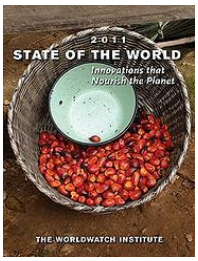

STATE OF THE WORLD 2011

Innovations that Nourish the Planet

NOURISHING THE PLANET
www.NourishingthePlanet.org

INNOVATIONS IN ACTION: Nourishing People and the Planet

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WORLDWATCH INSTITUTE

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Authors: *Molly Theobald, Danielle Nierenberg, Matt Styslinger, Dan Kane, and Abby Massey*
Editor: *Lisa Mastny*

Introduction

Finding ways to alleviate hunger and poverty while also protecting the environment depends on agricultural innovations that are found in fields, pastures, forests, markets, kitchens, backyards, city centers, radio waves, mountain areas, rivers, lakes, and rooftops all over the world.

Worldwatch Institute's Nourishing the Planet team traveled to 25 countries across Africa talking to farmers, policymakers, NGOs, educators, and others to learn about the many approaches that are working on the ground today. We've compiled this list to provide examples and highlights of just a few of the inspiring innovations that are helping to nourish both people and the planet.

To learn more about the Nourishing the Planet project, visit **www.NourishingthePlanet.org**.

1. Unreasonable Innovators for an Unreasonable World

At the Unreasonable Institute in Boulder, Colorado, a young social entrepreneur can gain exactly "the kind of perspective" he or she needs to get a solid business off the ground, says Jehan Ratnatunga, a fellow at the institute. In a single day, Ratnatunga says, "you [might] have lunch with someone from Pakistan and then go and talk to someone from France and then go bounce ideas off of someone from Nigeria."

The Unreasonable Institute was founded by five University of Colorado at Boulder graduates—Daniel Epstein, Teju Ravilochan, Tyler Hartung, Vladimir Dubovskiy, and Nikhil Dandavati—with the goal of providing promising young entrepreneurs with the skills they need to make their ventures sustainable, scalable, and replicable. "We were all trying to create some large-scale change in the world," Hartung explained in an interview with *Entrepreneur* magazine. "But we realized we lacked the skill, the knowledge, the networks—all the tangible things needed to create that impact. We want to give those tools to other young entrepreneurs."

To do that, the Institute selects 25 young entrepreneurs from around the world for a six-week training session in Boulder, which is followed by a trip to San Francisco to meet with potential investors and supporters. At the Institute, fellows meet with one other, attend classes and workshops, gain advice from expert mentors (among them Paul Polak, founder of International Development Enterprises (IDE), and Bernard Amadei, founder of Engineers Without Borders (EWB)—and refine their project proposals. The fellows are also given the opportunity to connect with the Institute's "capital partners," 30 of the world's top funds and foundations, including the Acumen Fund, Good Capital, and ResponsAbility. Representatives from each of these partner funding organizations spend time at the Institute, getting to know the entrepreneurs and building long-lasting relationships.

The Institute training sessions culminate in the Unreasonable Global Summit, an opportunity for fellows to further present and showcase their proposals to attract more funding and support. These presentations, which take place in Boulder, are broadcasted online on Unreasonable.TV and are available for worldwide viewing.

"To have an opportunity to get serious and pitch your ideas to investors….that's an amazing opportunity," says Nnaemeka Ikegwuonu, a participating fellow from Nigeria. Ikegwuonu manages a radio station in Nigeria that "broadcasts agricultural, environmental, and market information that is timely, relevant, and well adapted to over 250,000 listeners who are small-scale farmers." But Nigeria is home to more than 90 million small-scale farmers, Ikegwuonu notes in an interview on the Unreasonable Institute's website, and he wants to reach more of them.

Ikegwuonu needs an investment of US$270,000 to build a taller radio tower and to purchase a stronger transmitter. The Institute, he says, not only provided him with a platform to attract funders and supporters who might be interested in helping him reach additional farmers, but also gave him the experience of a "cross-fertilization" of ideas. "I already have a business plan," he explains. "But I want[ed] to make sure it includ[ed] one or two new ideas that will benefit my listeners and my pitch."

