



2011

STATE OF THE WORLD

*Innovations that
Nourish the Planet*

THE WORLDWATCH INSTITUTE



Member of a women's group waters their cabbage, Zimbabwe

CHAPTER 1

Charting a New Path to Eliminating Hunger

Brian Halweil and Danielle Nierenberg

Along the shoreline of the Gambia River, a group of women has achieved rare success in reducing hunger in their communities. It revolves around a certain briny mollusk. To boost their incomes and safeguard a source of nourishment, the 15 communities in the Women's Oyster Harvesting Association—a total of nearly 6,000 people—agreed to close one tributary in their oyster territories for an entire year and to lengthen the “closed” season in other areas.¹

These steps were difficult in the short term. But by the following season the oysters were bigger, and so was the price they commanded. Customers, primarily other local merchants or women who want to make fried oysters for

their families as a protein-filled treat, have so far been willing to pay a little bit more. Meanwhile, the harvesters—many of them immigrants from surrounding nations and the poorest of the poor in The Gambia—are also putting on plays about mangrove restoration and building hatcheries to further boost the wild stocks, as well as eyeing upscale markets in hotels and restaurants that cater to tourists.²

Oysters are not necessarily what come to mind when confronting the task of eliminating hunger and poverty around the globe. After all, according to the latest U.N. Food and Agriculture Organization (FAO) report, 925 million people are undernourished. (See Box 1–1.) That is 98 million fewer than in 2009.

Box 1–1. Global Hunger and Agricultural Trends

In September 2010, FAO released its latest report on hunger, finding that 925 million people are undernourished—98 million fewer than in 2009. (See Figure.) While the lower number is encouraging, it is still unacceptably high—and nowhere near the Millennium Development Goal of halving hunger by 2015. Ghana is the only sub-Saharan African country on course to cut its prevalence of hunger by then.

Globally, the 2010 hunger figure marked a decline of 7.5 percent from the 2009 level. The reduction was mostly concentrated in Asia.

FAO estimates that 80 million fewer people were hungry there in 2010. Gains were much smaller in sub-Saharan Africa, where one third of the population was hungry. Furthermore, the overall number of hungry people in sub-Saharan Africa has increased over the last decade. In Burundi, Comoros, the Democratic Republic of the Congo, and Eritrea, chronic hunger affects at least half the population.

Overall, women and children account for the highest proportion of the chronically hungry. High food prices and lower incomes put poor households at an additional risk of not providing expectant mothers, infants, and children with adequate nutrition. Indeed,

more than one third of child deaths worldwide are related to inadequate nutrition.

Most of the men and women, usually farmers, who live on less than \$1.25 a day are found in rural areas, lacking land tenure, infrastructure, and access to health services or electricity. Increasingly, however, cities are not immune to hunger. In the 1980s and 1990s urbanization increased by 4 percent each year, while poverty levels continued to increase as well. The population of slum dwellers is also growing worldwide—at almost 1 percent each year. Rising food prices during the 2007/08 world food price crisis were especially hard on the urban poor. In Kenya, for example, FAO estimated that 4.1 million urban poor in 2009 were “highly food-insecure” and as many as 7.6 million were unable to meet their daily food needs.

While world food prices have fallen since 2008, they remain well above pre-2007 levels, and the trend continued steadily upward in 2009 and 2010. Many food aid programs have not been able to purchase as much food, and the recession has meant less money for food aid. The U.S. Agency for International Development reported that it was only able to donate

But a child still dies every six seconds from undernourishment. Oysters alone cannot address this tragedy.³

What can? Typically the solutions cited are higher-yielding seed varieties, dams to irrigate vast areas, and mountains of fertilizer to rejuvenate depleted soils. Yet seafood provides about 15 percent of the calories and a third of the protein that people worldwide consume—and more than that in poorer nations, including much of West Africa. So fisheries will in many regions be lasting sources of food and income for poor communities. But seafood is just one neglected part of the food chain that might provide

answers where fertilizer or irrigation or a focus on boosting grain production alone has not.⁴

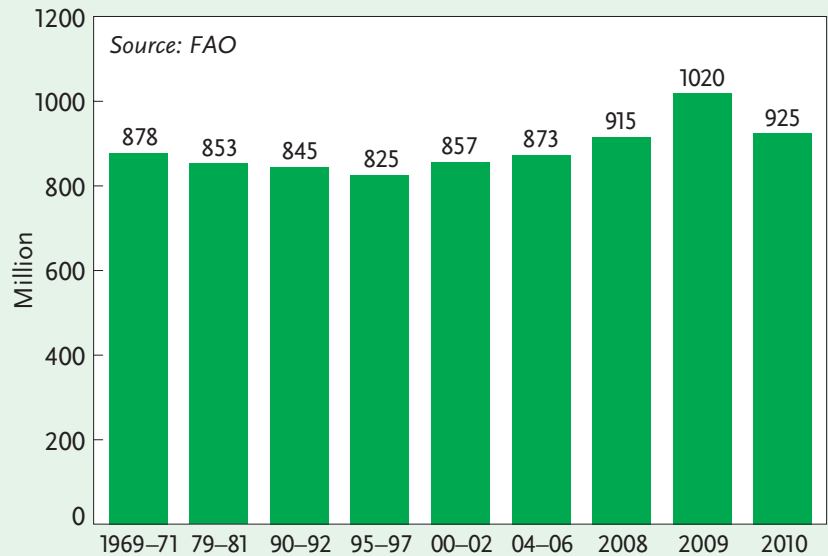
It was on a journey to find such neglected solutions that we came upon this group of oyster harvesters. The context, and the basis of Worldwatch’s Nourishing the Planet project, was this: Agriculture has come to a crossroads. Nearly a half-century after the Green Revolution, a major share of the human family is still chronically hungry. In addition, much of that revolution’s gains have been achieved through highly intensive agriculture that depends heavily on fossil fuels for inputs and energy—and the question of whether the

