Hunger Speaks

To feed the world's hungry will take more than a technology revolution; it will require an information revolution.

BY RICHARD MANNING

First, this is not about food, nor, as it is usually more specifically stated, is it about boosting yields to feed the exploding global population. Nor is this about food security, a popular turn of phrase that serves, as such terms often do, as euphemism. A tour of the more deprived reaches of Asia or Africa, or increasingly, Eastern Europe, will present faces of people who are not so much insecure as they are hungry. There are 840 million people on the planet suffering chronic malnourishment, most of them women and children; 2 billion—a third of humanity—suffer lesser degrees of malnutrition.[1] So why is this not about food?

The short answer is that because of dramatic increases in crop yields achieved in the last half of the 20th century, the world's farmers currently produce more than enough food to feed everyone a decent diet. Further, farmers in the leading grain-producing regions of the world are going broke because grain surpluses keep prices below the cost of production, a deficit met by about $28 billion in direct farm subsidies in the United States alone in 2000.[2]

People are hungry because they do not have enough money to buy food, even surplus food. This may not be about food, but it certainly is about agriculture.

Agriculture is proud of its record of the last 30 years. During that period, in which world population doubled, Green Revolution technologies produced yield increases that outstripped population growth, which is to say, there is more food per person than there was a generation ago. So there is progress, of a sort. But a generation ago, we could neatly slice the world's population into three groups: a billion that made more than $7,500 a year per person, a billion that made less than $700 a year, and a billion in between. The change in that structure since takes all the shine off the notion of progress. All 3 billion people added since have joined the poorest two classes. There are still about 1.1 billion making more than $7,500 a year; the rest make far less.[3] Indeed, at least 1.3 billion people today live on less than a dollar a day.[4] As a consequence, much of the increased grain production has been directed away from the poor and toward livestock to produce meat for the world's wealthiest. Is there progress without equity? What has agriculture to do with this?

Reinventing Agriculture

To find some answers to these questions, I spent 1998 and 1999 touring the world as a working journalist, specifically profiling nine agriculture research projects in the developing world, research paid for by the Minneapolis-based McKnight Foundation.

These projects dealt with both subsistence and industrial agriculture in Zimbabwe, Uganda, Ethiopia, India, China, Mexico, Peru, Chile, and Brazil, a sample that runs the broad range of conditions in the developing world. The nine projects were selected from a list of 450 applications by an independent, international, and interdisciplinary panel of scientists. The selection process produced a sample of the most intriguing work generated by the needs of the developing world, in most cases by national scientists intimately in touch with the needs of their region. If there is a thread that emerges from these projects, it is a sort of evolutionary birth of a second Green Revolution.

The environmental costs of the first Green Revolution are well known, particularly nitrogen and pesticide pollution, freshwater depletion, and soil erosion. These

are not trivial issues and, in fact, must be addressed in this process of reinventing agriculture. Agriculture as we know it now is simply unsustainable.

The environmental difficulties are urgent, but so are the social woes that divide our world into the few with excess and the many who are hungry. The way we raise food is wrapped up in the cause of this inequity, but redesigning agriculture can play a major role in finding a solution.

Down on the Farm

Prabhu Pingali is an economist and a grain guy. His work is anchored at the International Center for the Improvement of Maize and Wheat at Mexico City, which in turn anchors it solidly in the Green Revolution. The center is where the Green Revolution's founding father Norman Borlaug began developing higher yielding wheat crops.

There is a continuum of views among food experts. One of its poles is represented by those who believe that the solution to feeding more people is producing more grain, the old-guard Green Revolutionaries. Place Pingali toward that pole. But just toward it. There remain very few unrepentant, pure-form Green Revolutionaries.

The notion of a Green Revolution is a mental construct, a simplification born of a prior simplification: that the task of agriculture is simply growing food. On its most fundamental level, the Green Revolution made the simple calculation that every human needs 2,000 calories a day, then set about developing an equation that harmonized that number with the number of breathing bodies on the planet. If we have learned anything, it is that the job of agriculture is not simply feeding 6 billion today, or however many billion a decade hence. Seeing it only as this simple matter will get us in terrible trouble. Old-line Green Revolutionaries understand this, as do most others working in the field.