"Nigeria is a big country, and a big country should also have big problems and big solutions," Ikegwuonu says. At the Unreasonable Institute, he is gaining the support and the tools he needs to make his business part of the solution.

2. Providing the Skills—and the Confidence—Needed to Improve Livelihoods

For most women living in rural and remote India, the day begins as early as 3:00 a.m. The flour for the day's meals needs grinding, livestock need to be fed, breakfast needs to be cooked, and water needs to be carried from wells, rivers, and streams. And that's all before the children—usually only the boys— head off to school for the day.

Rural Indian women generally work more and sleep less than their male counterparts, and they have almost no access to education. But the Mona Foundation's Barli Development Institute for Rural Women in Indore is working to change that. The Institute provides young women with education to help them develop practical skills such as reading, sewing, and horticulture, as well as more abstract skills such as confidence and self esteem. They can then use this knowledge to start businesses, produce food, care for their families, and improve their livelihoods.

Women attending the Barli Institute are taught to read at a level that prepares them to sit for the National Open School theory exams. They are introduced to new methods of irrigation, composting, and crop cultivation, and are also taught to weigh their crops, assign value to harvests, estimate costs, count cash, and give change. The women learn how to grow indigenous plants, prepare traditional meals, and make natural remedies for minor ailments, as well as how to protect trees, collect and save seeds, and use compost to benefit both the local environment and the farm. In rural India, 90 percent of births take place at home, so the Institute teaches students about prenatal healthcare and how to identify emergencies, prepare for birthing, and ensure a sanitary delivery. The school also provides classes on forming and running micro-credit groups and managing small businesses.

But just as important as the practical skills they gain is the self-confidence that the young women need to put those skills to use. The Institute helps its students develop leadership skills and to recognize the important contributions that women make to the community. Classes include lessons on problem solving, participating in group discussions, and public speaking.

The Barli Institute started its first classes in 1985 with 19 students, and has since trained more than 4,000 young women from the state of Madhya Pradesh and other parts of India. One of these women is Antari, who before attending the Institute had dropped out of school three times. She was very shy and had trouble keeping up with her studies. But the Institute catered specifically to the kinds of skills that Antari needed to earn a living and to gain self-confidence. She learned sewing and embroidery and was soon helping to teach other students.

When Antari went back to her village, she was able to start her own tailor shop, and six months later she took the national higher-education exams. She did well enough to attend university, where she eventually received a Bachelor of Education and a Master of Philosophy in Education. She is now a post-graduate student in Hindi Literature and is working as a teacher.

Thanks to the support of the Barli Institute, Antari has grown from a young girl who would hide behind her classmates during lessons into a poised, educated, and financially independent professional who is helping other young girls gain an education and learn the value of their own potential.

3. Keeping It Cool. . . and Hot

Every summer, the world's farmers and gardeners face the sometimes unfortunate reality that the weather is out of their control. Vegetables wilt in the heat, and the rain never seems to come when it's needed. In parts of sub-Saharan Africa, where the summer heat is intense and water shortages are common, it can be particularly difficult to keep crops healthy and productive through the growing season.

But one innovative company—Roots Sustainable Agriculture Systems Ltd. (Roots Ltd.)—has developed a system that could help farmers beat the heat. The company's Root Zone Temperature (RZT) Optimization technology uses geothermal energy to enable farmers to control the soil temperature at root zones, increasing plant growth and production dramatically.

Root-zone temperature innovations can be used on both covered and uncovered crops, require very little energy, and can operate "off the grid," meaning they can be installed in remote locations. *(Photo credit: Bernard Pollack)*

Using a low-pressure pump that can be powered easily by a solar panel, water is circulated from an above-ground tank into a system of pipes buried nearly two meters underground that acts like a radiator. In the summer, the ground cools the water, and in the winter, it warms it. The water is circulated back to closed pipes embedded beneath the vegetable rows, cooling or warming the roots before it returns to the tank for re-use.