Box 1–1 continued

\$2.2 billion in 2009, a decrease of 15 percent from 2008.

Funding for agricultural development is down as well. The new multibillion-dollar U.S. food security and agriculture initiative (Feed the Future) proposes to invest \$20 billion in African agriculture in the next decade. This is a timely recognition of the urgent need to invest more in this sector—but much of the money still needs to be raised. Agriculture's share of global development aid has dropped from over 16 percent to a meager 4 percent since 1980. Moreover, only nine African nations allocate even 10 percent of their national budgets to agriculture. Most of the continent's poor and hungry people depend on agriculture for all of their livelihoods. Yet public spending on agriculture is often lowest in countries with economies based on agriculture—in other words, farmers are, ironically, the hungriest people of all.

Number of Undernourished People in the World, 1969–2010



Increasingly, over the past two decades, the least developed countries have depended more on food imports. In 11 sub-Saharan African countries, half of the grain they used was imported in 2005–06. In seven other countries, imports accounted for 30–50 percent of their grain.

Source: See endnote 3.

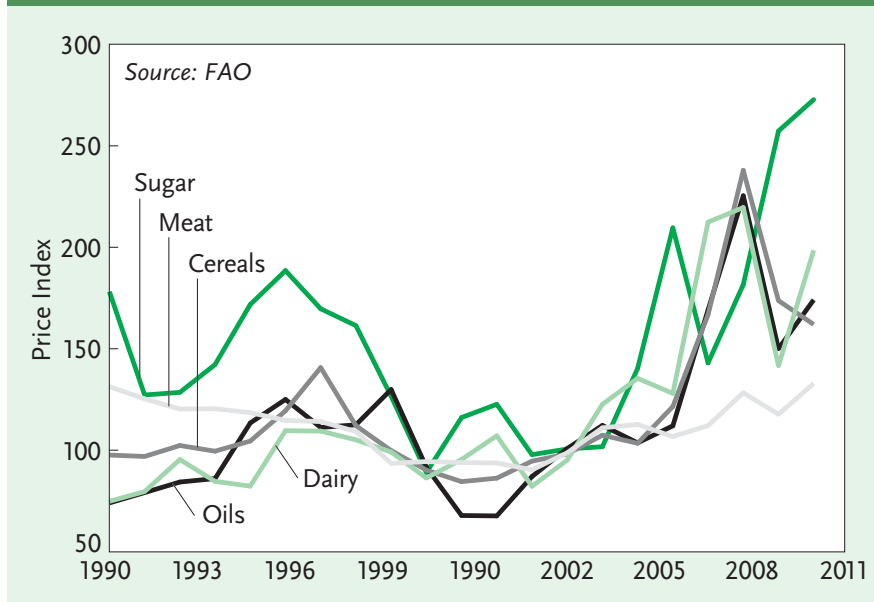
world's croplands can yield more food is being trumped by the question of whether they can do so without compromise to the soils, fresh water, and crop diversity the world depends on. Food prices worldwide are under strong upward pressure (see Figure 1–1), driven by rapidly rising demand for meat in Asia, for wheat in Africa, for biofuels in Europe and North America, and other factors. Climate change is not likely to ease that pressure or make things easier for farmers.⁵

Perhaps most troubling is that investments in agricultural development by governments, international lenders, and foundations are near historic lows. However, the same record food

prices that handicap food-aid organizations and threaten hundreds of millions with hunger are also pushing governments, foundations, and other groups to consider dramatically shifting investments in agriculture. A recent World Bank analysis, for instance, suggested that the Bank has mistakenly neglected this sector and needs to shift resources back to rural areas—which is hands down the most cost-effective investment for reducing poverty and hunger around the world.⁶

Over the last two years we have traveled to 25 sub-Saharan African nations—the places where hunger is greatest and rural communities have struggled most—to hear people's

Figure 1–1. Food Prices, 1990–2010



stories of hope and success in agriculture. Africa has among the most persistent problems with malnutrition—it is home to the most nations where more than a third of the people are hungry. In spite of this, the continent is becoming a rich and diverse breeding ground for innovations in agriculture that support farmer income and nourishment for people at the same time.⁷

This journey has paid off in a treasure trove of innovation. On dozens of farms in Malawi we saw yield-boosting techniques used by more than 120,000 farmers, such as planting nitrogen-fixing trees that enrich the soil for the subsequent corn crop and that boost yields fourfold with no other added fertilizer. Across West Africa, we met farmers and shopkeepers using simple storage systems to prevent cowpeas, a major crop in the region, from rotting. If half of the area's cowpea harvest were stored this way, it would be worth \$255 million annually to some of the poorest people in the world.⁸

Our aim was to shine a light on communities, countries, and companies that are models on the path to a sustainable future. And beyond the goal of reducing poverty and hunger, we

were guided by some more-traditional Worldwatch criteria. In order to keep feeding humanity for generations to come, and to feed people better, farming must reinforce conservation goals by adding diversity to the food chain and by healing ecosystems. What also becomes clear in visiting farms throughout Africa is that the food production base is in many places being degraded by soil mining, water scarcity, and a loss of the crop diversity that ultimately feeds future farming.