Pingali stands before an audience of food scientists explaining a slide projected on a screen behind him, showing two simple columns. The first is a list of megacities, those cities in Asia that each contain a population of more than 10 million. The second column contains the list of cities expected to become megacities in Asia early in this century. There are 20, a doubling of this category in less than a decade. Then Pingali singles out one in the second column, a newcomer, Hyderabad, India. It's his hometown. There were 300,000 people in it when this middle-aged man was born there. To put this in the context of the American experience, which has no precedent for this sort of growth, imagine if you told the members of today's graduating class from a high school in Colorado Springs, Colorado, that their city would hold 10 million within their lifetimes.

Our Daily Gruel

We tend to identify raw population growth as the problem, but something beyond population growth is driving the explosion of these cities. The total mass is growing, true enough. But at an even greater rate, the mass is shifting, coagulating in dense urban pockets of population that must be fed by dense packages of carbohydrates. Fed cheaply, because most of them are very poor. What they will get is not much more than the daily dose of gruel based in the primary grain of the region. If they are lucky. To feed them, commodity prices must be kept low, which means prices to farmers must be low, which means that the other great collection of the world's poor, the rural poor, will be increasingly marginalized and impoverished to make room for "efficiency." The world is on a treadmill driven by large-scale industrial agriculture, which has been the major force in pushing people off the land, in making those megacities that grow far faster than the overall population growth.

Wrapped in this has been an industrialization of diet, a sort of assembly line approach toward efficient eating, replacing what we used to think of as cuisine. Farmers no longer speak of food, but of commodities, specifically of three: corn, wheat, and rice. This phenomenon is also a harvest of the Green Revolution.

Borlaug's 1970 Nobel Prize gives him much of the credit for what we now call the Green Revolution, but that work came after the hybridization of corn—the rest of the world calls it maize—in the first half of the last century. This greatly boosted yields in the United States and set one leg of the tripod.

Borlaug then framed the other two legs—wheat and rice—with a simple, elegant solution to greatly increasing yields for wheat and rice. He bred short plants. He was not the first to do so, but he picked up the idea and ran with it, developing a string of dwarf varieties. Simply, these allowed the grain plants to invest less energy building stems, and more building grain. At the same time, the short plant could support a fatter seed head, so it wouldn't topple, a problem farmers call lodging. This allowed growers to hypercharge the plants with water and fertilizer. The result of all of this was that grain yields tripled.

With some minor exceptions, corn, wheat, and rice are the three crops targeted by past research. We put everything in a single bread

basket, and cereals now account for more than two thirds of the calories humans consume.

The remains of an Iron Age man found in a bog in Denmark included a stomach that contained residues of 60 plant species, not the total diversity of the primitive diet, but just the diversity of a day's eating.[5] Now, people live mostly on three species of plants, year round. And true enough there is diversity: protein, vegetables, fruit, and meat in varieties beyond imagination, but these are not available to the poorest billion or even poorest 4 billion. In the developed world, less than a third of the average person's calories come from cereal; in the developing world, cereals account for 56 percent. The resident of the developed world, to be sure, accounts for more grain consumption, but it's indirect, either wasted or fed to livestock. Thus, per capita grain consumption in the richest countries of the world, including that fed to livestock, is about five times that of a low-income country.[6]

All of this is the result of the hammer principle—once you have a hammer, everything starts to look like a nail. There were no problems in the world that could not be solved by increased grain yields, never mind that people around the world, especially rural people in the tropics, couldn't grow and didn't want to eat grain. They wanted the mangoes, bananas, chilis, tomatoes, cassava, sweet potatoes, mashua, quinoa, carrots, turnips, lettuce, favas, sprouts, wing beans, groundnuts, chickpeas, lentils, onions, garlic, citrus, and on and on.

