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Varied Menus for Sustaining a Well-Fed World

By ANDREW C. REVKIN

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On many issues relevant to charting a smooth human journey in this century, arguments are often framed between camps seeking to promote and spread “sustainable” behaviors and those pushing to advance and/or disseminate “better” technologies. In such polarized discussions, it’s hard to find acknowledgment that a variegated world heading toward roughly 9 billion people by 2050 will almost assuredly require “[all of the above.](#)”

Still, there is plenty of room for agreement, and potentially progress.

[Exchanges here this morning between Vaclav Smil and Lester Brown on food security](#) revealed utterly divergent forecasts and preferences, but agreement on one uncomfortable reality — that substantial technological advances, along with shifts in appetites in prosperous societies, will be needed to fit human appetites on a finite, thriving planet.

On the production end, finding agreement on what the science writer Paul Voosen recently described as “[a unified theory of farming](#)” is unlikely. But finding ways to break down either-or thinking and foster traditional agricultural methods or advanced technologies where they fit best is clearly feasible.

On the consumption end, the challenges of moderating appetites may be greater.

As promised, here are more reactions to this same query from a wide range of other analysts and practitioners focused on food:

[Nina Fedoroff](#), a life sciences professor at Pennsylvania State University and visiting professor at King Abdullah University of Science and Technology in Saudi Arabia:

I don’t have a crystal ball, Andy, but my considered assessment is that [Paul] Krugman* (among many others) is right. That is why I am now in Saudi Arabia developing a research program at KAUST, the new King Abdullah University of Science and Technology, in desert agriculture, with a special emphasis on halophytes. Some of the most populous parts of the world are getting hotter and drier. Growing

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ABOUT

By 2050 or so, the human population is expected to pass [nine billion](#). Those billions will be seeking food, water and other resources on a planet where humans are already shaping climate and the web of life. Dot Earth was created by [Andrew Revkin](#) in October 2007 -- in part with support from a John Simon Guggenheim Fellowship -- to explore ways to balance human needs and the planet’s limits.



The blog moved to the Opinion side of The Times in 2010 when Revkin left the Times staff to teach communication courses at Pace University. He won a [National Academies Communication Award](#) for Dot Earth in 2011 and Time Magazine named him one of the web’s 25 top bloggers in 2013.

In December 2016, Revkin ended the blog and left Pace to return to full-time journalism as senior reporter on climate and related issues for the public-interest newsroom [ProPublica](#).

Click here for a [narrated slide show](#) on the roots of Revkin’s journalistic journey.

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zones are moving north, but it's hard to know how well that will compensate for decreasing productivity in the drylands, which have been kept on life support with fossil water — a practice that is self-limiting and whose time is just about up.

The continuing distaste for [GMOs](#) and their consequent absurd over-regulation means that the most up-to-date, environmentally benign crop protection strategies are used almost exclusively for the mega-crops that are profitable for biotech companies. The public agricultural research sector remains largely excluded from using modern molecular technology. Will this change soon? I don't think so, although there are signs of movement here and there. India's getting there with brinjal, China seems to be creeping up on biotech rice.

But I don't see any really large-scale efforts to develop new feed crops that can be grown on land that can't be used for the current ones using salty water not currently considered suitable for agriculture.

The problem is not so much that we don't have or can't develop the technology to increase food and feed production, it's that urbanization has rendered an ever increasing fraction of humanity unable to produce its own food — and more than that — totally unaware of what it takes. (What's the problem? I just run over to the grocery store.)

Governments (including our own) subsidize food in many different ways, knowing well that hungry people make destructive mobs. If you look back through history, a plausible case can be made that empires unravel not for political reasons, but because of disruptions in the food supply chains that feed their urban seats of power. Those food supply chains are now vast and global. They deliver and will continue to deliver anything and everything to those who can pay. The screams of pain will come first from the poorest countries that already import way beyond their ability to pay and too poor (or perhaps unwise) to make the requisite investments in developing new high-tech approaches to agriculture in hot places.

And now we we're pouring our ag bucks into biofuels, of all the imaginable absurdities. The idea that you could ever replace the rate of utilization of energy from fossil fuels, which has been estimated as consuming 400 years worth of photosynthesis per year, with a fraction of the annual photosynthetic harvest that does not impinge on food production is part of today's magical thinking, along with reducing deficits by cutting taxes while continuing to increase spending.

[Gerald Nelson](#), senior research fellow, International Food

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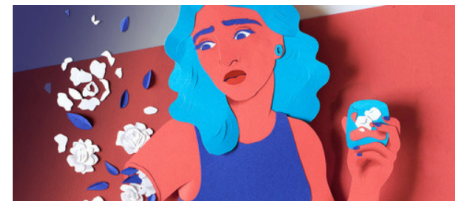
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Policy Research Institute:

A few thoughts. In the two pieces Andy references, Krugman tends to underestimate the ability of humans to substitute one resource for another. So the end of oil, for example, doesn't mean the end of energy use or necessarily, of human civilization. And more people with more income doesn't necessarily mean mass starvation and riots.