By maintaining plant roots at an optimal range of 22–30 degrees Celsius, this system can increase the rate of carbon dioxide exchange in plants, as well as the transport of sugars from leaves to roots, boosting plant growth. In trials conducted by Roots Ltd. on Israeli farms between 2007 and 2010, the system successfully raised yields of strawberries, cucumbers, and peppers and helped crops reach maturity earlier.

Roots Ltd. has developed a similar technology that irrigates crops via condensation. Instead of going through an underground radiator, the water is pumped through a solar-powered unit that chills it. The chilled water is then circulated through un-perforated pipes next to the plants, causing water vapor in the air to condense on the pipes, just as it would on a glass of ice water. The condensation then drips off, simultaneously irrigating and cooling the crops. By utilizing water from the air, the system conserves water supplies elsewhere.

These innovations can be used on both covered and uncovered crops, require very little energy, and can operate "off the grid," meaning that they can be installed in remote locations. Following installation, costs are minimal and upkeep is simple, making the systems inexpensive and viable options for small farmers in developing countries. By keeping it cool (and hot) Roots Ltd.'s technologies could help smallholder farmers grow more food at less cost.

4. A Business Model that Makes It Easier—and Cleaner—to Do One's Business

It started out as a mobile toilet business for parties, events, and other large gatherings. But Isaac Durojaiye, founder of Dignified Mobile Toilets (DMT) in Nigeria, soon recognized that there was a greater need for his services on the streets of Lagos, the country's capital. With very few functioning public toilets nationwide, residents of Nigeria's cities are often forced to defecate and urinate in streets, back lots, and other public spaces, causing not only a health and sanitation risk, but also embarrassment and shame.

Still today, nearly 20 years after DMT was founded, it is not unusual in Nigeria to see a person defecating or urinating in the same river or stream where someone else is taking a drink or washing clothes. And as migration to Africa's cities continues to grow, the need for waste management, disease control, and privacy continues to increase as well.

So Durojaiye turned his focus to providing cleanliness and hygiene—and privacy—to Nigeria's streets. DMT manufactures and distributes mobile toilets to fit the various needs of public spaces throughout the country. The company builds squatting mobile toilets for markets, parks, and streets, and reserves the "executive toilets" for conferences, construction sites, and parties.

"I named it 'dignified' to show the world that there is dignity in the business," Durojaiye explained in a 2006 interview with *BBC News*. "There is nothing to be ashamed of about human waste. It is a reality—we all have to answer the call of nature."

In addition to providing clean and private places for people to go to the bathroom, DMT is creating jobs. The company's public mobile toilets are leased out by unemployed or street youth, who in turn charge a small fee to toilet users. The youth make sure that the facilities are clean, and also guard the latrine doors. At the end of the day, after paying the flat lease rate, the youth can keep whatever extra money they make. An average day brings in about US$15 in earnings, a fairly good income by Nigerian standards.

Eventually, DMT hopes to expand its services to include waste recycling, and Durojaiye is looking into using the collected waste to generate biogas, electricity, and fertilizer for farmers.

5. Gathering the Food Growing at Our Feet

After many years of studying invasive plant species in Patagonia, Argentina, Dr. Eduardo Rapoport, a professor at the Universidad Nacional del Comahue, realized that many of the "pests" he was cataloging were edible. "I found that, especially in areas disturbed by man, such as roads, back lots, and gardens, there are a great deal of unintentional food sources," he explains. As a result, Rapoport found himself looking at these "pests, invaders, and weeds" in a very different light.

(Photo credit: Bernard Pollack)

"I gathered together a group of students, and we set out to assess how many kilograms of wild-growing edible food could be found in a hectare of urban space," Rapoport explains. Starting with the airport and working through different parts of the city, he and his students found that the average amount of food per hectare was 1,300 kilograms, or about 3,400 pounds per acre.