I visited a "primitive" farming region of Mexico where farmers relied on a total of 250 species of domestic and wild food plants, a place that was a vestige of the diverse village life wiped out around the world by industrialization of agriculture and urbanization.

India is a good example of how the broad brush trends have played out at local tables. India relies heavily on an efficient vegetarian diet, so it gets its protein from legumes such as lentils and chickpeas. A generation ago when the Green Revolution first hit India—and in fact, when the country faced widespread famine—per capita plant protein production was about equal to nutritional needs. Now, with vastly increased grain production, the country no longer faces those famines, but the success of grains has pushed the lesser crops off the land. Now, per capita protein production is about half what it should be. Indians are not so much hungry as they are malnourished.

The same can be said about lower income people in the United States, among whom obesity is a plague. This is not so much the result of overeating, but of a woefully unbalanced diet loaded with sugars. Those sugars are the cornbelt's surplus, rendered by manufacturing to corn syrup that is now ubiquitous in cheap, processed foods, from corn chips to colas.

Local Culture

It is not exactly correct to say we know how to grow enough food. Rather, it is more correct to say we know how to grow enough grain. We know how, because increasing grain yields was a relatively simple and straightforward trick. Everything else, everything that must be done from here on out is devilishly difficult by comparison, including reinventing the way we grow grain. That step is necessary because the Green Revolution's methods are, by and large, industrial agriculture's methods: capital intensive, large-scale, mechanized. They are the very methods that have left only about 1 percent of Americans working on farms. The globe simply cannot accommodate that degree of urbanization in the developing world.

There is, however, much to be gained by looking at this same issue from the positive side, at the link between agriculture and poverty and the integrity of local culture. Consider, for instance, that between two-thirds and three-fourths of new jobs created in India during the past generation—from truck drivers to grain brokers—are agriculture related.[7] This begins to suggest a path and at the same time point to the shortsightedness of attempting to deal with the problem simply by shipping grain to the poorest regions. Agriculture—local, sustainable, subsistence farming—is the first rung of development. It feeds people, but gives them a small surplus of the locally preferred crops to sell at villages and to ship to urban markets.

Stand on a busy street in Kampala on market day and watch the trucks piled high with the pale, white sweet potatoes that Ugandans prefer—each grown by farmers working two- and five-acre plots by hand and selling to middlemen—and you begin to get some idea of the importance of this vital link to a country's growing economic integrity.

Uganda is a standout among developing countries in that its government quite consciously chose in the 1990s to gear agriculture research and investment toward subsistence crops, as opposed to cash crops for export. That single, simple step has humanity headed in the right direction, but getting there—in Uganda and in all of the developing world—will take all of the running we can do.

Knowledge Gap

In India, I toured a university test farm for chickpeas, but the fields were no longer being used for tests. Instead, they were planted to the latest improved varieties to multiply seed to give to farmers. Researchers had beaten a problem, so the remaining task was to get the solution into the hands of farmers.

One reason India doesn't grow enough chickpeas for protein is that the crop suffers from a fungus, fusarium wilt, even though the breeders have produced wilt-resistant varieties. I had seen a real solution growing robustly in a field, and it was enough to give me the sense that the case was closed, but the case was not closed. I left the test field and headed down a farm lane to visit a farmer, a poor man. Most of his mud brick house was caved in, its roof half off. A clutch of kids stood in the yard and stared, vacantly, as did the farmer—the nobody-is-home stares that look out from the world's most dehumanized level of poverty. The man had maybe a half acre of land, rocky and thin. He'd planted his chickpeas too late, for no special reason. He'd used whatever seed was cheap in the local market. He'd weeded carefully and tended, but still his plants were pathetic, devastated by drought and fusarium wilt. What he needed most to keep his kids from starving was knowledge and improved seed. Both were literally within sight, just across the road, growing in an agricultural school's state-of-the-art test plot.

Later, I got a chance to talk about this with an Indian researcher. Dipak Santra is a young man, but has already published results of distinguished research. He is the son of a village teacher.

