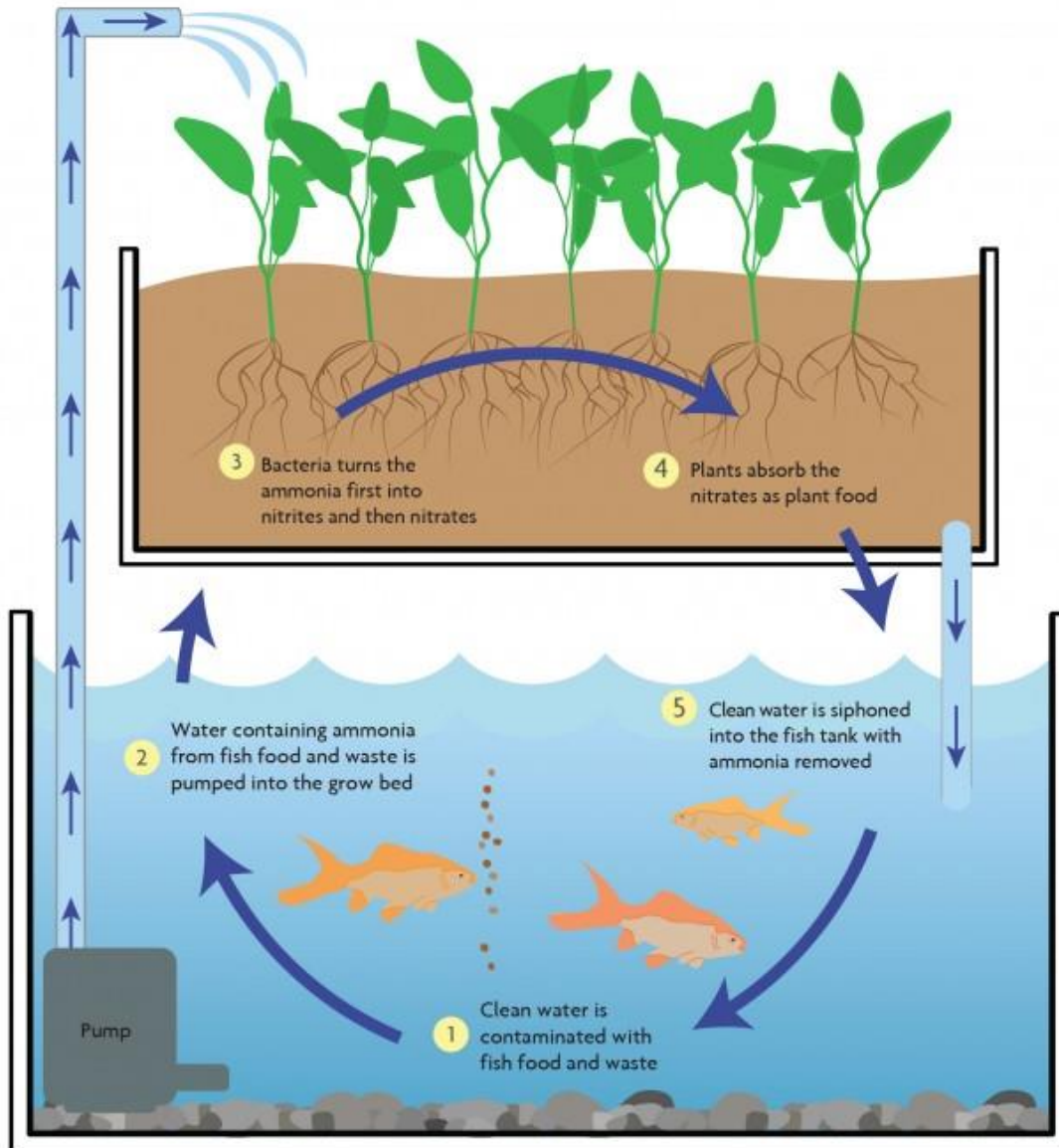


Illustration by Jillian Helvey
Source: aquaponichowto.com

<https://greenlivingaz.com/aquaponics-education/>

Comparison of Land, Water, and Energy Requirements of Lettuce Grown Using Hydroponic vs. Conventional Agricultural Methods

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Abstract: The land, water, and energy requirements of hydroponics were compared to those of conventional agriculture by example of lettuce production in Yuma, Arizona, USA. Data were obtained from crop budgets and governmental agricultural statistics, and contrasted with theoretical data for hydroponic lettuce production derived by using engineering equations populated with literature values. Yields of lettuce per greenhouse unit (815 m²) of 41 ± 6.1 kg/m²/y had water and energy demands of 20 ± 3.8 L/kg/y and $90,000 \pm 11,000$ kJ/kg/y (\pm standard deviation), respectively. In comparison, conventional production yielded 3.9 ± 0.21 kg/m²/y of produce, with water and energy demands of 250 ± 25 L/kg/y and 1100 ± 75 kJ/kg/y, respectively. Hydroponics offered 11 ± 1.7 times higher yields but required 82 ± 11 times more energy compared to conventionally produced lettuce. To the authors' knowledge, this is the first quantitative comparison of conventional and hydroponic produce production by example of lettuce grown in the southwestern United States. It identified energy availability as a major factor in assessing

1. Introduction

Conventional agricultural practices can cause a wide range of negative impacts on the environment. “Conventional” or “modern industrial agriculture” has been historically defined as the practice of growing crops in soil, in the open air, with irrigation, and the active application of nutrients, pesticides, and herbicides. Some of the negative impacts of conventional agriculture include the high and inefficient use of water, large land requirements, high concentrations of nutrients and pesticides in runoff, and soil degradation accompanied by erosion [1,2]. As the world population continues to grow at a rapid rate, so too must the food production. However, approximately 38.6% of the ice-free land and 70% of withdrawn freshwater is already devoted to agriculture [3,4]. To sustainably feed the world’s growing population, methods for growing food have to evolve.

The benefits of hydroponic agriculture are numerous. In addition to higher yields and water efficiency, when practiced in a controlled environment, hydroponic systems can be designed to support continuous production throughout the year [5]. Hydroponic systems are very versatile and can range from rudimentary backyard setups to highly sophisticated commercial enterprises. Various commercial and specialty crops can be grown using hydroponics including tomatoes, cucumbers, peppers, eggplants, strawberries, and many more. Leafy vegetables, such as lettuce can also be grown hydroponically and perform best using the nutrient film technique (NFT) [6]. Hydroponic NFT production involves the circulation of a nutrient solution through shallow channels in a closed-loop system [7].

In 2012, in terms of production by weight, head lettuce was the second largest vegetable crop in the United States, second only to onions [8]. A substantial portion of that production (approximately 29% in 2012) occurs in Arizona, primarily in Yuma [8,9]. Since Arizona devotes approximately 69% of its current freshwater withdrawals to agriculture [10], investigations into hydroponic alternatives could be beneficial in reducing the strain on water resources in such regions. There is considerable research available regarding conventional lettuce production and hydroponic lettuce production separately, but few studies that have compared the resource inputs of the two at a commercial level.

Regarding conventional lettuce production, in 2001, the University of Arizona Cooperative Extension developed county-specific crop budgets estimating the operating and ownership costs of producing vegetables in Arizona using representative cropping operations and such resource inputs as water, fuel, and fertilizer [11]. Realizing that the water and energy use for agriculture is substantial, Ackers *et al.* (2008) [12] performed an

“order of magnitude” study and determined a reasonable range of estimates for resources used in the production of Arizona agriculture.

Regarding hydroponics, the Ohio State University developed an enterprise model designed to estimate the revenue, expenses, and profitability associated with a typical hydroponic greenhouse lettuce production system in Ohio [13]. Various other authors have investigated components of hydroponic lettuce production as it relates to water and energy inputs [14,15].

The objective of this study is to determine whether hydroponic lettuce production is a suitable and more sustainable alternative to conventional lettuce production in Arizona. For this study, “a suitable and more sustainable alternative” is one that outperforms (*i.e.*, is more efficient than) conventional agriculture in the metrics of land use, water use, and energy use, normalized by yield.

2. Results and Discussion

In terms of yield area, the hydroponic production of lettuce in Arizona was found to be 11 ± 1.7 times greater than that of its conventional equivalent. Specifically, hydroponic lettuce production was calculated to result in a yield of 41 ± 6.1 kg/m²/y (\pm standard deviation, SD, here and in the following), while conventional lettuce production was projected to yield 3.9 ± 0.21 kg/m²/y (Figure 1).

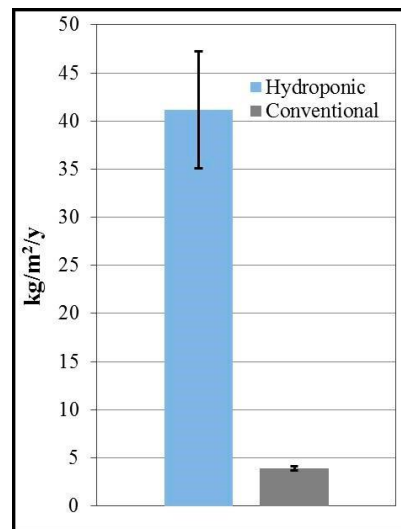


Figure 1. Modeled annual yield in kilograms per square meter of lettuce grown in southwestern Arizona using hydroponic vs. conventional methods (Error bars indicate one standard deviation).

Water consumption between the hydroponic and conventional production of lettuce in Arizona was comparable on an area basis, but when normalized by yield the average was 13 ± 2.7 times less water demand in hydroponic production compared to conventional production. Specifically, hydroponic lettuce production had an estimated water demand of 20 ± 3.8 L/kg/y, while conventional lettuce production had an estimated water demand of 250 ± 25 L/kg/y (Figure 2).

Results for energy consumption found that the hydroponic production of lettuce in Arizona requires 82 ± 11 more energy per kilogram produced than the conventional production of lettuce in Arizona. Dominating

the hydroponic energy use are the heating and cooling loads at $74,000 \pm 10,000$ kJ/kg/y, followed by the energy used for the supplemental artificial lighting at $15,000 \pm 2100$ kJ/kg/y. The circulating pumps contributed the least to the total energy use at 640 ± 120 kJ/kg/y. In total, the hydroponic energy use was calculated to equal $90,000 \pm 11,000$ kJ/kg/y (Figure 3).

The total energy use for the conventional production of lettuce in Arizona was calculated to be 1100 ± 75 kJ/kg/y (Figure 3). This total was split between the energy use related to fuel usage at 330 ± 20 kJ/kg/y and groundwater pumping at 760 ± 74 kJ/kg/y.

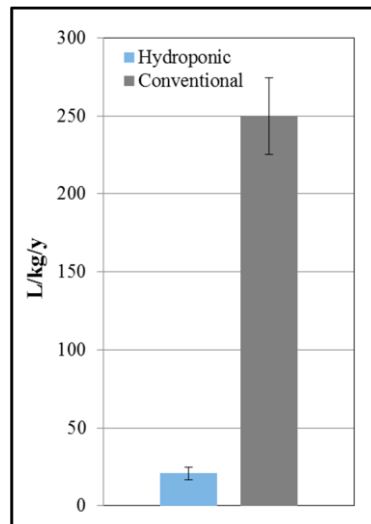


Figure 2. Modeled annual water use in liters per kilogram of lettuce grown in southwestern Arizona using hydroponic vs. conventional methods (Error bars indicate one standard deviation).

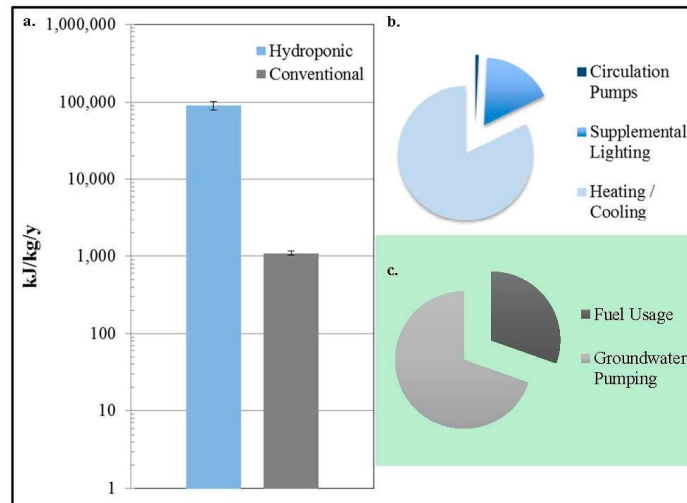


Figure 3. (a) Modeled annual energy use in kilojoules per kilogram of lettuce grown in southwestern Arizona using hydroponic vs. conventional methods; (b) The energy use breakdown related to the hydroponic production of lettuce; (c) The energy use breakdown related to the conventional production of lettuce (Error bars indicate one standard deviation).