We were also interested in useful models for larger-scale efforts and for applications

beyond Africa—even in wealthy nations that struggle with food waste, overeating, and other forms of agricultural dysfunction. A rooftop gardening cooperative that is feeding people in Dakar, Senegal, offers guidance for neighborhoods struggling with food shortages in inner-city New York. Individually, the hundreds of millions of small-scale farmers and their families who are the majority of the world's poor seem to have little power in the face of global issues like hunger, climate change, and water availability. But if each of their individual innovations were scaled up to bring food to the tables of not one farmer but 100 million or more, as well as to the consumers who depend on them, it could change the entire global food system.

But the global connections go beyond Africa. Everyone is in this together, in more ways than one. First, agriculture encompasses such a large chunk of the planet that healthy rural economies are also fundamental to global sustainability. To prevent disastrous climate change, it will help if farmers all over the world are rewarded for building up the carbon content of their soils. Second, even deter-

mined “locavores” who try to support local farmers depend on distant regions for coffee, cocoa, fruits, and other daily essentials or out-of-season specialties. The same Americans who are flocking to farmers’ markets and pushing agribusiness away from feedlots may emerge as new lobbying allies in matters of international hunger policy. Third, even if people do not get their corn, rice, and beans from African farmers, they are sustained by the crop diversity in those fields. Poorer nations still house most of the world’s dwindling food biodiversity, not to mention cultural wisdom that may be a source of enjoyment or better health. Finally, for most people there is also the moral dimension. It is hard to fully enjoy a hearty meal when nearly a billion people elsewhere in the world—perhaps including those nearby—cannot do the same.⁹

There is no single solution. In fact, it is the one-size-fits-all approach that has been so crippling. Past attempts have failed because they squeezed out diversity or depended too much on chemicals and other inputs that farmers could not afford. They also stumbled because they ignored women farmers or neglected to consider food culture as a way to change how they farm. Although a slightly smaller share of humanity is hungry, what the world has been doing about hunger has not really worked. And because attention has been focused relatively narrowly—on a few types of crops, on a few technologies—entire regions and ecosystems, not to mention myriad varieties of crops and rural ways of life, have been ignored.

So, here are three major shifts that we invite farmers, scientists, donors, agribusiness executives, and the global community to consider.

Go Beyond Seeds

The first shift needed is to look beyond the handful of crops that have absorbed most of agriculture’s attention and also beyond devel-

oping new seeds as the default solution for hunger and poverty. The long-standing focus on seeds is no surprise: they are elegant vessels for delivering new technology to a farm. Whether it is an American corn farmer looking for more drought tolerance or a bean farmer in the Kenyan highlands, buying a new type of seed is a relatively inexpensive and immediate way to try to boost a farm’s harvest and income. But this search for just the right seed has tended to erode crop diversity in both rich and poor nations. At the same time, building soils, growing crops other than grains, making better use of rainfed farms, and investing in other elements of the farm landscape have been profoundly neglected. Yet these hold vast promise for raising incomes and reducing poverty.

The Consultative Group on International Agricultural Research (CGIAR) spends 27 percent of its funding on genetic improvement of seeds, and most CGIAR centers are still organized around growing a particular crop—rice, wheat, corn, or potatoes, for instance. But in recent years this global research network has evolved by adding centers focused on agroforestry, integrated pest management, and irrigation; these centers now get nearly 25 percent of the CGIAR’s budget.¹⁰

Because of their relative neglect until recently, the returns on investments in such technologies and strategies can be impressive. That does not necessarily mean they get invested in, however. Developing new seed varieties, for instance, can be a lucrative proposition for seed companies. But few companies have figured out ways to profit from encouraging the rebuilding of soils or aquifers. And the new reality of agricultural investment is that it comes less from public institutions like governments and universities than from private entities. In 1986, for example, of the \$3.3 billion that the United States invested in agricultural research, 54 percent came from the public sector and 46 percent from the private

sector. Today, in contrast, agribusiness firms—primarily seed and agrochemical companies—have emerged as the majority investors, responsible for 72 percent of the total.¹¹