Rapoport repeated the same study in Mexico to compare the results from temperate Patagonia with a tropical environment. His team uncovered an even greater wealth of food in that area—some 2,100 kilograms per hectare. "It was surprising," Rapoport says, "and it was incredibly valuable. There are people who are going hungry, and they are surrounded by plenty of food. They just don't know it."

Not only is there a wide variety of wild edible plants growing in or near city streets, schools, and other public areas throughout South America, but much of this vegetation is also incredibly productive, according to Rapoport. "These are weeds," he explains. "They multiply and grow quickly. We found that many of them could be harvested multiple times per season, meaning that a gatherer could get more than one meal from one plant over the course of a very short period of time."

Rapoport and his wife, Barbara Drausal, with the help of the university, have published a guidebook that identifies and describes 240 edible weeds growing throughout South America. The book, *Malezas Comestibles del Cono Sur* (*Edible Weeds of the Southern Continent*), includes illustrations and recipes and also directs readers to the parts of each plant that are edible, providing detailed instructions on how to best prepare them.

Although Rapoport does not encourage people to plant these edible species—most of which are invasive—he says that they can be an important source of inexpensive food. "This is not a solution to world hunger. But it is valuable knowledge that has been lost over the years. There is food all around us, but most people just don't notice it. Or they destroy it because they mistake it for useless pests."

In addition to distributing his book, Rapoport visits primary school classrooms to help educate the next generation of Argentina's food gatherers. He also has reached out to the Ministry of Education in the hope that his research might become a part of standardized curriculum. "Often, I take students outside to their school yard, and they are amazed by how many edible plants are growing right there," he explains.

With edible plants throughout South America originating from North America, Asia, Africa, and Europe, Rapoport hopes to have his book translated into English and other languages. The more people that he can share this information with, the better, he says. "It's about getting this valuable information to the people who need it most: the hungry people who are surrounded by food."

6. Putting Classroom Theory into Practice

‘‘The idea was to bring a lot of expertise from the corporate world to help young social start-ups,” says Fred Rose, when asked about his motivation for founding the Acara Institute in 2008. As part of Minnesota University’s Institute on the Environment, Acara has developed a classroom curriculum for universities in the United States and India that challenges students to think creatively about how to use private businesses to solve pressing global issues such as hunger and poverty. But instead of ending the semester with an exam or a paper, Acara provides students with the tools to turn their best classwork into reality.

“There is a lot of energy in the business world and in young people that is being directed toward providing services or materials that help make the world a better place,” says Morse. “I wanted to provide young business students with better tools to help them make a profit through solving some of the global challenges we face today.”

As part of their studies, students enrolled in Acara’s program compete in the Acara Challenge. Participating U.S. universities are partnered with universities in India, creating teams of 15 students who work together to develop a business plan for addressing a specific problem that is chosen by Acara. “Last year’s competition theme was clean water for cooking, and this year’s is food and water security,” says Morse. “Basically, we are asking the question: ‘How are we going to feed 9 billion people without destroying everything?’”

Winning teams are given the opportunity to attend the Acara Summer Institute, and to see if their model can become reality. Working with experts in the field and on the ground, students can refine their business plans and prepare for an actual launch. “There are always assumptions about what will or won’t work,” Morse says. “Even the best models may be based on incorrect assumptions, and it’s incredibly valuable for students to view that firsthand. They also get to meet their international teammates in person to discuss their project’s future potential.”

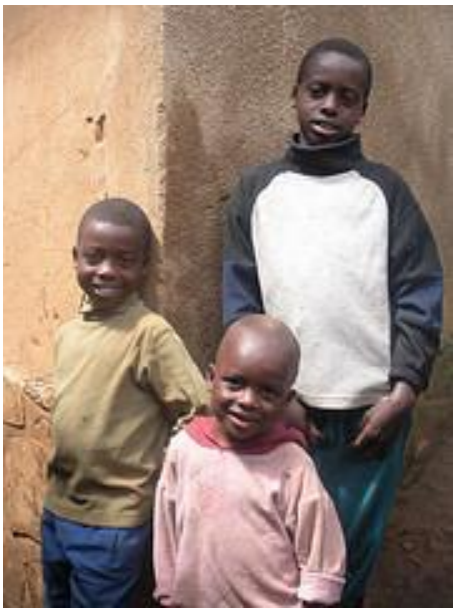
Several projects from past years have moved beyond that final assessment stage, earning attention from funders. “We have some prototype businesses that have gotten started and received some funding,” Morse explains. “Currently, there is a program on the ground that is developing drip-irrigation systems to sell and improve farm water management, and a program that is using biodigesters to create fuel from dairy-cow waste.”