Conclusions

Despite its high demand for energy, hydroponics remains a promising technology. Several factors could influence the feasibility of hydroponic production of crops, specifically lettuce, in the future. As more sophisticated control devices become available, the cost of maintaining the controlled environment of hydroponic greenhouses could decrease. The future availability of water, land, and food will also influence feasibility through increased demand. Increasing land and water scarcity will make the more land- and water-efficient hydroponic systems more appealing to city planners. Government and local grass-roots support could also influence the future of hydroponic farming, as subsidies could be used to offset the high initial cost of hydroponic infrastructure or more simplified hydroponic systems take hold.

At this point in time, hydroponic farming of lettuce cannot be deemed a more sustainable alternative to conventional lettuce farming techniques, but it provides promising concepts that could lead to more sustainable food production. In summary, hydroponic gardening of lettuce uses land and water more efficiently than conventional farming and could become a strategy for sustainably feeding the world's growing population, if the high energy consumption can be overcome through improved efficiency and/or cost-effective renewables.

HOW TO CREATE CHANGE: DECOLONIZING THE REVOLUTIONARY IMAGINATION: VALUES CRISIS, THE POLITICS OF REALITY, AND WHY THERE'S GOING TO BE A COMMON-SENSE REVOLUTION IN THIS GENERATION

By Patrick Reinsborough

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Patrick Reinsborough is a writer, grassroots organizer, and popular educator who has worked on a wide range of issues including forest protection, nuclear power, police brutality, urban sprawl, peace in northern Ireland, indigenous rights, and numerous local and global environmental justice struggles. He is the cofounder of the smartMeme Strategy and Training Project and the Wake Up America campaign.

"If you expect to see the final results of your work, you simply have not asked a big enough question." -- I.F. Stone

Introduction: Post-Issue Activism

Our planet is heading into an unprecedented global crisis. The blatancy of the corporate power grab and the accelerating ecological meltdown is evidence that we do not live in an era where we can afford the luxury of fighting merely the symptoms of the problem. As is often noted, crisis provides both danger and opportunity. The extent to which these two opposing qualities define our era will be largely based on the appeal and breadth of the social movements that arise to address the crisis.

This essay is part of my own struggle to explore a politics that is commensurate with the scale of the global crisis. In part it was inspired by a profound strategy insight I received while watching a circling bird of prey. The raptor seemed to spend hours calmly drifting on the breezes, waiting and watching, then suddenly made a lightning quick dive to seize its prey. Had I only witnessed the raptor's final plunge, I might not have realized that it took hours of patient surveillance for the raptor to be in the right place to make a seemingly effortless kill. I was struck by what a clear metaphor the raptor's circling time is for what our movements need to do in order to be successful. Social change is not just the bird of prey's sudden plunge -- the flurry of direct confrontation -- but rather the whole process of circling, preparing, and strategizing.

Analysis is the most important tool in the social change toolbox. It is this process of analysis -- the work to find the points of intervention and leverage in the system we're working to transform -- that suggests why, where, and how to use the other tools. Many of us are

impatient in our desire for change, and those of us from privileged backgrounds are oftentimes unschooled in the realities of long-term struggle.

I often recall the Buddhist saying, "The task before us is very urgent, so we must slow down." This essay is my effort to "slow down" a bit and explore some new analytical tools. My hope is that it will incite deeper conversations about strategies for building movements with the inclusiveness, creativity, and depth of vision necessary to move us toward a more just and sane world.

Let's begin by asking why aren't more global North movements coming forward with systemic critiques? Why, despite the increasingly obvious nature of the crisis, isn't there more visible resistance to the corporate takeover of the global political system, economy, and culture?

The answer to this question lies in our exploration of how pathological values have shaped not only the global system but also our ability to imagine true change. The system we are fighting is not merely structural, it's also inside us, through the internalization of oppressive cultural norms that define our worldview. Our minds have been colonized to normalize deeply pathological assumptions. Thus, oftentimes our own sense of self-defeatism becomes complicit with the anesthetic qualities of a cynical mass media to make fundamental social change seem unimaginable.

As a result, activists frequently ghettoize themselves by self-identifying with protest, and fail to think of themselves as building movements that could actually change power relations. All too often we project our own sense of powerlessness by mistaking militancy for radicalism and mobilization for movement building. It seems highly unlikely to me that capitalism will be smashed one window at a time.

Likewise, getting tens of thousands of people to take joint action is not an end in itself, rather only the first step in catalyzing deeper shifts in the dominant culture. Our revolution(s) will really start rolling when the logic of our actions and the appeal of our disobedience are so clear that they can easily replicate and spread far beyond the limiting definition of "protester" or "activist."

To do so, our movements for justice, ecology, and democracy must deepen their message by more effectively articulating the values crisis underlying the corporate system. We must lay claim to life-affirming, common-sense values and expose one of the most blatant revolutionary truths of the modern era: The corporate-rule system is rooted in sacrificing human dignity and planetary health for elite profit, and it is out of alignment with human values.

This is the domain of post-issue activism -- the recognition that the roots of the emerging crisis lie in the fundamental flaws of the modern order and that our movements for change need to talk about redesigning the entire global system -- now. Post-issue activism is a dramatic divergence from the slow progression of single-issue politics, narrow

constituencies, and Band-Aid solutions. Traditional single-issue politics, despite noble and pragmatic goals, is not just a strategic and gradualist path to the same goal of global transformation. Too often the framework of issue-based struggle needs to affirm the existing system in order to win concessions, and thus fails to nurture the evolution of movements for more systemic change.

Much of our social change energy is spent campaigning against the smoke rather than clearly alerting people to the fact that their house is on fire. Post-issue activism will not replace single-issue politics -- the people and ecosystems closest to the smoke need relief now -- but rather, it will strengthen ongoing struggles by providing a larger social-change context. Post-issue activism is the struggle to address the holistic nature of the crisis, and it demands new frameworks, new alliances, and new strategies. We must find ways to articulate the connections between all the "issues" by revealing the pathological nature of the system. To do so we must rise to the challenge of going beyond (rather than abandoning) single-issue politics. We have to learn to talk about values, deepen our analysis, and direct more resources into creating political space for a truly transformative arena of social change.

To think about decolonizing the revolutionary imagination, we must reference the history of colonization. Through colonization, Western civilization ("a disease historically spread by sharp swords"[1]) has been violently imposed upon the entire world. Colonialism is not just the process of establishing physical control over territory, it is the process of establishing the ideologies and the identities -- colonies in the mind -- that perpetuate control. Central to this process has been the manufacture of attitudes of racism, nationalism, patriarchal manhood, and the division of society into economic classes. If we are to take seriously the prospect of decolonizing the revolutionary imagination then we must examine how these attitudes shape the way we conceive of social change. Likewise, we must remember that analysis is shaped by experience, and that those who suffer directly as targets of these oppressive attitudes often live the experiences that create clear analysis. Let us not forget that effective revolutions are based on listening.

In facing the global crisis, the most powerful weapon that we have is our imagination. But first we must liberate ourselves from the conceptual limitations we place on social change. As we expand the realm of the possible we shape the direction of the probable. This means directly confronting the myths and assumptions that make a better world seem unattainable. To that end, this essay endeavors to explore some tools to help us unshackle our imaginations and increase the momentum of the global justice movements' process of creating a political space to fundamentally redesign the global system.

On a final note of introduction I wish to clarify that most of the ideas presented in this essay are neither new nor truly my own. Ideas by their nature quickly cross-pollinate and grow beyond any individual's role in their articulation. All activists owe a great debt to shared experience. I personally am indebted to many seasoned activists and theorists from across numerous movements who have shared their thoughts and helped me deepen my analysis. Likewise, all of these ideas are a work-in-progress. They are intended as

tools to spark discussion and encourage debate, and it is my sincerest hope that they will generate more questions than they answer. Questions are always more radical than answers.

The Doomsday Economy

We live in a dangerous time, an urgent time, a time of profound crisis. Ecologically speaking it is an apocalyptic time defined by the sixth mass extinction of the earth's species,[2] the destruction of the last wilderness areas, and the forced assimilation of the planet's few remaining earth-centered cultures. Every ecosystem, every traditional culture, and every subsistence economy is on the chopping block as the global corporatizers force their consumer monoculture "development" model (read antidevelopment) upon the entire world. Corporate capitalism's drive toward global domination has literally pushed the life support systems of the planet to the point of collapse.

More and more people are recognizing that we are at a turning point. The corporate takeover -- the latest offensive in the 500-plus-year conquest of the planet by Western culture -- is being met with massive resistance around the world. However, the elite planners and architects of the global economy seem incapable of hearing their multitude of critics and are continuing to push toward total commodification, assimilation, and a global corporate state.

Over the last few years, as corporate power has begun to undermine the economic self-determination and political sovereignty of even the over-consumers of the global North, resistance has grown more visible in the heart of it all -- the United States. Unprecedented coalitions have formed, and different movements have been uniting in creative mass protest to slow the pace of corporate globalization. But slowing things down is one thing, replacing the doomsday economy with a democratic, just, and ecologically sane world is another.

The global system is mutating. Although it remains deeply rooted in its history of colonial genocide, corporate power grabs, and ecological devastation, the structure has changed dramatically over the past generation. The biggest shift has been the rise of the speculative economy. As the world financial sector has been deregulated, with many countries forced to drop limits on investment, there has been a dramatic transition in economic priorities from the production of real goods to a global casino economy based on high-risk, short-term speculation. In 1986 the world's foreign exchange markets were handling nearly \$200 billion a day. By 1998 this figure had grown eightfold to \$1.5 trillion dollars every day![3] Since the entirety of world trade is estimated to be worth about US \$6.5 trillion a year,[4] that means that five days of currency transactions surpasses the value of an entire year of world trade. But the most important aspect of this so-called "financial revolution" is that the massive numbers represent growth in the speculative sector of the economy. Financial speculation has accelerated to the point that

by the year 2000, for every \$1 of international investment facilitating trade in real goods, \$9 were being spent on short-term speculation.[5]

An understanding of the rise of the speculative economy is key to debunking the neoliberal myth of growing prosperity. The reality is that none of the money circulating in the speculative economy feeds anyone, clothes anyone, nor does it provide anyone with meaningful jobs. Rather, the speculative economy is mostly just a way for rich people -- through their corporate institutional proxies -- to use the money they already have to make more. Moreover, this massive speculative economy is a powerful destabilizing force that threatens local economies and ecosystems, since speculation is the opposite of sustainability and encourages a deeper disconnect between ecological realities (limits, natural cycles of production, etc.) and the arbitrary mechanics of financial manipulation.

Since 1980 the total value of the planet's financial assets (money in stocks, bonds, bank deposits, and cash) has increased sevenfold, from \$12 trillion in 1980 to \$80 trillion in 2000.[6] These statistics are supposed to represent the "rising tide that lifts all boats" and the "miracle of economic growth" that is the basis for the politicians' promise of prosperity. But anyone (especially those not brainwashed by the arcane logic of conventional economics) can see that surely seven more earths haven't been created over the last two decades -- so where did all this new "wealth" come from?

Once we cut through the numbers games and semantics we recognize that what economists call economic growth is really the liquidation of the natural wealth of the planet. Almost literally, they are destroying the natural economy of living forests to make an economy of disposable paper on which they print money to tell themselves how rich they are. It is a true doomsday economy, incapable of seeing the natural systems that sustain life as anything other than resources to be extracted. The flawed accounting of the speculative economy hides the horrible truth that what the corporate globalizers call "progress" is really the earth's going-out-of-business sale.

Our strategies must be informed by the fact that we're not fighting that colloquialism once called in activist parlance "The Man" -- these days we're fighting "The Machine." This machine is the culmination of the pathological world-view that has hard-wired patriarchy, white supremacy, capitalist domination, and ecological illiteracy into the global operating system. The rich, white (self-congratulatory) men who have always benefited from global domination continue to do so, but ultimately they have created a runaway machine that is beyond even their own control.