If seeds represent the short-term payoff option, the truly long-term investment with big returns is investing in the soil and water that nourish crops. In Mali and other parts of the African Sahel, soils are severely damaged from overgrazing and drought, but the use of green manure and cover crops can dramatically improve soil fertility without the use of expensive fertilizers. In Chapter 6, Roland Bunch cites recent interviews with farmers from more than 75 villages in six African countries that, like much of sub-Saharan Africa, suffer from well-documented soil exhaustion. “People no longer had any way of maintaining soil fertility,” he notes. “Harvests were crashing, dropping 15–25 percent a year.” Bunch notes that subsidizing chemical fertilizers, which some African nations are doing heavily (by up to 75 percent in Malawi, for example), has generally not been a good long-term strategy and actually reduces farmers’ incentive to invest in more agroecological approaches to nourishing soils. When the fertilizer subsidies end, productivity will drop to virtually nothing. Instead, Bunch maintains that green manure/cover crops are the only sustainable solution to Africa’s soil fertility crisis.¹²

Or consider that across much of Africa, only 15–30 percent of the rain that falls on fields gets used productively by crops, and if the land is severely degraded this share can drop to 5 percent. In these places, crop failures may be caused more by “poor on-farm rainwater management than by a shortage of rainfall,” notes Sandra Postel in Chapter 4. Only a very small share of African farms currently have access to irrigation—albeit a share that is surging with low-cost, human-powered pumps like the MoneyMaker, the Mosi-O-Tunya (“the pump that thunders”), or the more ubiquitous treadle pump that is used by more than 2.3 mil-

lion poor farmers in Asia and Africa.¹³

But even without irrigation, farmers are finding they can insulate themselves from the worst effects of drought and boost yields dramatically in a rainy year by mulching, reducing tillage, and planting cover crops. As Postel notes, “working with farmers on six experimental farms in Kenya, Ethiopia, Zambia, and Tanzania, researchers found yield gains of 20–120 percent for maize and 35–100 percent for tef (a staple grain of the Ethiopian diet) on farms using such soil- and water-conserving practices versus those using traditional methods.” This broad strategy, used in parallel with investing in place-appropriate irrigation, is relevant across the continent’s 18 or more distinct growing regions, all of which are predicted to be shocked by more severe rainfall patterns in coming years.¹⁴

Go Beyond Farms

As Olivier De Schutter notes in the Foreword to this book, eliminating hunger does not just depend on the world’s ability to produce enough food. For many communities, the solutions lie in making better use of the food already produced. A new study from the U.K.-based Soil Association suggests that the best way to ensure that everyone gets enough to eat is to change what kind of food is produced and improve its distribution: less meat production, use of more environmentally sustainable agricultural methods that do not rely on petrochemicals, and more local and regional production of food. In fact, many of the farms and organizations we visited seemed to be having the most success reducing hunger and poverty with work that had little to do with producing more crops.¹⁵

As Tristram Stuart notes in Chapter 9, some 25–50 percent of the harvest in poorer nations spoils or is contaminated by pests or mold before it reaches the dinner table. This amount of loss—sometimes the harvest gets returned

to enrich soils, but increasingly it ends up in landfills and trash dumps—is shocking, considering that many experts estimate the world will need to double food production in the next half-century as people eat more meat and generally eat better. So it would make good sense to invest at least as aggressively in making better use of what is already produced as in boosting global production. Simple, low-cost fixes can go a long way in this respect, including inexpensive plastic bags that keep cowpeas dry and pests out, better-built silos for preserving grain, and preserving fruit (and vitamins) through solar drying techniques.¹⁶

Often food goes to waste because the link from farmer to market is slow, inefficient, or broken. In Zambia, Samuel Fromartz found that corn production was actually in oversupply in 2010 due to good rains and fertilizer subsidies. In theory, this could be profitable, since the excess could be sent to countries in short supply. But Zambia lacks infrastructure and marketing networks to do this, and farmers were simply dumping corn on the market at low prices—thereby entrenching poverty and sending a market signal to all the farmers to grow less. But Fromartz found some exceptions to this, such as Justine Chiyesu, as described in Chapter 13. With the help of the Production, Finance, and Technology (PROFIT) program of the U.S. Agency for International Development, Chiyesu was able to mechanize his farm and increase yields. PROFIT helped him find ways to bypass inefficient marketing networks, allowing him to sell directly to millers and get a better price for himself and the village of growers he represented.¹⁷

“Add value” has long been the mantra for struggling rural communities from the American Midwest to the North China Plain. That is, process, preserve, or otherwise transform raw commodities into a more valuable product—peanuts into peanut butter, for instance. But Africa has lagged in this realm, partly because of neglect in the off-farm businesses



©IFAD/G. Maurette

A young boy retrieves the day's ration of peanuts from inside a silo, Cameroon

that help farmers add value. In the last half-century, the amount of value-added to agriculture per person has nearly doubled across the developing world; over the same period, it has declined slightly in Africa, where investment in agricultural infrastructure like food processing facilities has lagged. This is partly why the poorest countries in Africa are twice as dependent on food imports today as 20 years ago—a precarious shift because global food prices have also become more erratic.¹⁸

And while most of the world's poor and hungry remain in rural areas, hunger is often migrating as the world becomes more urban. Where people in cities have jobs and can afford their next meal, the food may come from far away. But for slum dwellers in Kenya and