"I know what the farmers are facing," he says. When he goes to visit his family, he leaves behind the world of biochemistry for a village where most of the farmers are illiterate to the point of not understanding the basics of fertility.

"They don't use green manure crops. They don't use dung. They use it for fuel. They are ignoring that we are killing our next generations," he says. "They don't know." That last phrase echoes in what becomes a monologue.

> They don't know. And somehow we have got to fill up this gap. Whatever the existing cultivars are, with proper management, you can still get good yield, but you've got to stop this leakage of information. You've got to start training. They just don't know. People have been appointed by the government to transfer the technology, but somehow that is not happening. I don't know why. Their job is to transfer technology from the lab. Somehow that is not happening. I know that the government has taken care of the system but somehow it is not working.

Failed Model

It is not that there is a shortage of people in the villages offering information, but as in much of the world, "information" comes from marketers, especially pesticide salesmen.

It is easy to get lost in the halls of science, wound up in the layers of sophisticated research that is producing a hypertechnology that can feed the world. This preoccupation with research fails to recognize that India would not have a protein problem if all chickpea fields used readily available technology. The same idea applies generally around the world. The technology we need, by and large, remains on the shelf. At the same time, we push our few resources toward research that will develop more technology that will largely be ignored.

This Indian case is a particularly stark example of an area experts call agricultural *extension*. It is a telling word choice. Think of an extension of a line. It is generally drawn from a straightforward linear model that says researchers develop technology, then technology is transferred to farmers and everyone lives happily ever after. Only it doesn't work. Nowhere does it work well, and in most places it works not at all.

That is not to say that technology does not get adopted. It does, but often a few generally successful, innovative farmers—early adopters—experiment with the new varieties and succeed. The bellwether strategy suggests that their neighbors will see their success and follow along, but more often it works another way, that the technology gives the early adopter a competitive advantage that he uses to drive his neighbors off the land. Then those refugees become the urban poor. I have no way of proving this, but my dark hunch suggests that this phenomenon was as much at work in depopulating rural America as was the inherent advantage of efficiency. That is, the failure of the family farm in the United States was really a failure of extension. Some farmers learned the new tricks and succeeded at the expense of their neighbors, who were, to use Woody Guthrie's term from the 1930s, "tractored out."

Never mind romantic notions about the importance of the yeoman farmer and the benefits of village life. Think of the untenable mass of cities. Can the world allow this failing to continue?

Agricultural research has by definition come from researchers, which in itself is a cultural issue. The world

is good at research and knows how to do it. Scientists can home in on scientific problems to create technology. Then they turn this technology loose, believing extension is not their job. That's their cultural bias. They are easily blindsided by the attendant social issue, which keeps them on the path of least resistance. Research is the path of least resistance for all of us. Our culture knows how to develop technology. We are at a loss as to explain how it filters into society.

If science is weak in this area, government is a complete failure. In each of the target countries of the McKnight Foundation program, there is a government-run extension service. McKnight told the scientists doing the research explicitly to link up with those services to foster farmer adoption of appropriate technologies. In some, Uganda, for instance, that has worked reasonably well, but in most it has not.

A Networking Revolution

Part of the solution to the developing worlds' problems may be found in the example of Uganda, which understood from the outset that research needs to first be cast in a social matrix. That is, the country self-consciously decided the goal of its agricultural program was to assist subsistence farming, as opposed to developing commercial crops for export. That framework of policy went a long way toward developing technology appropriate to the farmers who needed it.

Still, the framework alone won't get the job done, and the world is short on people who know how to do the rest, especially the world's governments.

Don Duvick—a career researcher with Pioneer Seed, a company that develops and markets hybrid seed worldwide—told me in one of the first interviews for this project:

> One of the things that has impressed me so much and that is so clear in so many developing countries is that the people who are governing the country are rotten through and through, and that's all there is to it. The laws are to enrich the people in power and nothing more.

In the months I traveled the world and talked to people in country after country, that was one of the things that impressed me so much too. They might not be so blunt about it, but most in the field would agree with Duvick. This is one of the foundation assumptions of people doing the work: government cannot be counted on for help; in many cases, it can be counted on for just the opposite.