The success of these projects would not be possible, Morse says, without the partnerships between the students in the United States and India. “The idea is that the students in India have to do the field work because they are already on the ground. They go out and conduct interviews and observe, so that they can create a business model with the people in the U.S. that will actually work on the ground.”

The partnership also helps to ensure that the business models are sustainable. “The long-term sustainability of any of these projects has to be with the students in India,” says Morse. “It’s pretty arrogant to think you can sit here in a classroom in Minneapolis and fix these hugely complicated problems halfway around the world.”

7. Taking the Classroom to the Field

Over the last 50 years or so, "the world has changed a lot," says Paul Clark, project manager for the South Africa-based Knowledge Network®. "In rural areas, there is a growing demand for resources that are...increasingly depleted. Meanwhile, knowing how to use computers and exposure to the Internet is increasingly important. So we are combing these skills to improve the local environment and livelihoods."



Knowledge Network is partnering with schools to give children the tools they need to help improve the environment and their livelihoods. *(Photo credit: Bernard Pollack)*

To help children—and adults—deal with their changing world, Knowledge Network® provides training in basic computer skills, graphic and web design, spreadsheet creation and use, and business skills. But Knowledge Network® also integrates issues such as climate change, wildlife conservation, and natural resource restoration into its lesson plans. By partnering with schools, such as the Eastern Cape region's Bedford Country School, Knowledge Network® is helping to bring these lessons to the young people who need them the most. "A lot of the kids in South Africa come from very poor families," Clark explains. "They are mostly worried about what is going to be on the table for lunch or dinner, and many don't have electricity or flowing water. Bedford Country School is in a farming community, and the ability to grow what they need to survive and not destroy the environment while they do that is important."

Part of what exacerbates poverty in the area, Clark says, is that "the demand for local resources is growing but the resources are decreasing with pollution and urbanization." Often, farmers clear forests to make room for more farmland, and the water is contaminated from farm runoff and lack of infrastructure. "Soon, the water in the area won't even be potable or safe to use for irrigation," Clark says.

Back in the classroom, students learn to use computers as a tool for doing research on improved methods of irrigation and other farming practices, and for preparing presentations, documents, posters, and other materials that they can use to present their new knowledge to their class and community.

"The great part about this program," says Clark, "is that kids can go out in the garden and actually plant the tomatoes. Then they can learn about the best way to keep the tomatoes healthy while also minimizing any damage to the surrounding environment. Then they can come inside and share everything they've learned with each other, gaining further skills in computer use that they'll need in the business world."

Clark explains that the program is improving more than just computer skills: "The students are really getting into the research and applying their new knowledge, and it's filtering down to every area. Their English and communication skills are improving, their math is improving, and they understand that they can find answers and information online all on their own."

With the project succeeding at Bedford Country School, the program now hopes to gain funding to move into other communities that can benefit from it. Meanwhile, Bedford students are sharing the resources they have and developing their skills rapidly. "They are very young, with so much in front of them," says Clark. "It is amazing to see what they are achieving now, and exciting to imagine what is ahead of them."

8. Turning an Invasive Species into a Livelihood

For the more than 5,000 people living in rural communities near Lake Victoria—Africa's largest freshwater body—the lake is a lifeline. It is the main source of water for bathing, drinking, and cooking in the area, and its fish populations provide both protein and income to families.