SIDEBAR: A Few Notable Characteristics of the Doomsday Economy

- * Corporatization and increasingly centralized control
- * Reliance on coercion (both physical and ideological) to maintain control
- * Drive to commodify all aspects of life
- * Community fragmentation/cultural decay (replacement of lived experience with representation-image-based mass culture, television addiction, increasing alienation)
- * Elevation of consumerism to the center of public life
- * Increased mechanization and blind faith in technology
- * Fetishization of speculative/financial wealth
- * Distorted accounting that masks the liquidation of ecological and social capital
- * Pathological values/flawed assumptions
- * Undermining of planetary life support systems, accelerating ecological collapse

Naming the System (Global Pathology)

In this era of escalating global crisis one of the most important roles radicals can play is to help build a common analysis of the system's flawed design. Not by imposing some kind of dogmatic vanguardism of a single analysis, but rather by creating the political space for a critical mass of people to define the problems they face in their own lives in a systematic way that allows the imagining of fundamental change. We don't have to convince people that something is wrong -- as corporate control becomes more blatant and the ecological crisis worsens, the system is doing much of the work to discredit itself. We must, however, help people to imagine alternatives that go beyond tinkering with the symptoms to actually dismantling and redesigning the global system.

Radicals have always struggled to build oppositional power by naming the system. If only it were as easy as putting "Capitalism" or "Corporate Rule" or "Algae Bloom Civilization/Insane World" on a banner, we'd have won the battle by now. But naming the system isn't merely a semantic or intellectual exercise. Rather, it is the revolutionary process through which a critical mass of people recognize the deadly design flaws of the current social order. The process of "naming" is our way of revealing the hypocrisy,

brutality, and idiocy of the corporate-controlled world in order to build the popular consciousness necessary to inspire transformative action.

One of the beauties of the recent global uprisings has been their ability to look beyond tactical, cultural, and ideological differences to see a unifying commitment to structural change. The better we articulate the fundamental flaws of the current world order the more we will see links between the many types of resistance that are springing up to confront the doomsday economy.

A useful description of our current system can be found in the science of pathology, the branch of medical study that examines the nature of disease. The modern system is pathological on many levels, but the disease that most closely corresponds to the global crisis is the quintessential modern pathology -- cancer. Cancer is not merely a metaphor but a literal diagnosis of the doomsday economy.[7]

Cancer is a perversion in the biological systems of the human body -- our internal ecosystem -- when a cell goes haywire and forgets its own boundaries and its own mortality. The infected cell lives forever, dividing and replicating itself without limits until it finally overwhelms the entire biological system of which it is a part. This disease, now so common at the cellular level, is a chillingly apt description of what is happening at the macro level -- the emergence of a pathological world system.

Corporate power is a cancer in the body politic. Corporations are the institutional embodiment of the perverted values system of modern capitalism -- shaped through the historic lens of white male supremacy to be antidemocratic, exploitive, and incapable of respecting ecological limits. The corporation is a machine that blindly focuses on one function: the maximization of profits. As the elites attempt to institute de facto global corporate rule with their neoliberal free trade agenda, the cancer is metastasizing throughout the host -- planet earth.

We can use this analogy to learn about the pathological nature of the corporate takeover by examining four ways in which cancer operates in our physical bodies.

1. Cancer is a perversion by definition. Cancer usurps the function of the cell away from the collective interest of the organism and into an illusory self-interest separate from the host. Corporations are the manifestation of a similar perversion in modern culture -- alienation from nature and the failure to recognize that our collective self-interest is tied to the overall health of the biosphere. The corporate paradigm is incapable of seeing the ecological reality, the interdependence between humans and ecosystems that define the real limits of the economic sphere. It defines itself around unlimited growth and exists through its desire to expand, consolidate power, and subvert any limits placed upon its ability to maximize profits. Like the cancer cell, it forgets that it is part of and dependent upon a larger biological system

2. Cancer rewrites the rules. Cancer infects the cell's genetic instructions to make the cell operate separately from the rest of the organism. This is exactly what corporate elites have done, first in America and then around the world: rewritten the laws to limit democratic tendencies and to consolidate power. Since 1886, when corporations achieved legal "personhood" in the United States through judicial fiat, the corporate form has become the preferred method for elites to organize their wealth and rationalize their seizure of public property and assets.[8] Corporations continue to undermine the regulatory framework and to subvert democratic decision making with campaign finance corruption, influence peddling, and public relations campaigns. Freed from its historic limits, the corporation has risen to become the defining institution of the modern world. The ideology of privatization has facilitated the corporatization of every aspect of life. International trade, health care, schools, prisons, even the building blocks of life itself -- our genetic material -- are all being gobbled up as corporations become the de facto tool of governance. Corporate pathology has become so ingrained that the Bretton Woods Institutions (World Bank, IMF, WTO) now overtly force rule changes to favor corporations over the public interest. The essence of the doomsday economy is that the same corporations who profit from destroying the planet are being allowed to write the rules of the global economy. Structural adjustment is the macroeconomic equivalent of cancer reprogramming a cell.

3. Cancer masquerades as the host. Since cancer is not an outside invader but instead a perversion within the body's existing cells, our immune system fails to recognize it as a threat. The body's defenses fail to attack the cancer because the cancer masquerades as part of the body. This is probably cancer's most important quality for informing our strategies because it is central to understanding how the corporate takeover has managed to become so advanced without triggering a stronger backlash. Corporate rule masquerades as democracy. The elites use the symbols, trappings, and language of democracy to justify control while corporations hijack the democratic form without the democratic function. This process conceals the deepening values perversion -- ecological illiteracy masquerades as "market forces," monopoly capitalism masquerades as "free trade," and doomsday economics masquerade as "economic growth."

4. Cancer kills the host. Cancer's suicidal destiny is a product of its initial perversion. If not confronted, cancer inevitably metastasizes, spreading throughout the body and killing the host. This is exactly what the corporate pathology is doing to the biosphere. Spread across the planet by waves of colonizers, from the conquistadors to the resource extraction corporations to the International Monetary Fund, the corporate system is on the brink of killing the host -- the biological and cultural diversity of life on the planet. People's ability to govern their own lives is sacrificed along the way since corporate rule is antithetical to real democracy. By definition, corporate decision making must operate within the narrow, short-term interests of their shareholders. Corporations are not wealth-generating machines as the American mythology would have us believe, but rather wealth-consolidating machines. Corporations extract the biological wealth of the planet, liquidating our collective natural heritage in order to enrich a tiny minority. The corporate

drive to shorten the planning horizon, externalize costs, and accelerate growth has pushed the life support systems of the planet to the brink of collapse.

The Control Mythology: Consume or Die

At the center of the ever-growing doomsday economy is a perverse division of resources that slowly starves the many while normalizing overconsumption for the few.

Maintaining control in a system that creates such blatant global injustice relies on the age-old tools of empire: repression, brutality, and terror. Multinational corporations have long since learned how to "constructively engage" with repressive regimes and put "strong central leadership" to work for their profit margins. Whether it's U.S.-approved military dictatorships or America's own ever-growing incarceration economy, the naked control that is used to criminalize, contain, and silence dissent among the have-nots is obvious.

But this brutality is just one side of the system of global control. Far less acknowledged is that in addition to the widespread use of the stick, the global system relies heavily on the selective use of the carrot. The entire debate around globalization has been framed to ensure that the tiny global minority that makes up the overconsuming class never connects their inflated standard of living with the impoverishment of the rest of the world,

Most people who live outside the small overconsumption class can't help but be aware of the system's failings. But for the majority of American (and more generally, global North) consumers the coercion that keeps them complicit with the doomsday economy is not physical; it is largely ideological, relying heavily on the mythology of America. It is this mythology that buys people's loyalty by presenting a story of the world that normalizes the global corporate takeover.

In this story, America is the freest country in the world and corporate capitalism is the same as democracy. The interests of corporations are represented as serving popular needs -- jobs being the simplistic argument -- and the goal of U.S. foreign policy is presented as a benevolent desire to spread democracy, promote equality, and increase standards of living. This control mythology prevents people from seeing how pathologized the global system has become. Much of this story is merely crude propaganda that relies on Americans' notorious ignorance about the world, but elements of the control mythology have become so deeply imbedded in our lives that they now define our culture. Among the most deep-seated elements of the control mythology is the ethic of an unquestioned, unrestrained right to consume. Consumerism is the purest drug of the doomsday economy. It epitomizes the pathology -- the commodification of life's staples and the human and cultural systems that have been created to sustain collective life.

Children's author Dr. Suess provides an eloquent critique of consumerism in his cautionary tale *The Lorax* when he describes how the forests get destroyed to make

useless disposable objects appropriately called "thneeds." A slick businessman markets "thneeds" and maximizes production until the forest is entirely destroyed. This is the essence of consumerism -- creating artificially high rates of consumption by getting people to believe they need excessive or useless things. Overconsumption (invented in America but now exported around the planet) is the engine that drives the doomsday economy. Bigger. Faster. Newer. More! More! More!

We live in a culture of information saturation that constantly redefines an increasingly insane world as normal. The media advocacy group, TV Free America, estimates that the average American watches an equivalent of fifty-two days of TV per year.[9] As corporations have seized the right to manufacture and manipulate collective desire, advertising has grown into a nearly \$200 billion-a-year industry and has become the dominant function of mass media. Feminist media critic Jean Kilbourne estimates that each day the average North American is bombarded by 3,000 print, radio, and television ads.[10] This media saturation plays heavily into the control mythology by overdigesting information, thereby shrinking our attention spans to the point where we can no longer reassemble the story of the global crisis.

The doomsday economy's elevation of consumerism to the center of public life is causing massive psychological damage to people around the world. Advertising works because it subtly assaults a customer's self esteem to get them to buy unnecessary stuff. This process is fundamentally dehumanizing. The culture-jamming magazine Adbusters has rehashed William S. Burroughs to give us the concept in a slogan: "The Product is You." The result is a pathologized global monoculture that fetishizes overconsumption, self-gratification, and narcissism. Although this may ensure ongoing profits for the corporations who manage the "culture industry," it also prevents people from recognizing the impacts of their overconsumption on communities and ecosystems around the world.

The control mythology masks the realities of the doomsday economy by narrowing the popular frame of reference to the point that it's impossible to see beyond the next upgrade of prepackaged lifestyle. The omnipresent commodification of all aspects of life turns freedom into "image branding" and "product placement" while the distinction between citizen and consumer becomes more blurred. The army of one. Individual purchasing power. America open for business. How else could we get to the point where the United Nations estimates that nearly one in six people on the planet do not get their basic daily calorie needs met,[11] but in America shopping is still presented as entertainment?

In the corporatized world a person's rights are defined by their purchasing power -- access to health care, education, a nutritious diet, mental stimulation, or nature are all a factor of how much money you have. The right to overconsume becomes the centerpiece of the new unspoken Bill of Rights of America, Inc. A country of the corporations, by the corporations, and for the corporations. The unification of Europe looks ready to follow a similar path towards a United States of Europe. The cancer spreads.

Consumerism is the manifestation of our pathological reprogramming to not ask questions about where all the "stuff" comes from. The American bootstrap mythology (as in, "pull yourself up by") relies on our ecological illiteracy to convince us that everyone could live the "American" overconsumption lifestyle if they only worked hard enough. Fully conditioned consumers think only in terms of themselves, acting as if there were no ecological limits in the world. The cancer cell operates as if it were not part of a larger organism.

The twisted logic of consumerism continues to function as a control mythology even as much of the affluence of working America has been siphoned off by corporate greed. A complex range of sophisticated anesthetics helps bolster the control mythology by keeping people distracted. Whether it's the digital opium den of 500-channel cable TV, the cornucopia of mood-altering prescription drugs, or now the terror-induced national obsession with unquestioned patriotism, there's little opportunity for people to break the spell of modern consumerism.

The mythology of prosperity still holds, even as the reality becomes more and more elusive. For now perhaps, but for how much longer? As author and media theorist James John Bell writes, "images of power crumble before empires fall." [12] There are many signs that the empty materialism of modern consumer life is leaving many ordinary people discontent and ripe for new types of political and cultural transformation.

Articulating the Values Crisis

To articulate the pathology of the corporate system we must avoid debating on the system's terms. As the classic organizer's tenet says, "We have to organize people where they are at." In other words, if we tell people our truths in a way that connects with their experience, they will understand it, and they will believe it.

I find that most people largely believe the stories that activists tell them about bad things happening in the world. Activists excel at packaging issues, explaining the problem, the solution, and the action that people can take. Activists break it all down into sixty-second raps with accompanying flyers, fact sheets, and talking points, and these tactics win important campaign victories. But where is our system-changing mass movement? Although many of our critics are so blinded by propaganda and ideology that they will always see us as naive, unpatriotic, or dangerous, there is already a critical mass of people who recognize that our society is facing severe problems.