Ghana, the most reliable source of nourishment is often what they can grow themselves in patio gardens, on vacant lots, or on parcels of land near slums. At least 800 million people worldwide depend on urban agriculture for most of their food needs. Right now the majority of these urban farmers are in Asia, but with 14 million Africans migrating from country to city each year, the residents of Lagos, Dakar, and Nairobi will likely become as dependent on food raised in cities as people who live in Hanoi, Shanghai, and Phnom Penh. Urban agriculture is already an important source of income for millions of Africans. In Chapter 10, Nancy Karanja and Mary Njenga note that the poor in cities are not only supplying food to their own communities but also establishing seed multiplication projects, making their “farms” an important source of local seed for urban and rural farmers alike.¹⁹

Over the long term, the most important “off-farm” investment may well be making sure that the farmers of tomorrow have the opportunity and the desire to actually become farmers. In Uganda, Project DISC (for Developing Innovations in School Cultivation) has found that teaching students how to grow, cook, and eat spiderwiki, amaranth, and other native vegetables can help give young people a reason to stay in rural areas and become farmers.²⁰

Working in schools can also help reduce hunger. In the United States, where 16.7 million children are deemed “food-insecure,” the most effective government intervention has been the meals that children get in school. The school feeding programs of the World Food Programme (WFP) now reach at least 10 million girls worldwide, helping to combat gender inequities in education and nutrition. Take-home rations provide an incentive for parents to send girls to secondary school, and improved nutrition helps children develop properly and stay focused during classes.²¹

One thing they can focus on is getting the most out of local foods. Serena Milano from

Slow Food International reports in Chapter 7 that teachers and chefs all over Africa are helping families do more with their limited food budgets by documenting, reviving, and teaching traditional recipes and food preservation techniques. In places where indigenous or wild plants are the only crops thriving, Milano suggests investing in preserving wild resources, like coffee and honey, as well as encouraging farmers to “grow” biodiversity in their fields by planting indigenous crops.²²

Go Beyond Africa

No matter where food comes from—a farmers’ market, a discount superstore, a household garden, or even online vendors—people everywhere are tied into a global food system. (See Table 1–1.) In this sense, international solidarity in the realm of food—embodied by everything from fair trade cashews to farmers’ groups like Via Campesina and cross-continental collaborations like the Global Crop Diversity Trust—is one of the most hopeful innovations for reducing poverty and hunger.²³

Food aid in Africa and elsewhere has traditionally come from the United States and other rich nations. But food aid could be much more cost-effective if the United States, the world’s major donor, purchased the food in or near recipient countries. The United States currently donates only U.S.-grown crops. These shipments provide much-needed calories to hungry people, but they also disrupt the food supply system by lowering prices for locally grown food and by crowding producers in neighboring areas out of nearby markets. “We are changing how we view the ultimate goal of development,” said President Barack Obama on issues of global food security. “Our focus on assistance has saved lives in the short term, but it hasn’t always improved those societies over the long term.” Europe, the other major food donor, has already modified its aid policy. Today the highways in southern Africa are

Table 1–1. Putting Sub-Saharan Africa in Perspective

| Indicator | World | Sub-Saharan Africa |
|--|--------------------------|--------------------------|
| Population | 6.8 billion | 863 million |
| Total arable land | 1,380,515,270 hectares | 179,197,800 hectares |
| Share of food production that is smallholder | 70 percent | 90 percent |
| Urban population | 3.49 billion | 324 million |
| Share of population that is urban | 51 percent | 33 percent |
| Hungry | 925 million (14 percent) | 239 million (27 percent) |
| Children underweight | 148 million (24 percent) | 39 million (28 percent) |
| Average age | 29.1 years | 18.6 years |
| Per capita added value output of agriculture between 1961 and 2006 | Increased 35 percent | Decreased 12 percent |

Source: See endnote 23.

filled with trucks carrying food aid across the continent, more and more of it from African farmers selling directly to the World Food Programme. In Liberia, Sierra Leone, Zambia, and several other nations in sub-Saharan Africa (as well as in Asia and Latin America), WFP is not only buying locally, it is helping small farmers gain the skills necessary to be part of the global market. And there is good evidence that the need for food aid will soar in coming years, not only because of higher crop prices but also because of climate-related and geopolitical chaos.²⁴

The global impact of farming also extends to agriculture's impact on climate change. African farmers could remove 50 billion tons of carbon dioxide from the atmosphere over the next 50 years, primarily by planting trees among crops and stewarding nearby forests. That is like eliminating an entire year of all the world's greenhouse gas emissions—and it would be a generous contribution from a region that emits a tiny share of these gases. Already roughly 75 projects in 22 countries across Africa are in the works in the hopes of compensating farmers and rural communities

for providing this climate-healing service, including a proposal to create an African Agricultural Carbon Facility that could incubate projects and help connect them with buyers.²⁵

Farmers and communities throughout the developing world can thus play an important role in solving certain global problems—a role that could lead simultaneously to income, jobs, and self-reliance. Not all of these experiments will work. But David Lobell argues in Chapter 8 that “we need to be adaptation agnostics, willing to be honest about what we do not know and ready to expend the effort to figure out what actually works....The key will be whether public and private investors can quickly recognize what works and scale it up.”²⁶

Farmers' groups are already making changes throughout Africa—sometimes through Pro-Innova-supported projects where farmers share information via workshops, meetings, photographs, and the Internet, as described in Chapter 5. At the same time, farmer advocacy and activists groups, including GRAIN and The Land Coalition, are mobilizing to prevent corporate and foreign acquisitions of agricultural land in Ethiopia, Madagascar, and other

countries. In Chapter 12, Andrew Rice reports that millions and perhaps tens of millions of hectares have been acquired by international buyers, like Saudi Arabia and China, in just the last decade. Currently this land is mostly used to grow crops for people back home or elsewhere in the world.