But more people with higher incomes does mean greater demands. And with most of the additional population in developing countries, the additional demand is concentrated geographically. There is also some indication, although with great uncertainty, that the climate change challenges will be concentrated in these same geographies. So the great food security questions are:

- the extent to which technical innovations can keep up both with growing food demand (with more or less the same resource use) and the debilitating effects of climate change (a large set of biological challenges)

- the extent to which we (humans) will actually invest in those innovations (some/many of the needed innovations are likely to be public goods, ie, the private sector can't capture the returns from investing in them)

- the extent to which we can use international trade to compensate for changes in agricultural comparative advantage driven by either economics, demographics, or climate change.

The relative threats change with time. At the moment, population and income growth are the big drivers, with random weather shocks causing more problems today than they would have in the past.

As we get closer to 2050 population growth becomes less of an issue and income growth and climate change grow in relative importance. After 2050, climate change becomes the biggest threat, unless something is done sooner rather than later about reduce GHG emissions.

Just a few findings from our recent [research monograph](#):

Between 2010 and 2050, our scenarios result in maize price increases of 87 to 106 percent in real terms; rice is 31 to 78 percent; and wheat is 44 to 59 percent.

With a 40 percent increase over our base productivity growth in the developing countries, the price increases in the baseline scenario drop from 101 percent to 56 percent for maize; 55 to 31 for rice; and 54 to 20 percent for wheat. In other words, this increase productivity results in roughly a halving of the real price growth.

[Juergen Voegele](#), director, agriculture and rural development, the World Bank:

Somewhat higher food prices are *a good thing for overall global food production* because they stimulate investments in the agricultural sector which are long overdue. Those investments need be economically, socially and environmentally sustainable, everywhere, but particularly in poor countries because they are most vulnerable to climate change and social disruption.

Somewhat higher food prices are *a bad thing for the poor* because they cannot afford a healthy diet in the first place and are forced to make further cuts on education and health spending if their food bill goes up. We already have close to one billion people go hungry today, not because there is not enough food in the world but because they cannot afford to buy it.

The high [food price volatility](#) we have seen since 2008 is *a bad thing for both producers and consumers* because of the uncertainty and risk that comes with it. Particularly poor smallholder farmers have no means to absorb these risks as producers and are discouraged from planting. As poor consumers they cannot risk not being able to feed their families.

Can we potentially feed 9 billion people in 2050? Without a doubt we can. But not by continuing business as usual. Or we will have 1.5 to 2 billion hungry people in the world by 2050. It will require very significant investments in agriculture R&D and in overall productivity increases. And it will require a sustained global effort to target the poor and fundamentally address rural poverty. The successful reform of the [CGIAR](#) is a positive step in this direction. But both the public and the private sector will be key to achieve sustainable development for all.

Feeding nine billion will come at a high environmental cost unless we choose to go a different path. That different path includes minimizing further forest conversions, rehabilitating large-scale degraded eco-systems ([the Loess Plateau story](#) is a great example), climate smart agriculture with sustainable land, nutrient, water and carbon management practices, etc.

Arguably the two biggest challenges we face in this century are to overcome poverty and to manage climate change. One cannot be achieved without the other. [Climate smart agriculture](#) will be key to achieving both because investments in agriculture help the poor – 70 percent live in rural areas – more than any other program, and because agriculture is key to both mitigation and adaptation to climate change. It is the plants on the planet that absorb carbon dioxide, so it is

between forests and the rest of the productive landscape to take carbon out of the atmosphere. The mitigation potential for improved climate smart agricultural practices is huge and needs to be tapped. It's [a triple win](#): if done well, higher production and productivity leads to better incomes, it improves resilience, and it captures carbon.

Pamela Ronald, a [plant pathologist at the University of California, Davis](#), and "[Tomorrow's Table](#)" blogger and author:

I see this latest price surge as another bump in a long, climbing road and another stark reminder that we need a global focus on food security to address the challenges ahead (Ronald and Adamchak, 2008).