This analysis is supported by the work of researcher and author Paul Ray, who has done extensive demographic research into the beliefs and values of the American public. Ray's work first received prominence through his discovery of the "cultural creatives" which he describes as the cultural by-product of the last forty years of social movements. The defining characteristics of this social grouping includes acceptance of the basic tenets of environmentalism and feminism, a rejection of traditional careerism, big business, and monetary definitions of "success," a concern with psychological and spiritual

development, belief in communities, and a concern for the future. Perhaps most profound is the fact that since the mass media of America still reflects the modern technocratic consumerist worldview, cultural creatives tend to feel isolated and not recognize their true numbers. Most important, based on their 1995 data, Ray and his coauthor Sherry Ruth Anderson conclude that there are 50 million cultural creatives in America and the numbers are growing.[13]

Ray has continued his work in *The New Political Compass*, in which he argues with statistical data that the Left/Right breakdown of politics is now largely irrelevant and proposes a new four-directional political compass. Ray's compass is a fascinating tool for illustrating the complexity of public opinion, mapping not only political beliefs but also cultural shifts. Ray contrasts the Left of New Deal liberalism and big government as "West" with the "East" of cultural conservatism and the religious right. Ray gives "North" on his compass to a grouping he calls the New Progressives, composed largely of cultural creatives and completely unrepresented in the current political system. He defines their major concerns as ecological sustainability, the corporate dominance, child welfare, health care, education, a desire for natural products and personal growth. He contrasts them with "South," who espouse the Big Business Paradigm of profits before planet and people, economic growth, and globalization. Again, his statistical data has profound messages for all of us working to change the world. He estimates that whereas only 14 percent of the population supports the Big Business paradigm, 36 percent of Americans fall into the New Progressives category.

To me the message is a simple affirmation of post-issue activism. Our movements need to stop focusing on only the details and start getting the bigger picture of a holistic analysis out there. Unless the details articulate a broader vision, they are just more background noise in our information-saturated culture. The eighteenth-century political frameworks of left versus right no longer fully capture the political fault lines of our era. Perhaps a better description of the real debate is flat earth versus round earth. The corporate globalizers' program of ever-expanding industrial exploitation of the earth is in such deep denial of the ecological realities of the planet that it is akin to maintaining that the earth is flat. Fortunately, more and more people understand that the earth is in fact round and that we need to make some big changes to both the global system and the way we think of our relationship with the planet. What we need now are social movements with the vision and strategy to harness this consciousness into real momentum for shaping a better world.

The ability to choose your issue is a privilege. Most people involved in resistance are born into their community's struggle for survival. They didn't choose their issue any more than they chose their skin color or their proximity to extractable resources. Activists from more privileged backgrounds have the luxury of choosing what they work on and have to be aware of the dynamics that privilege creates. To expand the base of struggle and support frontline resistance with systemic work we need to confront the silent (and frequently uninformed) consent of the comfortable.

Unfortunately, all too often we still speak in the language of single-issue campaigns and are thus competing with ourselves for overworked, overstimulated people's limited amount of time and compassion. The aware, concerned people who are not immersed in frontline struggle are constantly having to choose between issues. Do I work on global warming or labor rights? World Bank or deforestation? Health care or campaign finance reform? One result is that a lot of people fail to make the connection between a general sense of wrongness about modern society and their own interests and actions. Without an impetus to overcome the colonization of people's revolutionary imaginations it is often easier to retreat into self-centeredness, apathy, or cynicism.

One of the strengths of the emerging global justice movement has been to create a new framework that goes beyond the age of single-issue politics to present the corporate takeover as a unifying cause of many of the planet's ills. The problem has been the amount of information we've been packaging into the critique as we slowly try to work the public through the alphabet soup of corporate cronies, trade agreements, and arcane international finance institutions. I don't doubt people's ability to grapple with the mechanics of corporate globalization but I do doubt our movement's ability to win the amount of air time from the corporate media that we need to download endless facts.

Everything -- including the corporate global system -- is very complicated. But likewise everything is very simple. There is sick and healthy. Just and unjust. Right and wrong. Despite the obvious oversimplification of binary frameworks, the language of opposing values is a powerful tool to build holistic analysis and subvert the control mythology.

Ultimately, our society must shift collective priorities and engage in a values shift to overcome some of our deepest pathologies such as patriarchy, fear of "otherness," and alienation from nature. However, we must be very careful how we frame this concept. Picture yourself knocking on the country's front door and announcing that you have come to shift people's values. Slam! In fact, this is far too often the way that activists are perceived.

An alternative strategy for a first step is to articulate the values crisis. This means speaking to people in terms of their basic values and showing them that the global system that is engulfing them is out of alignment with those values. In other words we have a "values crisis," a disconnect between what kind of world people want to live in and the corporate world that is rapidly taking over.

Long-term activist and movement theorist Bill Moyer wrote about the concept within psychology of "confirmatory bias" or people's habit of screening information based on their own beliefs. In other words, people are much more likely to believe something that reinforces their existing opinions and values than to accept information that challenges their beliefs.[15]

Moyer's point is that social movements succeed when we position ourselves within widely held existing values. The emerging global justice movements are already laying

claim to core values such as democracy, justice, diversity, and environmental sanity as part of an inclusive vision of a life-affirming future. Now our work is to expose the flawed values of the corporate takeover.

We can articulate the values crisis by showing people that corporate capitalism is no longer grounded in common-sense values. The corporate paradigm is a cancerous perversion that masquerades as being reflective of commonly held values while it writes the rules of the global economy to metastasize corporate control across the planet.

A simple dichotomy for articulating the crisis is the clash between a delusional value system that fetishizes money and a value system centered around the biological realities of life's diversity[16] (see sidebar).

SIDEBAR: Money Values versus Life Values

exploitation / dignity	absentee landlordism / stewardship
centralized control / democratic decisionmaking	ecological illiteracy / biocentrism
commodification / sacredness	proxy decision making / real democracy
privatization / global commons	short-term gain / sustainability
corporatization / collective responsibility	narrow economic indicators / full cost accounting
shareholders / stakeholders	artificial scarcity / abundance
output / throughput	inequitable distribution / economic justice
disposable / renewable	corporate rule / global justice
mechanistic models / organic models	empire / community
information / wisdom	The System / systemic change
productivity / prosperity	
consumers / citizens	
spectator / participant	
global economy / local economies	
extraction / restoration	
monoculture / diversity	
transferable wealth / replenishable wealth	
property / ecosystem	
alienation from nature / earth-centered values	

We need to cast these opposing value systems as two very different paths for the future of our planet. The path shaped by life values leads toward many choices -- decentralized,

self-organizing, diversity of different cultures, political traditions, and local economies. In contrast, the money values path leads to fewer and fewer choices and finally to the homogeneity of global corporatization.

It is our job as activists to clarify the choice by revealing the nature of the system and articulating the alternatives. Will it be democracy or global corporate rule? Will we be subsumed into a fossil fuel-addicted global economy or will we build vibrant sustainable local economies? Which will win out, ecological sanity or pathological capitalism? Will it be the corporate globalization of economics and control or a people's globalization of ideas, creativity, and autonomy? Democracy versus corporate rule. Ecology versus pollution. Life versus the doomsday economy. Hope versus extinction.

Framing the Debate

One of the biggest pitfalls activists face to effectively articulate the values crisis is that the category of protester has been constructed to be highly marginal by the establishment. Within the pathological logic of corporate capitalism, dissent is delegitimized to be unpatriotic, impractical, naive, or even insane. Unfortunately, radicals are all too often complicit in our own marginalization by accepting this elite depiction of ourselves as the fringe.

The reality is that the elite policy writers and corporate executives who think the world can continue on with unlimited economic growth in a finite biological system are the wackos, not us. We are not the fringe. We can frame the debate. In fact, as Paul Ray's research has shown us, a sizable percentage of the population already shares our commitment to cultural transformation, and all we need to do is reach them.

The significance of the recent mass actions against corporate globalization has not been tactics. Movements aren't about tactics -- take this street corner, blockade that corporate office -- movements are about ideas. Movements are about changing the world. When we say a better world is possible, we mean it. We want a world that reflects basic life-centered values. We've got the vision and the other side doesn't. We've got biocentrism, organic food production, direct democracy, renewable energy, diversity, people's globalization, and justice. What have they got? Styrofoam? Neoliberalism? Eating disorders? Designer jeans, manic depression, and global warming?

In a context where the elites hold so much power, almost all our actions are by necessity symbolic. Accepting this can be one of our greatest strengths and help us realize that the most important aspects of our actions are the messages they project into mass culture. We must exploit the power of narrative structure to weave our ideas and actions into compelling stories. Inevitably, our broadest constituency will begin their interaction with new ideas as spectators. Thus, our campaigns and actions must tell inclusive, provocative stories that create space for people to see themselves in the story. We must tell the story of the values crisis. Our stories must make people take sides -- are you part of the

sickness or are you part of the healing? Are you part of the life-affirming future or are you part of the doomsday economy?

The first step is to separate dissent from the self-righteous tone that many people associate with protest. This tone can be particularly strong in activists from privileged backgrounds who are invested in visible "defection" as a way to validate their resistance. These politics of defection by their very nature create obstacles to communicating with the mainstream and frequently rely on symbols of dissent and rebellion that are already marginalized.

We need new symbols of inclusive resistance and transformation. We need a better understanding how to create effective memes[17] -- self-replicating units of information and culture -- to convey the values crisis. Memes are viral by nature, they move easily through our modern world of information networks and media saturation. We need to be training ourselves to become "meme warriors"[18] and to tell the story of values crisis in different ways for different audiences. We must get a better sense of who our audiences are, and target our messages to fit into their existing experiences.

We need to be media savvy and use the corporate propaganda machine. Not naively as an exclusive means of validating our movements, but as a tool of information self-defense to oppose the information war being waged against us. The corporate media is another tool we can use to name the system and undermine the grip of the dominant mythology. While we play at spin doctoring, we simultaneously need to promote media democracy and capitalize on the alternative and informal media and communication networks as a means to get our message out. Our movements must become the nervous systems of an emerging transformative culture. It's essential that we frame our ideas in such a way that as people wake up to the crisis they have the conceptual tools to understand the systemic roots of the problem. Over the next decade as the global crisis becomes more visible we won't have to do much to convince people about the problem. Rather, our job will be to discredit the elite's Band-Aid solutions and build popular understanding of the need for more systemic solutions.

Whether we are talking about biological contamination, financial collapse, or nuclear meltdowns, if we haven't framed the issue in advance, even the most dramatic breakdowns in the system can be "crisis-managed" away without alerting the public to the system's fundamental failings. But if we do the work to challenge the control mythology and undermine the flawed assumptions, then people will know whom to blame. As we build a public awareness of the values crisis it helps shift the debate away from inadequate reforms and toward redesigning the global system.

This is the strategy of leap-frogging, or framing our issues in such a way that they force the public debate to "leap" over limiting definitions of the problem and elite quick-fixes to embrace systemic solutions. For example, instead of debating how many parts per million of pollution regulatory agencies should allow in our drinking water, we can challenge the right of industrial interests to poison us at all. An effective framing forces

questions to be asked about the upstream polluters -- do we need their product? If so, how can we make it in a way that doesn't pollute? In order to successfully leap-frog colonized imaginations and entrenched power-holders, we must have the skill and courage to articulate real solutions that avoid concessions that dead-end in inadequate reforms.

It is essential that as the ecological crisis becomes self-evident we are building mass awareness of the system's design flaws. As we become more effective at leap-frogging the elite framing of problems, we can prepare people to accept the dramatic changes that will be necessary to make another world possible.

There are any number of macro issues that when framed correctly can help us name the system. Global warming, commodification of basic human needs from health care to water, the rate of technological change, systemic racism, the spread of genetic pollution, ongoing violence against women -- these are just a few examples that can tell the story of the values crisis. The challenge is not what issue we work on but how we avoid becoming trapped in the limiting framework of single-issue politics.

Direct Action at the Point of Assumption

Direct action -- actions that either symbolically or directly shift power relations -- is an essential transformative tool. Direct action can be both a tactic within a broader strategy or a political ethic of fundamental change that defines all one's actions. Every direct action is part of the larger story we are retelling ourselves about the ability of collaborative power to overcome coercive power.

As we endeavor to link systemic change with tangible short-term goals we must seek out the points of intervention in the system. These are the places where when we apply our power -- usually through revoking our obedience -- we are able to leverage change.