This assumption has created the beginnings of a sort of ad hoc networked solution. That is, researchers are increasingly linking up with nongovernmental organizations—volunteer workers in the various countries—to do primary research and extension. There is an important difference, though, in the quality of this network as opposed to linear models based on government extension. The NGOs are far more likely to be committed to the primary goal of improving the life of the poor, and they pay much more attention to subsistence agriculture. The network approach can easily include those inclined to ask questions about the overall quality of rural life, and those people can help prevent technology from degrading it.

I have set up the Green Revolution and its industrial methods as one pole in this argument but have been somewhat lax in defining the other. In an evolved solution, definitions are necessarily lax, but the evolution of these networks draws some of the picture. Of the nine projects I visited in the course of researching my book,[8] there were three examples of genetic engineering at work. This technology has enormous potential to reshape crops. Yet in some sense that high-tech aspect of the work is not so very different from the Green Revolution with its emphasis on the increased yields. It gives the farmer a new seed. Seeds alone won't solve the problems.

The broader themes, the hallmarks of the emerging agriculture, involve increasing complexity and diversity, of not relying on seed alone but of incorporating the power of these genetics into a system with broad integrity. Solutions will vary with location. One size will not fit all. The array of crops will become more diverse, especially drawing from the genetically stored wisdom of native plants and forgotten crops. Cultural practices will become increasingly important. Local information will drive the process. Farming will become more attentive to its broader environmental context, not only by degrading it less, but by tapping natural forces for assistance.

Good Food, Good Lives

One of the more impressive sights I saw in my travels was in the highlands of Mexico, where university plant breeders worked not in experimental plots, but in real farm fields, with farmers. It was a joint effort in maize breeding, an example of participatory research. This suggests the real breakdown of the linear model. Information and knowledge will no longer flow from top to bottom, but originate in and reverberate through every part of the system. This is a flow of information among researchers and farmers that in the end could have them work-

ing a common ground, a common field of knowledge. It may be difficult to define whatever it is that will replace Green Revolution methods, but this concept lies at its core.

The genetic engineering business is going to get all of the headlines, but these simple matters are potentially far more earth shaking. What must happen, and to a degree is happening, in agriculture is also an information revolution. If there was a key mistake of the Green Revolution, it was in simplifying a system that is by its nature complex. Farming is not simply growing food. It is not simply a tool we use to feed however many beings our social structure generates. The way we grow food determines our structure, makes our megacities, makes us who we are. Agriculture is culture, at bottom, about the integrity of individual lives. Those lives gain their integrity and value when they are deeply embedded in a rich environment of information. This is about growing good food, but, more importantly, about making good lives. We will fail if we attend to the former without considering the latter.■

Richard Manning is a freelance writer in Lolo, Montana.

NOTES

1. "Winning the Food Race," *Population Reports* 25(4) (Baltimore, MD: Johns Hopkins University School of Public Health, December 1997), pp. 1-2.

2. Tim Egan, "Failing Farmers Learn to Profit from Federal Aid," *New York Times* (December 24, 2000), p. 1.

3. Alan Durning, *How Much Is Enough: The Consumer Society and the Future of the Earth* (New York, NY: W.W. Norton & Company, 1992), pp. 26-28.

4. Robert Livernash and Eric Rodenburg, "Population Change, Resources and the Environment," *Population Bulletin* 53(1) (Washington, DC: Population Reference Bureau, March 1998).

5. L.T. Evans, *Feeding the Ten Billion: Plants and Population Growth* (Cambridge, UK: Cambridge University Press, 1998), p. 180.

6. William Bender and Margaret Smith, "Population, Food and Nutrition," *Population Bulletin* 51(4) (Washington, DC: Population Reference Bureau, Inc., February 1997), pp. 14-15.

7. Ibid, p. 41.

8. Richard Manning, *Food's Frontier: The Next Green Revolution* (New York, NY: North Point Press, 2000).