Because the amount of arable land is limited and what is left is being lost to urbanization, salinization, and desertification, it no longer possible to simply open up more undeveloped land for cultivation to meet production needs. Another challenge is that water systems are under severe strain in many parts of the world. The fresh water available per person has decreased 4-fold in the last 60 years ([UNEP Global Environment Outlook 3 2002](#)). Of the water that is available for use, about 70% is already used for agriculture ([Vorosmarty et al. 2000](#)). Many rivers no longer flow all the way to the sea; 50% of the world's wetlands have disappeared and major groundwater aquifers are being mined unsustainably, with water tables in parts of Mexico, India, China, and North Africa declining by as much as one meter per year ([Somerville and Briscoe 2001](#)). Thus, increased food production must largely take place on the same land area while using less water. [[Read the rest.](#)]

Matt Ridley, science writer and author of "[The Rational Optimist](#)":

I see absolutely no reason that this food price spike is any different from any of the ones in the last four decades: ie, a normal self-correcting phenomenon in which a slight imbalance between demand and supply is reflected in a price rise, which will result in higher output next harvest. To read a trend into it is like trying to read a single flood in Pakistan as evidence of climate change (woops, they did that?).

Yields continue to rise faster than population, weather continues to matter less and less because of technology and trade (in the 1690s, when it was cheaper to move people than food, 15% of France's population starved because of a failed harvest that today would register as a small price blip), and famine continues to reflect more and more political, not ecological causes.

Food prices will continue their relentless fall over the long term.

Here are just a few pointers:

1. Remember the huge role ethanol and other biofuels are playing in competing for food crops, boosting price rises. Plenty of data on this.
2. Biotech is having a real impact on yields, see soya and maize in particular. Water efficient maize is going to be big.
3. High prices lead to more plantings and more inputs leading to more yields. The recent rise in wheat prices makes the man who manages my farm tell me in years when the price is good that "acres planted for wheat are up across Europe" or similar.
4. Human beings have tripled the amount of the big 3 cereals (rice, wheat and maize) we produce in 60 years - from a broadly unchanging total acreage. There is no sign of that slowing. Indeed, there is some sign of more and more land coming out of production - for forests, golf course, etc. a lot of that can reverse quickly (see 3).
5. The Chinese are getting richer at an astonishing rate - 10% this year - so they want to eat more meat, which supports prices. In other words, it's prosperity, not desperation.
6. Check out [the CO2 fertilisation effect](#), which is already far greater than any climate change effect on agriculture: 15-40% increases in wheat yields are likely from CO2 doubling.

Here's an excerpt from my book. F.A.O. is a serial (and cereal) pessimist purely because that's the way it gets headlines:

One of the hoariest causes for pessimism about the fate of humanity is the worry that food will run out. The prominent eco-pessimist Lester Brown predicted in 1974 that a turning point had been reached and farmers could 'no longer keep up with rising demand'. But they did. In 1981 he said that 'global food insecurity is increasing'. It was not. In 1984, he proclaimed that 'the slim margin between food production and population growth continues to narrow'. Wrong again. In 1989 'population growth is exceeding farmers' ability to keep up.' No. In 1994, 'Seldom has the world faced an unfolding emergency whose dimensions are as clear as the growing imbalance between food and people' and 'After 40 years of record food production gains, output per person has reversed with unanticipated abruptness.' (A turning point had been reached.) A series of bumper harvests followed and the price of wheat fell to record lows, where it stayed

for a decade. Then in 2007 the wheat price suddenly doubled because of a combination of Chinese prosperity, Australian drought, pressure from environmentalists to encourage the growing of biofuels and willingness of American pork-barrel politicians to oblige them by sluicing subsidies towards ethanol producers. Sure enough Lester Brown was once again the darling of the media, his pessimism as impregnable as it was 33 years before: 'cheap food may now be history,' he said. A turning point had been reached. Once again, a record harvest followed and the wheat price halved.

Fred Kirschenmann, [a farmer](#) and president of the [Stone Barns Center for Food and Agriculture](#) and distinguished fellow, the [Leopold Center for Sustainable Agriculture](#) at the University of Iowa:

You might want to take a quick look at Julian Cribb's new book, [The Coming Famine](#), which I think lays out some of the many inter-connected challenges that we are likely to encounter in the decades ahead. Given that scenario, which I think is accurate, the short answer to your question is that the food price spikes we see now are only a dim pretext to what is to come—unless we make some major design changes in our food system. Personally I think that [the U.N. IAASTD report](#) [The International Assessment of Agricultural Knowledge, Science and Technology for Development], which we in the U.S. have largely ignored, provides a pretty good road map for some of the design changes, economic, social and ecological, that we need to take seriously. In the short term, we should take at least one of Cribb's suggestions seriously—namely the waste of food. We keep focusing on how much more food we need to PRODUCE to feed 9 billion people—in fact we already produce enough calories to feed 9 billion people but we waste over half of them. In the long term we cannot continue to devastate the healthy ecology that is vital to sustaining food production in the interest of keeping the current system going.

[* In my initial query to Brown, Smil and others, I noted how Paul Krugman had migrated in the last several years toward the conclusion he made in December that rising commodity prices were driven increasingly not by speculation or other such factors but by [fundamental constraints on resources](#) in the face of fast-rising demand). There was more from [Krugman on food, growth, and finiteness](#) on his blog on Tuesday.]



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