Direct action at the point of production was one of the original insights of the labor movement. Labor radicals targeted the system where it was directly affecting them and where the system was most vulnerable. From wildcat strikes to sabotage, slowdowns, and factory occupations, point-of-production actions helped promote the dignity and rights of working people.

Modern frontline resistance movements often target the system at the point of destruction. We become the frontline resistance by placing our bodies in the way of the harm that is happening. Whether it's plugging the effluent pipes that dump poison on a neighborhood, forest defenders sitting in trees marked for cutting, or indigenous peoples blocking road-building into their ancestral homelands, direct action at the point of destruction embodies values crisis. It polarizes the debate in an effort to attract the spotlight of public attention to a clear injustice. But, tragically, the point of destruction is oftentimes far from the public eye, and the values confrontation is made invisible by distance, imbedded patterns of bias, or popular ignorance. Frequently, the impacted

communities have little political voice, so in order to provide support we must find other points of intervention.

Inspiring point-of-consumption campaigns have been used by many movements as a way to stand in solidarity with communities fighting at the point of destruction. This is the realm of consumer boycotts, attacks on corporate brand names, and other campaigns that target the commercial sector as a way to shut down the market for destructive products. Activists have confronted retailers selling sweatshop products and forced universities to cancel clothing contracts. Likewise, forest activists have forced major chains to stop selling old-growth forest products. Attacking the point of consumption expands the arena of struggle to mobilize consumers made complicit in the injustice of the globalized economy by making them more aware of their own purchasing decisions. These strategies can be based on a very accessible notion of "ethical shopping" or a more profound rejection of the consumer identity altogether.

The point of decision has always been a common and strategic venue for direct action. Whether its taking over a slumlord's office, a corporate boardroom, or the state capital, many successful campaigns have used direct action to put pressure on the decision makers they are targeting. Much of the mass action organizing of the past few years has been largely aimed at redefining popular perceptions of the point of decision. The actions at WTO and World Bank meetings, G8 summits and free trade negotiating sessions have helped reveal the corporate takeover by showing that it is these new institutions of corporate rule that have usurped decision making power.

All of these points of intervention in the system are important, and the best strategies unite efforts across them. As the global financial sector has increasingly become the "operating system" for the planet, the pathological logic of doomsday economics has replaced specific points of decision in driving the corporate takeover. We aren't just fighting acts of injustice or destruction but rather we are fighting a system of injustice and destruction. In recognizing this we must expand our efforts to intervene in physical space, complementing them with similar initiatives in cultural and intellectual space. How can we sidestep the machine and challenge the mentality behind the machine? In other words, we need to figure out how to take direct action at the point of assumption.

Targeting assumptions -- the framework of myths, lies, and flawed rationale that normalize the corporate takeover -- requires some different approaches from actions at the other points of intervention. Point-of-assumption actions operate in the realm of ideas and the goal is to expose pathological logic, cast doubt, and undermine existing loyalties. Successful direct action at the point of assumption identifies, isolates, and confronts the big lies that maintain the status quo. A worthy goal for these types of actions is to encourage the most important act that a concerned citizen can take in an era defined by systematic propaganda -- questioning!

Direct action at the point of assumption is a tool to decolonize people's revolutionary imaginations by linking analysis and action in ways that reframe issues and create new

political space. Whether we're deconstructing consumer spectacles, exposing the system's propaganda, or birthing new rhetoric, we need actions that reveal the awful truth -- that the intellectual underpinnings of the modern system are largely flawed assumptions. Direct action at the point of assumption is an effort to find the rumors that start revolutions and ask the questions that topple empires.

The first action of the radical ecology network Earth First! is a great example of direct action at the point of assumption. In 1981, at a time when many wilderness preservation groups were fighting the construction of new dams, Earth First! did a symbolic "cracking" of Glen Canyon Dam by unfurling a 300-foot-long plastic wedge from the top of the dam, creating an image of a fissure down the dam's face.[20] This simple symbol sent a powerful message that rather than just stopping new dams, wilderness advocates should be calling for the removal of big dams and the rewilding of dammed rivers. Within the industrial paradigm of dominating nature, the question of removing a megadam was an unthinkable thought -- it was beyond the realm of imagination. The "cracking" action, however, challenged that assumption and created a new political space and a powerful image to forward that agenda. Two decades later, in the late nineties, the unthinkable thought had rippled right up to the power-holders and the U.S. government actually began removing dams.

Likewise, as the anti-car movement has grown, groups like Reclaim the Streets have taken effective direct actions at the point of assumption to make the idea of car-free cities imaginable. Reclaim the Streets groups showed what a better world could look like with actions that occupy car-clogged streets and transform them into people-friendly spaces with music, festivity, comfy furniture, and in some cases even grass and plants. Similarly, activists around the world have taken creative "Buy Nothing Day" actions to attack the assumptions of consumerism by calling for a twenty-four-hour moratorium on consumer spending on the busiest shopping day of the year. This simple idea, often popularized using ridicule and humorous spectacle, has led to many successful efforts to define consumerism itself as an issue.

Direct action at the point of assumption has taken many forms -- creating new symbols, embodying alternatives, or sounding the alarm. The Zapatista ski mask is a well-known example of a symbol that functioned as direct action at the point of assumption. The ski masks worn by the Zapatista insurgents and particularly their spokesman Subcomandante Marcos, created a symbol for the invisibility of Mexico's indigenous peoples. Marcos has eloquently written of the irony that only with the ski masks on -- the symbol of militant confrontation -- was the government able to see the indigenous peoples it had ignored for so long.[21]

In Argentina the cacerolazos -- the spontaneous mass banging on cacerolas (saucepans) -- is a tactic that has helped topple several governments since the popular uprising began in December 2001. The simple, inclusive direct action of banging a saucepan has created a dramatic new space for people from many different backgrounds to unite in resisting

neoliberalism and structural adjustment. It broke the assumption that people will simply accept the actions of a government that ignores them.[22]

Direct action at the point of assumption provides us with many new opportunities to expand the traditional political arenas because it is less reliant on specific physical space than other points of intervention. This gives us the opportunity to choose the terms and location of engagement. Effective point-of-assumption actions can transform the mundane into a radical conversation starter. For instance, putting a piece of duct tape across a prominent logo on your clothing can invite a conversation about corporate commodification.

Media activist James John Bell writes about "Image Events," events whether actions, images, or stories that "simultaneously destroy and construct [new] meaning." Image events either replace existing sets of symbols or redefine their meaning through the "disidentification" of humor or shock.[23] A simple application of this concept can be seen in what Adbuster magazine's founder Kalle Lasn has dubbed "culture jamming" to describe methods of subverting corporate propaganda by juxtaposing new images or coopting slogans.[24] For instance, when McDonald's hyperfamiliar golden arches are overlaid with images of starving children or Chevron's advertising slogan is rewritten to say "Do people kill for oil?" the power of corporate images are turned back upon themselves. This type of semiotic aikido exploits the omnipresence of corporate advertising to rewrite the meaning of familiar symbols and tell stories that challenge corporate power. These skills have been artfully applied in billboard liberations, guerrilla media campaigns, and creative actions, but unfortunately they often remain in a limited media realm. We need to expand guerrilla meme tactics to connect with long-term strategies to build grassroots power. The reliance of many megacorporations on their branding has been widely acknowledged as an Achilles' heel of corporate power. Indeed, effective grassroots attacks on corporate logos and brand image have forced corporations to dump multimillion-dollar advertising campaigns and sometimes even concede to activists' demands. However, not only are there many powerful industries that do not depend on consumer approval but we no longer have time to go after the corporations one at a time. Our movements need to contest the corporate monopoly on meaning. We must create point of assumption actions that go beyond merely jamming the control mythology to actually substituting transformative, life-affirming stories. Culture jamming has largely been applied like a wrench to disable the brainwashing infrastructure of corporate consumerism. We must supplement the wrench with the seed by planting new, transformative stories that use the information-replicating networks of modern society to grow and spread. Our actions must create image events and launch designer memes with the power to supersede the controlling mythologies of consumer culture, the American empire, and pathological capitalism.[25]

Concerted direct action at the point of assumption in our society could be an effort to draw attention to the design errors of the modern era and encourage widespread disobedience to oppressive cultural norms. We need to plot open attacks on the symbolic order of anti-life values. We need easily replicable actions, new symbols, and contagious

memes that we can combine with grassroots organizing and alternative institution building to expand the transformative arena of struggle.

What would this look like? What are the big lies and controlling myths that hold corporate rule in place? Where are the points of assumption? How can we exploit the hypocrisy between the way we're told the world works and the way it actually works in order to name the system, articulate the values crisis, and begin decolonizing the collective imagination? These are all questions for our movements to explore together as we challenge ourselves to be pragmatic idealists, calculating provocateurs, and revolutionary dreamers.

Case Study: The San Francisco Uprising (THIS CASE STUDY IS OPTIONAL)

The Bush administration's invasion of Iraq was met with massive resistance in the United States and around the world. In particular, the response in San Francisco was inspiring -- 20,000 people engaged in mass nonviolent direct action to shut down the financial district. Corporations invested in the mass destruction business (like Bechtel, Citibank, and the Carlyle Group) had their offices blockaded as did a military recruiting station, the British consulate, and a federal office building. Using tactics ranging from lockdowns to mobile blockades and critical mass bike rides, Bay Area residents transformed the usually car-clogged consumption zone into a living statement of hope and life-affirming resistance to Bush's war for empire. Over the course of the four business days after the invasion began, 2,600 people were arrested for engaging in acts of protest and resistance.

Although this uprising was decentralized and highly organic it grew out of a foundation of organizing laid by an affinity-group-based mobilization called Direct Action to Stop the War (DASW). For the preceding two months, DASW had organized the uprising's launching pad through a weekly spokescouncil, a web site (www.actagainstawar.org), and the simple notion that a rational response to an illegal and unjust war for empire would be a mass direct action shutting down the financial district.

The real success of the action came not only from the fact that several thousand people were preorganized into affinity groups, but that tens of thousands of people joined in on the day of the action. One of the reasons that so many people joined the action was that it was timed to harness a predictable mass psychic break -- a point where the unfolding of events shatters people's illusions that the system reflects their values (such as justice, democracy, peace). A psychic break is a massive point of intervention in the system's assumption of obedience, when people are uniquely open to new actions. In an infamously progressive city like San Francisco there was a predictable antiwar majority but a common framework was needed to facilitate action and make opposition visible.

DASW's work to build this framework for popular resistance was aided by a strategy of telling the future. Telling the future (similar to the "scenario planning" used by the Pentagon and multinational corporations) is a method of manifesting a specific outcome by normalizing a possible scenario. Advertisers have long known that the best way to get

people to do something (like buy their product) is to have them take action in their head first. Hence much of advertising is designed to help people imagine themselves buying a product -- to normalize a specific commercial scenario. Strategies that tell the future can use some of the same principles to unify people around a common goal and vision to literally self-organize a specific future through building collective belief. DASW organizers challenged the mass media narrative of normalized passivity by promoting an alternative story where if Bush invaded Iraq, residents would rise up in a nonviolent insurrection and shut down the financial district.

The future uprising was foretold with a series of foreshadowing events ranging from a high-profile press conference to an open letter to city residents to preemptive actions in the financial district, including a shut down of the Pacific Stock Exchange in which eighty people were arrested. All of this outreach, organizing, and media work was successful in the goal of promoting DASW's website and the action meeting spot, including getting it printed on the front page of newspapers and mentioned on major radio and television stations.

Likewise, in creating a public image of the action, DASW focused on a values-based critique that worked to mainstream the concepts of non-cooperation and civil disobedience. The DASW web site and kick-off press conference emphasized the diversity of participation by featuring endorsements from leaders of a cross-section of Bay Area communities -- queer, labor, faith, people of color, veterans, seniors, even the former CEO of the Pacific Stock Exchange. Without sacrificing the opportunity to put out a systemic analysis, the organizing appealed to mainstream values -- democracy, sense of security, justice, belief in international law, patriotism -- and used them to leverage opposition to the invasion of Iraq. As a result the streets were flooded with people from different walks of life. The combination of effectively telling the future and articulating a values-based analysis had reached a cross-section of American society who had never engaged in direct action before.

This type of inclusive mass organizing may stretch the comfort zone of many radicals; however, it has great potential to exploit some of the growing fault lines in American society. Bush's naked imperial agenda is challenging a lot of Americans' sense of national identity as an international beacon of democracy and justice. Regardless of the fact that much of America's national story has always been a hypocritical mythology, there is an incredible opportunity for activists to lay claim to widely held values like security, democracy, and national pride and direct these energies into "imploding" empire. Let's ask ourselves how our resistance can galvanize antiwar sentiments into a deeper movement for fundamental change that articulates the values crisis -- the disconnect between the values of empire and the values that ordinary Americans hold. In San Francisco the strategy worked well enough that 20,000 people took to the streets -- with more refinement and widespread application, who knows what might be possible?