"But the shores of Lake Victoria are choking," says Shana Greene, founder and director of Village Volunteers, a Seattle-based organization that partners with rural communities around the world to create environmentally sustainable solutions for hunger and poverty. "The shores of Lake Victoria are solid with water hyacinths," Greene explains, and the invasive plant is having a disastrous effect on the wildlife and people who depend on it for survival.

The water hyacinth originated in the Amazon and has spread rapidly through tropical and sub-tropical regions in South America, Africa, and Asia, crowding out indigenous plants and fish. The hyacinth form lush green carpets that warm the water while simultaneously reducing sunlight, depleting oxygen levels, and blocking access to the shallows, tangling fishnets and trapping boats. The plants also make an ideal hiding ground for disease-carrying snails and poisonous snakes. "Fish are an important source of protein for local communities," says Greene, "and the warmer water harbors all sorts of diseases, making it less safe for drinking."

As a result, Village Volunteers is helping local communities fight back and turn a potentially devastating situation into a financial boon. "Water hyacinth is actually a really great raw material for so many things," says Greene. "We are helping communities in Kenya harvest it and use it to create tools to use in the home and to sell. We are using it to make fuel briquettes for cookfires and turning it into a very effective fertilizer."

Village Volunteers is also helping local entrepreneurs produce chairs, baskets, and other pieces of furniture that can be made by weaving together the tough stems and leaves of the hyacinths, as well as biodegradable sanitary napkins. "The hyacinth invasion is an overwhelming problem, but it is becoming a business," says Greene. "And by using only locally available materials and labor—oxen help to harvest the hyacinth, for example—the end result is largely self-sustaining."

Although the villages abutting Lake Victoria can't eliminate the hyacinth altogether, they are clearing it away from the immediate shores, helping to improve both the quality of the water supply and the habitats of fish the populations depend on.

"We are helping farmers to not only improve their incomes and livelihoods, but also to make at least a small difference on their local surroundings," says Greene. "They are turning a devastating situation into a life-improving situation."

9. Improving the Harvest, from the Soil to the Market

Farmers in Tanzania's Uluguru Mountains are fighting a losing battle against increasingly degraded land. Repeated plantings are quickly depleting the nutrients in the soil, leaving it nearly barren and vulnerable to erosion. Meanwhile, downstream, the water is dark with sediment, unfit for drinking, and expensive to treat. "Downstream, people are complaining about the quality of water," says Lopa Dosteus, program manager for CARE International's Equitable Payment for Watershed Management (EPWM) program. "And upstream, the farmers are struggling to grow enough food while their soil washes away."

CARE encourages farmers to plant trees as crops to help sequester carbon in the soil and restore nutrients.
(Photo credit: Bernard Pollack)

In response to the growing concerns voiced by those living both up- and downstream, CARE International, an organization fighting poverty and hunger around the world, is partnering with the World Wildlife Fund and the International Institute for Environmental Development to improve farming practices and create financial incentives to take better care of the soil. "The objective," Dosteus says, "is to see if we can help farmers manage natural resources while at the same time increase their income."

EPWM encourages, and works closely with, smallholder farmers to use farming techniques that help restore—and hold in place—the soil. "We encourage these farmers, who are all farming on small pieces of land, to build terraces to limit soil runoff and erosion," Dosteus says. "We also encourage them to plant trees as crops and to plant trees in the areas of their land that are otherwise going unused. This helps sequester carbon in the soil and restores much-needed nutrients."

EPWM also provides supplies and support, such as seeds and crop-maintenance training, and encourages farmers to leave sections of their land alone for one- or even two-year periods to give the soil a chance to regenerate on its own.

Once the harvest is improved, EPWM works to make sure that farmers have a place to sell the surplus. Most farmers in the Uluguru Mountain region do not have relationships with sellers at local markets. Instead, farmers take their produce to market dealers who purchase the rice, maize, beans, groundnuts, tomatoes, cabbages, and bananas at the lowest rate possible in order to turn around and sell them to local businesses at marked-up prices. "We support farmers throughout the process to go out and identify the market for themselves," says Dosteus. "They collect information and meet with interested businesses. Then they don't need the dealers anymore."