Even as countries and communities start to invest in local agriculture, people remain tied to a global food system. And even where fewer people are hungry, governments and communities struggle with problems that ultimately relate to what people eat. Consider that the American diet, anchored in a major way to food products made from corn and soybeans, has been implicated in the massive dead zone in the Gulf of Mexico, which is caused partly by fertilizer and manure from midwestern farmland, as well as in rampant public health problems related to meals bulked up by corn syrup, soy oil, and grain-fed meat. The New York-based Feed Foundation's 30 Project is bringing international activists involved in hunger issues together with domestic advocates who are addressing obesity, looking for long-term solutions that will make the food system better for everyone. "Kids in the South Bronx need nutritious foods and so do kids in Botswana," explains founder Ellen Gustafson. Among the organization's goals for the next 30 years are easy access to fresh fruits and vegetables for every person on the planet, global sustainability standards for meat production, and processed food priced to account for all the negative impacts from its production and distribution.²⁷

Steps on the New Path

The innovations we uncovered on our African journey represent the kind of radical new thinking that more and more people are call-

ing for. Most recently, the International Assessment of Agricultural Knowledge, Science and Technology for Development suggested that farmers and researchers need to abandon the conventional reductionist approach that separates agriculture from the environment and the environment from meeting human needs. The report noted that there is no uniform approach to solving hunger and poverty, that re-integrating livestock and crop production could dramatically improve rural economies in the most degraded environments, and that "orphan crops" and traditional seeds have more potential than previously assumed. These are the types of innovations that will help nourish people and the planet alike.²⁸

Needless to say, we have great expectations for the world's food producers in Africa and beyond. Agriculture is emerging as a solution to mitigating climate change, reducing public health problems and costs, making cities more livable, and creating jobs in a stagnant global economy. In the most hopeful future—one that is entirely achievable—countries that are currently food-short could begin to feed themselves and generate surpluses to help other countries.

Our hope is that this book will serve as a partial road map for foundations and international donors interested in supporting the most effective and environmentally sustainable agricultural development interventions—and that it will offer some inspiration and support for the rural communities that are the source of these innovations.

Given the limited ability of scientists to find solutions, the finite generosity of donors to support agricultural research, and the overstretched patience of struggling farmers and hungry families, shifting funds and attention in new directions is long overdue.

September 2010. International Water Management Institute, “In a Changing Climate, Erratic Rainfall Poses Growing Threat to Rural Poor, Justifying Bigger Investment in Water Storage, New Report Says,” press release (Stockholm: 6 September 2010); Conservation International, “Shell Shock: The Catastrophic Decline of the World’s Freshwater Turtles,” press release (Washington, DC: 10 September 2010); FAO, “925 Million in Chronic Hunger Worldwide,” press release (Rome: 14 September 2010); Allan Dowd, “World Pays High Price for Overfishing, Studies Say,” *Reuters*, 14 September 2010; “Global Fisheries Research Finds Promise and Peril: While Industry Contributes \$240B Annually, Overfishing Takes Toll on People and Revenue,” *ScienceDaily.com*, 14 September 2010; Vattenfall, “Vattenfall Inaugurates World’s Largest Offshore Wind Farm,” press release (London: 23 September 2010).