Beware the Professionalization of Social Change (RESUME READING)

The worst thing that can happen to our movements right now is to settle for too little.

But tragically that is exactly what is happening. We are largely failing to frame the ecological, social, and economic crisis as a symptom of a deeper values crisis and a pathological system. Thus, many of the modest visions of social change being put forward seem incapable of even keeping pace with the accelerating global crisis, let alone providing true alternatives to the doomsday economy.

Too many of our social change resources are getting bogged down in arenas of struggle that can't deliver the systemic shifts we need. Most of the conventional venues for political engagement -- legislation, elections, courts, single-issue campaigns, labor fights -- have been so coopted by elite rule that it's very difficult to imagine how to use them for strategies that name the system, undermine the control mythology, or articulate values crisis from within their limited parameters.

One of the most telling symptoms of our colonized imaginations has been the limited scope of social change institutions. Most social change resources get directed toward enforcing inadequate regulations, trying to pass watered-down legislation, working to elect mediocre candidates, or to win concessions that don't threaten the corporate order. One of the main reasons that so many social change resources get limited to the regulatory, electoral, and concessionary arenas is the fact that much of social change has become a professionalized industry. The NGO -- nongovernmental organization -- a term made popular by the United Nations policy discussion process, has become the most familiar social change institution. These groups are frequently made up of hard-working, underpaid, dedicated people, and NGOs as a group do a great deal of important work. However, we must also acknowledge that generally the explosion of NGOs globally is a loose attempt to patch the holes that neoliberalism has punched in the social safety net. As government cedes its role in public welfare to corporations, even the unlucrative sectors have to be handed off to someone. A recent article in the Economist revealingly explains the growth of NGOs as "... not a matter of charity but of privatization." [26]

My intention is not to fall into the all-too-easy trap of lumping the thousands of different NGOs into one dismissable category but rather to label a disturbing trend, particularly among social-change NGOs. Just as service-oriented NGOs have been tapped to fill the voids left by the state or the market, so have social-change NGOs arisen to streamline the chaotic business of dissent. Let's call this trend NGOism, the belief -- sometimes found among professional "campaigners" -- that social change is a highly specialized profession best left to experienced strategists, negotiators, and policy wonks. NGOism is the conceit that intermediary organizations of paid staff, rather than communities organizing themselves into movements, will be enough to save the world.

This very dangerous trend ignores the historic reality that collective struggle and mass movements organized from the bottom up have always been the springboard for true progress and social change. The goal of radical institutions -- whether well-funded NGOs or gritty grassroots groups -- should be to help build movements to change the world. But

NGOism institutionalizes the amnesia of the colonized imagination and presents a major obstacle to moving into the post-issue activism framework. After all, who needs a social movement when you've got a six-figure advertising budget and "access" to all the decision makers?

A professional NGO is structured exactly like a corporation, down to having an employee payroll and a board of directors. This is not an accident. Just like their for-profit cousins, this structure creates an institutional self-interest that can transform an organization from a catalyst for social change into a self-perpetuating entity. NGOism views change in reference to existing power relations by accepting a set of rules written by the powerful to ensure the status quo. These rules have already been stacked against social change. NGOism represents institutional confusion about the different types of power and encourages overdependence on strategies that speak exclusively to the existing powers -- funding sources, the media, decision makers. As a consequence, strategies often get locked into the regulatory and concessionary arenas -- focused on "pressure" -- and attempt to redirect existing power rather than focusing on confronting illegitimate authority, revealing systemic flaws, and building grassroots power.

The mythology of American politics as populist or democratic is rapidly being undermined by the blatant realities of corporate dominance. As people's confidence in the facades of popular rule (like voting, lobbying, and the regulatory framework) has waned, more and more campaigns are directly confronting destructive corporations. This is an essential strategy for revealing the decision making power that corporations have usurped, but unfortunately most of these NGO-led efforts to confront individual destructive corporations are failing to articulate a holistic analysis of the system of corporate control.

This is an extremely dangerous failure because in pursuing concessions or attempting to redirect corporate resources we risk making multinational corporations the agents of solving the ecological crisis. This is a flawed strategy since by their very nature corporations are incapable of making the concessions necessary to address the global crisis. There is no decision-maker in the corporate hierarchy with the power to transform the nature of the corporate beast and confront its identity as a profit-making machine. The CEO who has an epiphany about the need to redefine her corporation as a democratic institution that looks beyond the limited fiduciary interests of shareholders will find herself on the wrong side of a century of corporate law. We need to avoid the temptation to accept concessions that legitimize corporate control and obscure the fundamental democracy issues underlying the global crisis.

Too often, political pragmatism is used as an excuse for a lack of vision. Pragmatism without vision is accepting the rules that are stacked against us while vision without pragmatism is fetishizing failure. The question shouldn't be what can we win in this funding cycle but rather how do we expand the debate to balance short- and long-term goals? Like a healthy ecosystem, our movements need a diversity of strategies. We need to think outside the box and see what new arenas of struggle we can explore.

This is not to say that corporate campaigns and winning concessions is merely "reformist" and therefore not important. The simplistic dichotomy of reform versus revolution often hides the privilege of "radicals" who have the luxury of refusing concessions when it's not their community or ecosystem that is on the chopping block. A more important distinction is which direction is the concession moving toward? Is it a concession that releases pressure on the system and thereby legitimizes illegitimate authority? Or is it a concession that teaches people a lesson about their collective power to make change and therefore brings us closer to systemic change?

NGOism creates ripe conditions for going beyond mere ineffectiveness and into outright complicity with the system. Time and time again we've seen social-change NGOs grow to become a part of the establishment and then be used as a tool to marginalize popular dissent by lending legitimacy to the system. Whether it's the World Wildlife Fund giving a green seal of approval to oil companies or the American Cancer Society's downplaying of environmental pollution's role in cancer,[27] it's clear that NGOs can become an obstacle to transformative change.

The professionalization of social change requires extensive resources, and it's obvious that NGO agendas can be shaped by their funding needs. Whether reliant on a membership base or institutional funders, NGOs are often forced to build a power base through self-promotion rather than self-analysis. Not only does this dilute their agendas to fit within the political comfort zone of those with resources, it disrupts the essential process of acknowledging mistakes and learning from them. This evolutionary process of collective learning is central to fundamental social change, and to have it derailed by professionalization threatens to limit the depth of the change that we can create.

When a system is fundamentally flawed there is no point in trying to fix it -- we need to redesign it. That is the essence of the transformative arena -- defining issues, reframing debates, thinking big. We must create the political space to harness the awareness of the increasingly obvious global crisis into a desire for real change toward a democratic, just, and ecologically sane world.

Our movements must evolve past mere mobilizing and into real transformative organizing. Transformative organizing is more than just making the protest louder and bigger. It's the nuts-and-bolts business of building alternatives on a grassroots level, and creating our own legitimacy to replace the illegitimate institutions of corporate society. Real transformative organizing gives people the skills and analysis they need to ground the struggle to reclaim our planet in both the individual and the structural arenas -- the creation of new identities and the transformation of global systems.

It is essential that we don't waste all our energy just throwing ourselves at the machine. Resistance is only one piece of the social change equation. It must be complemented by creation. Movements need institutions that can be the hubs to help sustain our momentum for the long haul. There are definitely NGOs that play this role well, we just have to

ensure that NGOism doesn't infect them with limiting definitions of specialization and professionalism.

We have to plant the seeds of the new society within the shell of the old. Exciting work is being done around the concept of dual-power strategies. These are strategies that not only confront illegitimate institutions, but simultaneously embody the alternatives, thereby giving people the opportunity to practice self-governance and envision new political realities. Examples of inspiring dual-power strategies are taking place across the world, particularly in Latin America. From indigenous autonomist communities in Mexico to the landless movement in Brazil to Argentina's autoconvocados (literally, "the self-convened ones"), peoples' movements are resisting the corporate takeover of their lives by defiantly living the alternatives.[28] In the creation of these alternatives -- the holistic actions of community transformation that go far beyond any of the limiting boundaries of professionalized social change -- we see a vision of direct action at the point of assumption, actions that reveal new possibilities, challenge the assumptions of the corporate monoculture and create infectious, new political spaces.

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Toward a Politics of Reality

Reality is that which is.

The English word "real" stems from a word which meant regal, of or pertaining to the king.

"Real" in Spanish means royal.

Real property is that which is proper to the king.

Real estate is the estate of the king.

Reality is that which pertains to the one in power,
Is that over which he has power, is his domain, his
Estate, is proper to him.

The ideal king reigns over everything as far as the
Eye can see. His eye. What he cannot see is not
Royal, not real.

He sees what is proper to him.

To be real is to be visible to the king.

The king is in his counting house.

-- Marilyn Frye, "The Politics of Reality"

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We can fight the doomsday economy by devoking the apocalypse with visions of a life-affirming future. In doing so we lay claim to a radical's best ally -- hope. But our hope must not be based on the naivete of denial. Rather, our hope must be a signpost, a reminder of the potential of our struggles. We must not position hope as some mythic endpoint of struggle but rather, learn to carry it with us as a blueprint for our daily efforts.

Feminist author Marilyn Frye writes about reality from the perspective of a lesbian fighting to "exist" within an oppressive heterosexist culture for which the idea of a woman who is not sexually dependant upon men is unimaginable. Her poem reminds us that reality is constructed, and that those in power get to decide who or what is "real." Or, in the words of the 1980s disco-industrial band My Life with the Thrill Kill Kult: "Reality' is the only word in the English language that should always be used in quotes."

Frye's poem uses the etymology of the word reality to expose the flawed assumptions that shape the dominant cultural lens. The king's counting house is the origin of today's corporate-driven doomsday economy. A "reality" that has colonized our minds to normalize alienation from nature, conquest, and patriarchal hierarchies. A "reality" based on the censorship of our history of collective struggle that makes us think rugged individualism is the only tactic for resistance.

"Reality" is the lens through which we see the world. If we want to create a different world we're going to need to create some new lenses. We can begin by understanding that the values that currently underlie the global system didn't win out because they are time-tested, democratically supported, or even effective. This "reality" is a product of the naked brutality of European colonization and the systematic destruction of the cultural and economic alternatives to our current pathological system.

The struggle to create political space for a truly transformative arena of social change is the fight to build a new collective reality. Our last (or is it first?) line of defense to the spreading consumer monoculture is the struggle to decolonize our minds and magnify the multitude of different "realities" embedded in the planet's sweeping diversity of cultures, ecosystems, and interdependent life forms.

At the center of these efforts must be the understanding that the ecological operating systems of the biosphere represent an overarching politics of reality. If we want to talk about reality in the singular, outside of its conceptual quotation marks, then we must talk about ecological reality -- the reality of interdependence, diversity, limits, cycles, and dynamic balance. A politics of reality recognizes that ecology is not merely another

single issue to lump onto our list of demands; rather, ecology is the larger context within which all our struggles take place. A politics of reality is grounded in the understanding that the ecological collapse is the central and most visible contradiction in the global system. It is an implicit acknowledgment that the central political project of our era is the rethinking of what it means to be human on planet earth.

We have to confront the cancer and pull the dooms-day economy out of its suicidal nosedive. The move toward a politics of reality is the essence of a fight for the future itself. Indian writer and activist Vandana Shiva said it eloquently in her speech at the World Summit on Sustainable Development countersummit in August 2002: "There is only one struggle left, and that is the struggle for survival."

Ecology must be a key ingredient in the future of pan-movement politics. But to achieve this, we must ensure that earth-centered values don't get appropriated by white, middle-class messengers and become artificially separated from a comprehensive critique of all forms of oppression. A global ecology movement is already being led by the communities and cultures most impacted by the doomsday economy, from international campesino movements to urban communities resisting toxic poisoning to the last indigenous homelands. Those of us dreaming of more global North counterparts to these earth-centered movements have much to learn from listening to the voices of frontline resistance.

The Western Shoshone people -- the most bombed nation on earth who have survived half a century of U.S. nuclear colonialism on their ancestral lands in what is now called Nevada -- have mobilized under the banner, "Healing Global Wounds." This inspiring slogan reminds us that despite the horrors of brutality, empire, and ecological catastrophe the strongest resistance lies in the ability to think big.

