

ENVIRONMENTALLY SPEAKING

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Food has its price, but does it have to be so high?

It is often said that one of the most pleasurable things we do in life is eat. The wonderful bounty of plants and animals that are available to us on this planet enable us to concoct a plethora of odoriferous, delectable, and sumptuous meals. Rarely when we consume such scrumptious meals do we reflect on the origin of our feast. Yet, such reflection is warranted, both because we have much to gain from connecting with our natural world and because we have much to learn about the way our food is currently being produced.

Just a few crops dominate our diets (and the diets of the meaty animals that we may eat). These few crops — which include maize, wheat, rice and soybean — primarily come to us by way of an industrialized and highly mechanized system that has enabled our species to provide food for our increasing numbers. This system of production, which requires extraordinary levels of technologically-derived inputs, has been replicated the world over. Many indications suggest that this has been done for the better. However, an examination of industrialized agriculture reveals that while much has been gained from it, perhaps, more has been (and continues to be) lost and sacrificed along the way.

Human agriculture, in the form of the cultivation of crops and the domestication of animals for food, began in several areas of the world roughly 10 millennia ago. The transition from hunter-gatherer to harvester-herder took place over several centuries and at different times in various corners of our planet. Yet, industrial agriculture, the 20th and 21st century's manifestation of our historical transformation, has had tremendous impact on the Earth's species and ecosystems. Some believe that is not sustainable either. (Unfortunately it appears that we are having to learn this hard lesson again. There is very strong evidence that when we were still largely an agrarian society, we, farmers alike, had a much better sense of the impact of our agricultural pursuits; currently only 9 percent of U.S. citizens work in the food production and distribution sector.)

Our labors on the soil have enabled human life-spans, populations and consumption levels to expand substantially. And despite Thomas Malthus's early 19th century prophetic warnings about the limits to agricultural production, numerous innovations have driven yields up to unprecedented highs. The 20th century definitely marked a turning point in food — both in terms of production methods as well as consumption habits.

The green revolution of the 1950s and 1960s brought tremendous expansion of food output within developed countries. A second wave of the green revolution, which began in the 1970s (and continues to this day), saw the expansion of food production and the institution of seed banks in developing countries as well. These increased yields allowed for augmented diets and nutritional supplies for many millions of people as well as increased national security in a few countries via the storage of "extra" grain production. The substantial increase in output also represented the culmination of more than one hundred years of industrial agricultural "successes." Through the industrialization of nearly all aspects of the agricultural process, including the genetic selection of seeds, the seeding, the harvest, and the distribution of foods internationally, humans literally took control of nature. Unfortunately, this control has its costs.

Industrial agricultural has resulted in drained aquifers, nitrate-laden waterways, and pesticide-laced vegetables and fruits. How about the millions of animals that are currently imprisoned in extremely

tight quarters, dosed with hormones and antibiotics only to be prematurely slaughtered? All of these things come with "advanced" agricultural methods. And all of us are complicit in this process, in part because (a) we lack the knowledge of the ecological and social costs, and/or (b) we lack options to avoid supporting this dominant form of agricultural ("we all must eat," it is often said). Thus, it behooves us to inform ourselves and to look at alternatives. But, in all fairness, all is not bad with modern agriculture.

Let's look at the bright spots. U.S. farmers now produce over 130 bushels of corn per acre, whereas in 1920 per acre yields were around 30 bushels (Horrigan *et al.*). (A bushel is a measure of volume equivalent to just over 35 liters.) On the global scale, per acre grain yields nearly tripled from 1950 to the present (Brown). The amount of land dedicated to soybeans worldwide has gone up over four-fold in the past 50 years as well (Gardner). Seafood catch (in weight) has gone up nearly five times over the same period. Closer to home, U.S. per capita meat consumption has increased 40 percent in the last 40 years. And finally, even in rural China, meat consumption grew 49 percent from 1985 to 1999 (adapted from Fuller *et al.*). Certainly production and consumption levels seem to be going up—both positive trends in terms of common standards of "well-being."

What has enabled these growth patterns? A few statistics should indicate quite clearly what the relevant factors have been. Consider that, since 1950 worldwide fertilizer use has increased ten-fold (or four-fold in per capita terms). In the U.S., between 1945 and 1989, insecticide use increased ten-fold as well (Horrigan *et al.*). Irrigated agricultural zones, which rely on human ingenuity to procure water, currently make up ~15 percent of all crops (and produce some 40 percent of the world's food) (Gardner). And lastly, huge allotments of fossil fuel—to drive machinery and make fertilizer and pesticides—have been employed in the past hundred years to enable fields to prosper. Currently, food production burns ~17 percent of the fossil fuel combusted in the United States. Clearly the drive to make ever-increasing amounts of food has required substantial inputs. These inputs were necessary to promote the carefully selected high-yielding hybrids to prosper. But these inputs are a tremendous burden on other ecosystems. More and more, many scientists and social scientists are questioning the factors that have contributed so mightily to the recent agricultural production hikes.

The "bright" statistics revealed here point to the conclusion that enhanced food production levels have been obtained through the use of more materials. And while this is true to a great extent, the simple picture belies much of the story. First, the use of increasing amounts of inputs has its material limitations. Second, the inclusion of these inputs in the agricultural sector comes at great cost to species and environments. Third, and perhaps most surprisingly, the production gains that have been made have provided more food for more people but not in a way that benefits many of them. Fourth, the notion that continued inputs might be the ideal (or obvious) method to produce future outputs overlooks many other tried and true methods. In the end, industrial agriculture comes with a great deal of baggage that, if properly accounted for, might recommend a preference for alternative agricultural systems.