Chapter 1. Charting a New Path to Eliminating Hunger

1. Christine Zaleski, e-mail to Danielle Nierenberg, 27 August 2010; Christine Zaleski, “Turning the Catch of the Day into Improved Livelihoods for the Whole Community,” *Nourishing the Planet Blog*, 12 July 2010.
2. Zaleski, “Turning the Catch of the Day,” op. cit. note 1.
3. U.N. Food and Agriculture Organization (FAO), “925 Million in Chronic Hunger Worldwide,” press release (Rome: 14 September 2010). Box 1–1 from the following: FAO, op. cit. this note; Ghana from Sara J. Scherr and Courtney Wallace, “Rural Landscapes and Livelihood in Africa: Sustainable Development in the Context of Climate Change and Competing Demands on Rural Lands and Ecosystems,” Issue Paper for Dialogue towards a Shared Action Framework for Agriculture, Food Security and Climate Change in Africa, Eco-Agriculture Partners, and World Wildlife Fund, Washington, DC, 6–9 July 2010, p. 4; FAO, “Global Hunger Declining, But Still Unacceptably High,” Policy Brief (Rome: 14 September 2010); FAO, “Food Security Statistics by Country,” at www.fao.org/economic/ess/food-security/statistics/food-security-statistics-by-country/en; World Health Organization, *Children: Reducing Mortality Fact Sheet* (Geneva: November 2009); International Food Policy Research Institute (IFPRI), “2009 Global Hunger Index Calls Attention to Gender Inequality,” press release (Washington DC: 14 October 2009); Shaohua Chen and Martin Ravallion, *The Developing World Is Poorer Than We Thought, But No Less Successful in the Fight against Poverty* (Washington, DC: Development Research Working Group, World Bank, 2008), p. 4; UN HABITAT, *State of the World’s Cities 2010/2011: Bridging the Urban Divide* (London: Earthscan, 2010), p. 28; U.S. Agency for International Development, “USAID’s Office of Food for Peace 2009 Statistics,” press release (Washington, DC: 10 January 2010); trends in agricultural development funding from U.N. Department of Economic and Social Affairs, *Trends in Sustainable Development 2008–2009: Agriculture, Rural Development, Land, Desertification, and Drought* (New York: United Nations, 2008); African national agricultural budgets from U.N. Department of Economic and Social Affairs, Division for Sustainable Development, “Summary Report of Multi-Stakeholder Dialogue on Implementing Sustainable Development,” 1 February 2010, New York; grain imports from Stacey Rosen et al., *Food Security Assessment, 2007 GFA- 19* (Washington, DC: Economic Research Service, U.S. Department of Agriculture (USDA), 2007); Figure from FAO, “Hunger Statistics,” at www.fao.org/hunger/en, and from FAO, “Hunger,” at www.fao.org/hunger/hunger-home/en.
4. FAO, Fisheries and Aquaculture Department, *The State of World Fisheries and Aquaculture 2008* (Rome: 2009), p. 4.
5. International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), *Agriculture at a Crossroads, Synthesis Report* (Washington, DC: Island Press, 2009); Figure 1–1 from FAO, *FAO Food Price Index* (2010).
6. World Bank, *World Development Report 2008: Agriculture for Development* (Washington, DC: 2007).
7. FAO, “Global Hunger Declining,” op. cit. note 3.
8. W. Makumba et al., “The Long-Term Effects

- of a *Gliricidia*-Maize Intercropping System in Southern Malawi, on *Gliricidia* and Maize Yields, and Soil Properties,” *Agriculture, Ecosystems & Environment*, August 2006, pp. 85–92; D. Garrity and L. Verchot, *Meeting the Challenges of Climate Change and Poverty through Agroforestry* (Nairobi: World Agroforestry Centre, 2008); storage of cowpeas from Purdue University, “Gates Foundation Funds Purdue Effort to Protect Food, Enhance African Economy,” press release (Seattle, WA: 6 July 2007).
9. Chris Reij, Gray Tappan, and Melinda Smale, *Agroenvironmental Transformation in the Sabel: Another Kind of “Green Revolution,”* IFPRI Discussion Paper (Washington, DC: IFPRI, 2009).
10. Consultative Group on International Agricultural Research, *Financial Report 2008* (Washington, DC: 2008).
11. Data on research expenditures from Board on Agriculture, *Investing in Research: A Proposal to Strengthen the Agricultural, Food, and Environmental System* (Washington, DC: National Research Council, 1989), “Appendix B: Private Sector Research Activities and Prospects.” Totals exclude Forest Service and Economic Research Service research and development and do not count research by the food processing industry.
12. R. Bunch, “Adoption of Green Manure and Cover Crops,” *LEISA Magazine*, vol. 19, no. 4 (2003), pp. 16–18; see Chapter 6 for interviews with farmers and information on soil exhaustion and fertilizer subsidies.
13. Johan Rockström et al., “Managing Water in Rainfed Agriculture—The Need for a Paradigm Shift,” *Agricultural Water Management*, April 2010, pp. 543–50; see Chapter 4 for MoneyMaker and other pumps.
14. See Chapter 4; Johan Rockström et al., “Conservation Farming Strategies in East and Southern Africa: Yields and Rain Water Productivity from On-farm Action Research,” *Soil & Tillage Research*, April 2009, pp. 23–32.
15. Soil Association, *Telling Porkies: The Big Fat Lie About Doubling Food Production* (Bristol, U.K.: 2010), p. 3.
16. Stockholm International Water Institute, *Saving Water: From Field to Fork—Curbing Losses and Wastage in the Food Chain* (Stockholm: 2008); see Chapter 9 for low-cost fixes.
17. See Chapter 13 for information on Justine Chiyesu.
18. Forum for Agricultural Research in Africa, *Framework for African Agricultural Productivity* (Accra: 2006); “Rural Landscapes and Livelihoods in Africa: Sustainable Development in the Context of Climate Change and Competing Demands on Rural Lands and Ecosystems,” draft Discussion Paper for Dialogue towards a Shared Action Framework for Agriculture, Food Security and Climate Change in Africa, Bellagio, Italy, 6–9 July 2010.
19. People depending on urban agriculture from Alice Hovorka, Henk de Zeeuw, and Mary Njenga, *Women Feeding Cities: Mainstreaming Gender in Urban Agriculture and Food Security* (Warwickshire, U.K.: Practical Action Publishing Ltd, 2009); see also Chapter 10.
20. Developing Innovations in School Cultivation, at projectdiscnews.blogspot.com, viewed 12 May 2010.
21. Number of hungry children in the United States from Mark Nord, Margaret Andrews, and Steven Carlson, *Household Food Security in the United States, 2008*, Economic Research Report No. 83 (Washington, DC: USDA, November 2009), p. 15; USDA, Food and Nutrition Service, “National School Lunch Program,” program fact sheet, at www.fns.usda.gov/cnd/Lunch/AboutLunch/NSLPFactSheet.pdf, updated September 2010; World Food Programme, *Feed Minds, Change Lives: School Feeding, the Millennium Development Goals and Girls’ Empowerment* (Rome: 2010).
22. See Chapter 7.
23. Via Campesina, at viacampesina.org/en, viewed 27 September 2010; Global Crop Diversity Trust, at www.croptrust.org, viewed 27 September 2010. Table 1–1 from the following: world population total and share that is urban from FAO,