In facing the global crisis, the most powerful weapon that we have is our imagination. As we work to escape the oppressive cultural norms and flawed assumptions of the corporate system we must liberate our imagination and articulate our dreams for a life-affirming future. Our actions must embody these new "realities" because even though people might realize they are on the Titanic and the iceberg is just ahead, they still need to see the lifeboat in order to jump ship. It is by presenting alternatives that we can help catalyze mass defections from the pathological norms of modern consumer culture.[29] Our job is to confront the sickness while articulating the alternatives, both ancient and new. Our true strength lies in the diversity of options presented by earth-centered values, whether we find the alternatives in the wisdom of traditional cultures, local economies, spiritual/community renewal, or ecological redesign. As we decolonize our own revolutionary imagination we will find new political frameworks that name the system and articulate the values crisis. We can base our work in an honest assessment of our own privilege, and a commitment to healing historic wounds. We can imagine a culture defined by diversity that promotes revolutionary optimism over nihilism and embraces collective empowerment over individual coercion. Not only can we redefine what is possible, but we must!

We are already winning. Life is stronger than greed. Hope is more powerful than fear. The values crisis is in full swing, and more and more people are turning their back on the pathological values of the doomsday economy. The global immune system is kicking in and giving momentum to our movements for change. Call it an Enlightenment. Call it a Renaissance. Call it a common-sense revolution. The underlying concepts are obvious. As the saying goes -- for a person standing on the edge of a cliff, progress must be defined as a step backward.

Imagination conjures change. First we dream it, then we speak it, then we struggle to build it. But without the dreams, without our decolonized imaginations, our efforts to name and transform the system will not succeed in time.

I take inspiration from a slogan spray-painted on the walls of Paris during the springtime uprising of 1968: "Be realistic. Demand the Impossible!" The slogan is more timely now than ever because the king can't stay in his counting house forever. And then it will be our turn....

(END)

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These ideas are works in progress. Feedback of all sorts (including scathing criticism) is welcome. Many of the concepts discussed in this essay have been translated into training and strategy tools through the work of the smartMeme Strategy and Training Project. Anyone interested in expanding upon or collaborating to implement some of these strategies are encouraged to contact the author at patrick@smartmeme.com or check out www.smartmeme.com. Join the fun! Start your own laboratory of resistance!

APPENDIX: A pragmatic dreamer's glossary

ABCNNBCBS -- the increasingly blurred brand names for the same narrow stream of U.S. corporate-filtered mass media. This is the delivery system for the advertising product that giant media corporations sell to the general public. This process used to occur primarily through overt advertising. Increasingly, however, it has become a complex web of cross-marketing, branding, and self-promotion among different tentacles of the same media empires.

advertising -- the manipulation of collective desire for commercial interests. Over the last twenty years as it has grown to nearly a \$200 billion industry it has become the propaganda shell and dream life of modern consumer culture. (See control mythology.)

articulating values crisis -- a strategy in which radicals lay claim to common-sense values and expose the fact that the system is out of alignment with those values.

controlMeme -- a meme used to marginalize, coopt, or limit the scale of social change ideas by institutionalizing a status-quo bias into popular perception of events. The type of memes that RAND Corporation analysts and Pentagon information warfare experts spend countless hours and millions of dollars designing.

control mythology -- the web of stories, symbols, and ideas that defines the dominant culture's sense of normal, limits our ability to imagine social change, and makes people think the system is unchangeable.

confirmatory bias -- psychological concept proven in studies which show that people are more likely to accept/believe new information if it sounds like something they already believe.

defector syndrome -- the tendency of radicals to self-marginalize by exhibiting their dissent in such a way that it only speaks to those who already share their beliefs.

direct action at the point(s) of assumption -- actions whose goal is to reframe issues and create new political space by targeting underlying assumptions.

earth-centered -- a political perspective within which people define themselves and their actions in the context of the planet's ecological operating systems, biological/cultural diversity, and ongoing efforts to recenter human society within the earth's natural limits/cycles. An emerging term used to draw links and build alliances between ecological identity politics, land-based struggles, indigenous resistance, earth spirituality, agrarian folk wisdom, and visions of sustainable, ecologically sane societies both past and future. A politicized acceptance of the sacredness of living systems.

global crisis -- the present time in the history of planet earth, characterized by the systematic undermining of the planet's life support systems through industrial extraction, unlimited growth, the commodification of all life, and emergence of global corporate rule. Symptoms include: accelerating loss of biological and cultural diversity, the deterioration of all ecosystems, the destabilization of global ecology (climate change, soil erosion, biocontamination, etc.), growing disparities between rich and poor, increased militarization, ongoing patterns of racism, classism, and sexism, and the spread of consumer monoculture. Part of the endgame of 200 years of industrial capitalism, 500 years of white supremacist colonization, and 10,000 years of patriarchal domination.

image event -- an experience, event, or action that operates as a delivery system for smartMemes by creating new associations and meanings.

meme -- (pronounced meem) a unit of self-replicating cultural transmission (i.e., ideas, slogans, melodies, symbols) that spreads virally from brain to brain. Word coined by evolutionary biologist Richard Dawkins in 1976 from a Greek root meaning "to imitate," to draw the analogy with "gene." "A contagious information pattern" -- Glenn Grant.

movement -- a critical mass of people who share ideas, take collective action, and build alternative institutions to create social change.

points of intervention -- a place in a system, be it a physical system or a conceptual system (ideology, cultural assumption, etc.) where action can be taken to effectively interrupt the system. Examples include point of production (factory), point of destruction (logging road), point of consumption (chain store), point of decision (corporate HQ), point of assumption (culture/mythology), and point of potential (actions which make alternatives real).

political space -- created by the ability of an oppositional idea or critique of the dominant order to manifest itself and open up new revolutionary possibilities. The extent to which our imaginations are colonized is the extent to which we lack political space and can't implement or even suggest new political ideas.

psychic break -- the process or moment where people realize that the system is out of alignment with their values.

psycho-geography -- the intersection of physical landscape with cultural and symbolic landscapes. A framework for finding targets for direct action at the point of assumption.

radical -- a person committed to fundamental social change who believes we must address the roots of the problem rather than just the symptoms.

smartMeme -- a designer meme that injects new infectious ideas into popular culture, contests established meaning (controlMemes), and facilitates popular rethinking of assumptions.

subverter -- an effective radical who works within the logic of the dominant culture to foster dissent, mobilize resistance, and make fundamental social change imaginable.

tipping point -- epidemiological term used to describe the point when a disease becomes an epidemic. Popularized by author Malcolm Gladwell to apply to the point where a new idea hits a critical mass of popular acceptance.

values -- the social principles, goals, or standards held or accepted by an individual, group, or society. The moral codes that structure people's deepest held beliefs.

values crisis -- the disconnect between common-sense values (justice, equality, democracy, ecological literacy) and the pathological values that underlie the global corporate system.

values shift -- a recognition that the global crisis is the expression of pathological values that we need to change. An area of extreme difficulty to organize since people's values are very ingrained and the effective language to communicate in the values arena is often

appropriated by powerful reactionary traditions and institutions (government, organized religion, patriarchal family, etc.).

Xerxes -- ancient Persian emperor who, despite having the world's largest military force, overextended himself and was defeated by the unity and creativity of the Greeks, starting a long decline that led to the end of Persian dominance. A conceptual archetype for the fall of all empires. America take note.

THOUGHTS AND REFLECTIONS

What would you focus on if you were an activist for sustainability and food security, and why?

Which of the solutions we presented are most compelling to you, and why?

Further Reading



Here we will post articles that perplexed us and questions we had as we were learning this new topic.

Here you will find an article that answers:

- Why do people say eating meat is bad?
 - "Rethinking the Meat-Guzzler by Mark Bittman"
- What era are we in? – An important term to learn
 - The Anthropocene

RETHINKING THE MEAT-GUZZLER BY MARK BITTMAN JAN. 27, 2008

New York Times: http://www.nytimes.com/2008/01/27/weekinreview/27bittman.html?_r=2

A SEA change in the consumption of a resource that Americans take for granted may be in store — something cheap, plentiful, widely enjoyed and a part of daily life. And it isn't oil.

It's meat.

The two commodities share a great deal: Like oil, meat is subsidized by the federal government. Like oil, meat is subject to accelerating demand as nations become wealthier, and this, in turn, sends prices higher. Finally — like oil — meat is something people are encouraged to consume less of, as the toll exacted by industrial production increases, and becomes increasingly visible.

Global demand for meat has multiplied in recent years, encouraged by growing affluence and nourished by the proliferation of huge, confined animal feeding operations. These assembly-line meat factories consume enormous amounts of energy, pollute water supplies, generate significant greenhouse gases and require ever-increasing amounts of corn, soy and other grains, a dependency that has led to the destruction of vast swaths of the world's tropical rain forests.

Just this week, the president of Brazil announced emergency measures to halt the burning and cutting of the country's rain forests for crop and grazing land. In the last five months alone, the government says, 1,250 square miles were lost.

The world's total meat supply was 71 million tons in 1961. In 2007, it was estimated to be 284 million tons. Per capita consumption has more than doubled over that

period. (In the developing world, it rose twice as fast, doubling in the last 20 years.) World meat consumption is expected to double again by 2050, which one expert, Henning Steinfeld of the United Nations, says is resulting in a "relentless growth in livestock production."

Americans eat about the same amount of meat as we have for some time, about eight ounces a day, roughly twice the global average. At about 5 percent of the world's population, we "process" (that is, grow and kill) nearly 10 billion animals a year, more than 15 percent of the world's total.

Growing meat (it's hard to use the word "raising" when applied to animals in factory farms) uses so many resources that it's a challenge to enumerate them all. But consider: an estimated 30 percent of the earth's ice-free land is directly or indirectly involved in livestock production, according to the United Nation's Food and Agriculture Organization, which also estimates that livestock production generates nearly a fifth of the world's greenhouse gases — more than transportation.

To put the energy-using demand of meat production into easy-to-understand terms, Gidon Eshel, a geophysicist at the Bard Center, and Pamela A. Martin, an assistant professor of geophysics at the University of Chicago, calculated that if Americans were to reduce meat consumption by just 20 percent it would be as if we all switched from a standard sedan — a Camry, say — to the ultra-efficient Prius. Similarly, a study last year by the National Institute of Livestock and Grassland Science in Japan estimated that 2.2 pounds of beef is responsible for the equivalent amount of carbon dioxide emitted by the average European car every 155 miles, and burns enough energy to light a 100-watt bulb for nearly 20 days.

Grain, meat and even energy are roped together in a way that could have dire results. More meat means a corresponding increase in demand for feed, especially corn and soy, which some experts say will contribute to higher prices.

This will be inconvenient for citizens of wealthier nations, but it could have tragic consequences for those of poorer ones, especially if higher prices for feed divert production away from food crops. The demand for ethanol is already pushing up prices, and explains, in part, the 40 percent rise last year in the food price index calculated by the United Nations' Food and Agricultural Organization.

Though some 800 million people on the planet now suffer from hunger or malnutrition, the majority of corn and soy grown in the world feeds cattle, pigs and chickens. This despite the inherent inefficiencies: about two to five times more grain is required to produce the same amount of calories through livestock as through direct grain consumption, according to Rosamond Naylor, an associate professor of economics at Stanford University. It is as much as 10 times more in the case of grain-fed beef in the United States.

The environmental impact of growing so much grain for animal feed is profound. Agriculture in the United States — much of which now serves the demand for meat — contributes to nearly three-quarters of all water-quality problems in the nation's rivers and streams, according to the Environmental Protection Agency.

Because the stomachs of cattle are meant to digest grass, not grain, cattle raised industrially thrive only in the sense that they gain weight quickly. This diet made it possible to remove cattle from their natural environment and encourage the efficiency of mass confinement and slaughter. But it causes enough health problems that administration of antibiotics is routine, so much so that it can result in antibiotic-resistant bacteria that threaten the usefulness of medicines that treat people.

Those grain-fed animals, in turn, are contributing to health problems among the world's wealthier citizens — heart disease, some types of cancer, diabetes. The argument that meat provides useful protein makes sense, if the quantities are small.

But the “you gotta eat meat” claim collapses at American levels. Even if the amount of meat we eat weren’t harmful, it’s way more than enough.

Americans are downing close to 200 pounds of meat, poultry and fish per capita per year (dairy and eggs are separate, and hardly insignificant), an increase of 50 pounds per person from 50 years ago. We each consume something like 110 grams of protein a day, about twice the federal government’s recommended allowance; of that, about 75 grams come from animal protein. (The recommended level is itself considered by many dietary experts to be higher than it needs to be.) It’s likely that most of us would do just fine on around 30 grams of protein a day, virtually all of it from plant sources.