The increased levels of water, fuel, fertilizer and synthetic pesticides that were the stimulus to revolutions in agricultural production show signs of drying up. While pesticide and fertilizer production isn't

limited on timescales that warrant attention, fossil fuel and ground water availability in the near future deserve attention. Since most of the non-renewable energy involved in industrialized agriculture derives from petroleum-based products, demands on that most limited of fossil fuels will only become more pressing. The hybrids that led to improved yields require high doses of water, which, unfortunately, have largely come from non-renewable sources — such as groundwater accumulated over hundreds and thousands of years or from redirected rivers. As a consequence of these thirsty crops, aquifers, like the huge Ogallala which dominates the central plains, are being depleted and/or salinized well beyond natural replenishment rates, and rivers, like the Colorado and the Yellow (China), are routinely drying up before they reach the ocean. This reduction in the usable water that is a prerequisite for mega-yields from thirsty hybrids has fueled conflicts worldwide (e.g., Israel-Palestine and Egypt-Sudan) and the prospects for future clashes over water are evident and widespread (Klare).

We are also just beginning to appreciate the great damage that has come by way of the overuse of pesticides and fertilizers. While much less than 1 percent of pesticides used on crops actually attacks the targeted pests (be it insect, rodent, or "weed"), the thousands of different chemicals used in only the past 60 years have caused excessive (and terribly underappreciated) problems. For instance, honeybee colonies, which provide natural pollination duties at no cost, have seen dramatic losses recently (Horrigan *et al.*). Genetic resistance has developed in pests that have been forced to evolve more quickly in an artificially chemical-laden environment. These "super" bugs will require even more powerful "-cides" to tackle economic losses. High levels of artificial fertilizer result in aquifers, lakes, rivers, and deltas overburdened with nitrates and phosphates. These detrimental inputs cause numerous human health problems — such as methemoglobinemia, a.k.a., "blue baby syndrome" — and major disruptions for aquatic ecosystems — including reduced dissolved oxygen levels.

More surprisingly, the amazing growth in food production over the past few decades does not hold up to its primary intention — to feed the hungry. Pre-1970, there were nearly a billion people on the globe suffering from chronic malnourishment and oddly the number today has only declined slightly. While it is true that now substantially more people are **not** suffering from this incredibly debilitating disorder (which is definitely a good thing), this affirmation is at least somewhat misleading. The drive to mass-produce a few high-yielding seed types has resulted in many problems as well. The fast growing crops allow for greater output but at the expense of a more narrow diet. Thus, many people living in the developing world now have enough calories but not proper nutrients. With excessive production taking place the world over, prices for many key crops have been kept so low that local farmers cannot compete with the large agribusinesses. This displacement of the local by the global has resulted in more people having to depend on other people to satisfy their food needs. This dependence becomes critical when other non-agricultural jobs are increasingly difficult to come by, and people who were once self-sufficient with their small tracts of land are not able to feed themselves. Many landowners in developing countries (where land ownership suffers from great inequities across the population) have responded to lowered values of staple crops by shifting to export crops, such as coffee, bananas, and

cacao (for chocolate) which benefit them but not the greater population.

Closer to home, the overproduction of corn and soybean (and its associated low price) has only fueled our cultural fixation on products that provide a quick (albeit short-lived) energy surge (via corn syrup in sodas and sweets) or protein doping (via meat). Simply put, unnaturally cheap corn lends itself to a situation where it is cheaper (and therefore often preferable, particularly among the poor) to buy and consume soda rather than milk or juice or red meat rather than healthy protein options (such as nuts, eggs, and legumes). Our cultural cravings for these unhealthy options cost us dearly — over \$90 billion in health care costs related to obesity according to a recent study published in the journal *Health Affairs*. Someone is consuming much of the increased production of food, and it is we who do so (rather than the "they" for which it was primarily intended), to our mutual detriment.

Lastly, looking nostalgically at the recent past often leads many agricultural practitioners to the conclusion that past success is the key to future success. But, as is true with any open-minded, futuristic vision, more options warrant inspection, especially given the price of the past success. Fortunately, there are many well-tested methods that deserve a reexamination. As more and more farmers are able to demonstrate, there are other much more harmonious ways to produce food. Specifically, organic farming, a catch-all-phrase for farming that is highly sensitive to the ecological tenets that govern sustainable production, offers a very promising alternative. Attention to several key methods (e.g., crop rotation, cover crops, no-till farming, soil management, diversity, and biological pest management) have shown continued success in providing healthy foods at sufficient yields, without the artificial chemical and toxic inputs attached to industrialized agriculture. For the benefit of humanity the world over, it is pressing that our society take these alternatives seriously, support them to their fullest, and reconcile ourselves to a much closer connection and awareness of the soil and plants that provide us nourishment.

All indications are that over the next 50 years, we will need to provide more food to more people — given continued increases in population as well as standards of living (i.e., affluence). The question is: are we going to continue to exploit our natural resources unsustainably to accomplish our goal of feeding the world or are we going to realize that we need better methods, ones more in keeping with ecological and social constraints, and more equitable ways to distribute the food we have? The answer is ours to make.

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