“Global Issue: World Hunger and Poverty Facts and Statistics 2010,” www.worldhunger.org/articles/Learn/world%20hunger%20facts%202002.htm; population in sub-Saharan Africa, world urban population, share of sub-Saharan Africa that is urban, and average ages from United Nations, *World Population Prospects: The 2008 Revision* (New York: 2008); arable land from FAO, *FAOSTAT Statistical Database*, at faostat.fao.org; share of world food production that is smallholder from Development Fund/Utviklingsfondet, *Norway, A Viable Food Future* (Oslo: 2010), p. 7; share of sub-Saharan African food production that is smallholder from Eric Holt-Giménez, “From Food Crisis to Food Sovereignty: The Challenge of Social Movements,” *Monthly Review*, July-August 2009, p. 145; urban population in sub-Saharan Africa from UN HABITAT, “Urban Indicators,” at www.unhabitat.org/stats; hungry populations from FAO, “Global Hunger Declining,” op. cit. note 3; underweight children from UNICEF, *The State of the World’s Children 2009* (New York: December 2008), p. 23; percentage underweight from UNICEF, *The State of the World’s Children 2008* (New York: December 2007); per capita added value output of agriculture from Forum for Agricultural Research in Africa, *Framework for African Agricultural Productivity* (Accra, Ghana: June 2006), p. 8.

24. Restriction to U.S. grown crops from U.S. Government Accountability Office, *International Food Assistance: Local and Regional Procurement Can Enhance the Efficiency of U.S. Food Aid, but Challenges May Constrain its Implementation* (Washington, DC: 2009); Barack Obama, Remarks at the Millennium Development Goals Summit, United Nations, New York, 22 September 2010; World Food Programme, “P4P Overview,” at www.wfp.org/node/18711, viewed 12 May 2010.

25. Sara J. Scherr and Sajal Sthapit, *Mitigating Climate Change Through Food and Land Use*, Worldwatch Report 179 (Washington, DC: Worldwatch Institute, 2009), pp. 5, 9; World Agroforestry Centre, *Creating an Evergreen Agriculture in Africa for Food Security and Environmental Resilience* (Nairobi: 2009), p. 23; Scherr and Wallace, op. cit. note 3, p. 33.

26. See Chapter 8.

27. Ellen Gustafson, “Obesity + Hunger = 1 Global Food Issue,” TEDxEast Talk, May 2010.

28. IAASTD, *Agriculture at a Crossroads: The Global Report* (Washington, DC: Island Press, 2009).

Measuring Success in Agricultural Development

1. P. B. R. Hazell, “Transforming Agriculture: The Green Revolution in Asia,” in D. J. Spielman and R. Pandya-Lorch, eds., *Millions Fed: Proven Successes in Agricultural Development* (Washington, DC: International Food Policy Research Institute, 2009), pp. 25–32.

2. J. W. Bruce and Z. Li, “Crossing the River while Feeling the Rocks: Land-Tenure Reform in China,” in Spielman and Pandya-Lorch, op. cit. note 1, pp. 131–38.

3. O. Erenstein, “Leaving the Plow Behind: Zero-Tillage Rice-Wheat Cultivation in the Indo-Gangetic Plains,” in Spielman and Pandya-Lorch, op. cit. note 1, pp. 65–70.

4. C. Reij, G. Tappan, and M. Smale, “Re-Greening the Sahel: Farmer-Led Innovation in Burkina Faso and Niger,” in Spielman and Pandya-Lorch, op. cit. note 1, pp. 53–58.

5. P. Roeder and K. Rich, “Conquering the Cattle Plague: The Global Effort to Eradicate Rinderpest,” in Spielman and Pandya-Lorch, op. cit. note 1, pp. 109–16.

Chapter 2. Moving Ecoagriculture into the Mainstream

1. Kijabe Environmental Volunteers 2008, at tdesigns.free.fr/kenvo/index.html.

2. Millennium Ecosystem Assessment, *Ecosystems and Human Well-being: Synthesis* (Washington, DC: Island Press, 2005); Z. G. Bai et al., *Global Assessment of Land Degradation and Improvement. 1. Identification by Remote Sensing* (Wageningen, Netherlands: ISRIC–World Soil Information, 2008); Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Impacts, Adaptation and Vulnerability* (Cambridge, U.K.: Cambridge