What can be done? There’s no simple answer. Better waste management, for one. Eliminating subsidies would also help; the United Nations estimates that they account for 31 percent of global farm income. Improved farming practices would help, too. Mark W. Rosegrant, director of environment and production technology at the nonprofit International Food Policy Research Institute, says, “There should be investment in livestock breeding and management, to reduce the footprint needed to produce any given level of meat.”

Then there’s technology. Israel and Korea are among the countries experimenting with using animal waste to generate electricity. Some of the biggest hog operations in the United States are working, with some success, to turn manure into fuel.

Longer term, it no longer seems lunacy to believe in the possibility of “meat without feet” — meat produced in vitro, by growing animal cells in a super-rich nutrient environment before being further manipulated into burgers and steaks.

Another suggestion is a return to grazing beef, a very real alternative as long as you accept the psychologically difficult and politically unpopular notion of eating less of it. That’s because grazing could never produce as many cattle as feedlots do. Still, said Michael Pollan, author of the recent book “In Defense of Food,” “In places where you can’t grow grain, fattening cows on grass is always going to make more sense.”

But pigs and chickens, which convert grain to meat far more efficiently than beef, are increasingly the meats of choice for producers, accounting for 70 percent of total meat production, with industrialized systems producing half that pork and three-quarters of the chicken.

Once, these animals were raised locally (even many New Yorkers remember the pigs of Secaucus), reducing transportation costs and allowing their manure to be spread on nearby fields. Now hog production facilities that resemble prisons more than farms are hundreds of miles from major population centers, and their manure

“lagoons” pollute streams and groundwater. (In Iowa alone, hog factories and farms produce more than 50 million tons of excrement annually.)

These problems originated here, but are no longer limited to the United States. While the domestic demand for meat has leveled off, the industrial production of livestock is growing more than twice as fast as land-based methods, according to the United Nations.

Perhaps the best hope for change lies in consumers’ becoming aware of the true costs of industrial meat production. “When you look at environmental problems in the U.S.,” says Professor Eshel, “nearly all of them have their source in food production and in particular meat production. And factory farming is ‘optimal’ only as long as degrading waterways is free. If dumping this stuff becomes costly — even if it simply carries a non-zero price tag — the entire structure of food production will change dramatically.”

Animal welfare may not yet be a major concern, but as the horrors of raising meat in confinement become known, more animal lovers may start to react. And would the world not be a better place were some of the grain we use to grow meat directed instead to feed our fellow human beings?

Real prices of beef, pork and poultry have held steady, perhaps even decreased, for 40 years or more (in part because of grain subsidies), though we’re beginning to see them increase now. But many experts, including Tyler Cowen, a professor of economics at George Mason University, say they don’t believe meat prices will rise high enough to affect demand in the United States.

“I just don’t think we can count on market prices to reduce our meat consumption,” he said. “There may be a temporary spike in food prices, but it will almost certainly be reversed and then some. But if all the burden is put on eaters, that’s not a tragic state of affairs.”

If price spikes don’t change eating habits, perhaps the combination of deforestation, pollution, climate change, starvation, heart disease and animal cruelty will gradually encourage the simple daily act of eating more plants and fewer animals.

Mr. Rosegrant of the food policy research institute says he foresees “a stronger public relations campaign in the reduction of meat consumption — one like that around cigarettes — emphasizing personal health, compassion for animals, and doing good for the poor and the planet.”

It wouldn’t surprise Professor Eshel if all of this had a real impact. “The good of people’s bodies and the good of the planet are more or less perfectly aligned,” he said.

The United Nations' Food and Agriculture Organization, in its detailed 2006 study of the impact of meat consumption on the planet, "Livestock's Long Shadow," made a similar point: "There are reasons for optimism that the conflicting demands for animal products and environmental services can be reconciled. Both demands are exerted by the same group of people ... the relatively affluent, middle- to high-income class, which is no longer confined to industrialized countries. ... This group of consumers is probably ready to use its growing voice to exert pressure for change and may be willing to absorb the inevitable price increases."

In fact, Americans are already buying more environmentally friendly products, choosing more sustainably produced meat, eggs and dairy. The number of farmers' markets has more than doubled in the last 10 years or so, and it has escaped no one's notice that the organic food market is growing fast. These all represent products that are more expensive but of higher quality.

If those trends continue, meat may become a treat rather than a routine. It won't be uncommon, but just as surely as the S.U.V. will yield to the hybrid, the half-pound-a-day meat era will end.

Maybe that's not such a big deal. "Who said people had to eat meat three times a day?" asked Mr. Pollan.

Mark Bittman, who writes the Minimalist column in the Dining In and Dining Out sections, is the author of "How to Cook Everything Vegetarian," which was published last year. He is not a vegetarian.

What Is the Anthropocene and Are We in It?

BY JOSEPH STROMBERG | SMITHSONIAN MAGAZINE | JANUARY 2013



Have human beings permanently changed the planet? That seemingly simple question has sparked a new battle between geologists and environmental advocates over what to call the time period we live in.

According to the International Union of Geological Sciences (IUGS), the professional organization in charge of defining Earth's time scale, we are officially in the Holocene ("entirely recent") epoch, which began 11,700 years ago after the last major ice age.

But that label is outdated, some experts say. They argue for "Anthropocene"—from *anthropo*, for "man," and *cene*, for "new"—because human-kind has caused mass extinctions of plant and animal species, polluted the oceans and altered the atmosphere, among other lasting impacts.

Anthropocene has become an environmental buzzword ever since the atmospheric chemist and Nobel laureate Paul Crutzen popularized it in 2000. This year, the word has picked up velocity in elite science circles: It appeared in nearly 200 peer-reviewed articles, the publisher Elsevier has launched a new academic journal titled *Anthropocene* and the IUGS convened a group of

scholars to decide by 2016 whether to officially declare that the Holocene is over and the Anthropocene has begun.

Many stratigraphers (scientists who study rock layers) criticize the idea, saying clear-cut evidence for a new epoch simply isn't there. "When you start naming geologic-time terms, you need to define what exactly the boundary is, where it appears in the rock strata," says Whitney Autin, a stratigrapher at the SUNY College of Brockport, who suggests Anthropocene is more about pop culture than hard science. The crucial question, he says, is specifying exactly when human beings began to leave their mark on the planet: The atomic era, for instance, has left traces of radiation in soils around the globe, while deeper down in the rock strata, agriculture's signature in Europe can be detected as far back as A.D. 900. The Anthropocene, Autin says, "provides eye-catching jargon, but from the geologic side, I need the bare bones facts that fit the code."

Some Anthropocene proponents concede that difficulty. But don't get bogged down in the mud, they say, just stipulate a date and move on. Will Steffen, who heads Australia National University's Climate Change Institute and has written articles with Crutzen, recommends starting the epoch with the advent of the industrial revolution in the early 1800s or with the atomic age in the 1950s. Either way, he says, the new name sends a message: "[It] will be another strong reminder to the general public that we are now having undeniable impacts on the environment at the scale of the planet as a whole, so much so that a new geological epoch has begun."

To Andrew Revkin, a *New York Times* reporter (now blogger) who suggested a similar term in 1992 that never quite caught on ("Anthrocene"), it's significant that the issue is being debated at all. "Two billion years ago, cyanobacteria oxygenated the atmosphere and powerfully disrupted life on Earth," he says. "But they didn't know it. We're the first species that's become a planet-scale influence and is aware of that reality. That's what distinguishes us."

Read more: <http://www.smithsonianmag.com/science-nature/what-is-the-anthropocene-and-are-we-in-it-164801414/#wrCE42sR3x4VXTUT.99>

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- [7] Canadian philosopher John McMurtry has probably done the most to articulate this analysis in his (cumbersome but useful) book The Cancer Stage of Capitalism (Pluto Press 1999).
- [8] Any analysis of the corporate takeover of the American legal system is indebted to the work of the Program on Corporations Law and Democracy. Info and materials can be found at www.poclad.org. Particularly noteworthy is their recent compilation, Defying Corporations, Defining Democracy: A Book of History and Strategy, edited by Dean Ritz and published by APEX 2001. Likewise, the 1993 pamphlet by Richard Grossman and Frank Adams, Taking Care of Business: Citizenship and the Charter of Incorporation, remains a classic. For a thorough discussion of the 1886 ruling and corporate personhood, see Santa Clara Blues: Corporate Personhood versus Democracy by William Meyers. The pamphlet can be ordered from www.iiipublishing.com.
- [9] Facts cited in the TV Free American newsletter of the TV Turnoff Network, which has extensive facts and figures about television addiction. See www.tvturnoff.org
- [10] The statistic comes from Jean Kilbourne's research into advertising and gender roles. Kilbourne is known for her award-winning documentaries Killing Us Softly, Slim Hopes,

and Pack of Lies. Her latest book is *Can't Buy My Love: How Advertising Changes the Way We Think and Feel*, (Touchstone, 2000).

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[16] The contrast of money values versus life values is widely used. For a particularly eloquent articulation of it check out the books or lectures of Global Exchange cofounder Kevin Danaher. Most are available through www.globalexchange.org. Also useful is the work of David Korten, particularly *The Post-Corporate World: Life After Capitalism* (Kumarian Press, 1999).

[17] Meme (pronounced meem) describes a building block of replicable meaning, a unit of cultural information with the ability to spread virally from brain to brain (such as ideas, slogans, melodies, symbols). Word coined by evolutionary biologist Richard Dawkins in analogy with "gene" from a Greek root meaning "to imitate." See *The Selfish Gene* (Oxford University Press, 1976). "A contagious information pattern" -- Glenn Grant.

[18] The term "meme warriors" was coined by Kalle Lasn in *Adbusters Magazine* and is expounded upon in his book *Culture Jam: How to Reverse America's Suicidal Consumer Binge and Why We Must* (New York: HarperCollins, 2000). Despite its militarist connotations, the term is not intended to be gender neutral.

[19] The phrase "energy sovereignty" represents the simple but radical concept that local communities should have the right to decide how to meet their own energy needs. Thus "development" decisions around energy are placed in the context of local communities and ecosystems rather than the macroscale context of multinational corporations, privatized utilities, and global economic infrastructure. The term comes from Oilwatch,

an international network of 120 ecological, human rights, religious organizations and local communities that support resistance against oil and gas activities from a southern countries perspective, (<http://www.oilwatch.org.ec/>). Also see U.S.-based organizations Project Underground, (<http://www.moles.org>) and CorpWatch, (<http://www.corpwatch.org>) .

[20] Martha F. Lee, *Earth First! Environmental Apocalypse*, (Syracuse University Press, 1995).

[21] The Zapatista uprising is one of the most documented revolutionary movements in recent history: there is no shortage of excellent coverage of their inspiring actions and important analysis. One of most the accessible and poetic of the compilations of Zapatista communiques and the writings of Marcos is *Our Word Is Our Weapon*, edited by Juana Ponce de Leon (Seven Stories Press, 2000).

[22] A spectacular account is recorded by John Jordan and Jennifer Whitney in their newsprint zine "Que Se Vayan Todos : Argentina's Popular Uprising," May 2002. More info at <http://www.weareeverywhere.org> .

[23] Bell, *The Last Wizard's Book*.

[24] Lasn, *Culture Jam*.

[25] Many of these strategies around "image events" and applying the elements of narrative structure to "telling the future" have been further developed by the smartMeme strategy and training project in their essays "The Battle of the Story" and "The Next Environmental Movement." These essays and an ongoing forum for activists to explore and apply these ideas is available at <http://www.smartmeme.com> .

[26] Quoted in James Davis, "This Is What Bureaucracy Looks Like," in *The Battle of Seattle: The New Challenge to Capitalist Globalization*, ed. Eddie Yuen, George Katsiaficas, and Daniel Burton Rose (Soft Skull Press, 2002). The article is also a useful and relevant examination of NGOs.

[27] The modern cancer epidemic has spawned a parasitic industry of drug companies that sell expensive treatment drugs, many of whom also produce carcinogenic chemicals. Connected to many of these hypocritical corporations are various high-profile, big-budget, nonprofit organizations that help keep public attention focused on expensive treatments (the mythic "cure") rather than the cause. For more information on the "Cancer Industry" see activist organizations like Breast Cancer Action (<http://www.bcaction.org>) and environmental justice resources like the Environmental Research Foundation (<http://www.rachel.org>).

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