Although transporting crops to the market is a problem, especially during the rainy season when mountain roads are almost entirely inaccessible even by foot, Dosteus says that the participating farmers, motivated by their improved harvest and increased incomes, are collaborating to fight for government assistance and improved infrastructure.

"Farmers are seeing that this is increasing their production and their incomes, and it's motivating them," says Dosteus. "They are happy that the area is being well conserved, and they feel like they have access to more things. We are helping them shout together and be heard by the government so that their already improved access to the market can be improved even more."

"Farmers are seeing that they can do this on the small level, and it's making them think and act bigger," Dosteus adds. "Now they are improving things all on their own."

10. Putting a Stop to the Spreading Sands

Throughout the Sahel, recurrent drought since the late 1960s is turning formerly crop-covered land into desert. And the sand is spreading. Picked up by the wind, soil particles from the West African coastline and the Sahel create dunes that are covering villages, roads, crops, and irrigation systems, making it increasingly difficult to farm and maintain infrastructure.

Every week during the pre-harvest season, poor farmers receive cereal as a credit. At the end of the season, farmers can pay back the loan with their own crops with a 25 percent interest rate that the villagers picked on their own. *(Photo credit: Bernard Pollack)*

In Mauritania in particular, desertification has significantly reduced arable land. Studies from the United Nations Food and Agriculture Organization (FAO) show that shifting sand dunes now cover two-thirds of the country's land area. Reduced farmland and water scarcity are threatening food security and forcing the large-scale movement of people to urban areas in a country where 70 percent of the population is rural.

A recent FAO report presents a model of success in halting desertification in the Sahel. Based on the FAO's seven-year project in Mauritania, the report, *Fighting Sand Encroachment: Lessons from Mauritania*, provides lessons for similar efforts taking place throughout sub-Saharan Africa.

Given the complexity of the problem as well as its significant economic implications, the Mauritanian government has made halting desertification a political priority, incorporating desertification control into every aspect of its development strategy. With support from partners such as the FAO, the United Nations Development Programme (UNDP), and the International Fund for Agricultural Development (IFAD), among many others, the government implemented national-level projects and programs to create widespread, synchronized action to stop the spreading sand.

Between 2000 and 2007, for example, the Rehabilitation and Extension of Nouakchott Green Belt Project—a partnership between the FAO and the Mauritanian government that was initiated by Prince Laurent of Belgium and funded by Belgium's Walloon Region—worked to improve sand-encroachment control and protect the infrastructure of Mauritania's capital city Nouakchott.

A series of fences was designed to redirect the wind in order to create artificial dunes surrounding the city. These dunes reduced the strength of the wind and slowed the advance of more sand. Set at a 120 to 140 degree angle, deflection fences were also erected to redirect the incoming winds and sand, further reducing sand buildup. Both fences were constructed from branches and twigs collected from mature forests. Woven together, the materials provide just enough permeability to slow the wind speed while still remaining upright in the face of strong gusts.

Once the artificial dunes have been halted using the hand-woven fences, the process of creating long-term barriers begins. Although sand dunes are perhaps the least hospitable environment on which to grow trees and other vegetation, walls of mature plant growth also provide one of the most effective barriers for sand. Depending on the climate and soil conditions, project workers select and plant dry-tolerant and indigenous tree species to act as barriers.

Initial care of the plants is critical to their survival due to the harsh growing conditions. But maintaining these natural barriers brings more benefits than just the slowing the sand. Government-hired guards protect the barriers from vandalism and wind damage, and the natural walls are also tended by members of the rural community, who will eventually benefit from the new source of food, firewood, seed, and livestock fodder.

11. From Township Garden to City Table

Roughly 1 million people in South Africa live in the shacks that make up Khayelitsha, Nyanga, and the area surrounding the Cape Flats outside Cape Town. The majority of these residents are recent arrivals from the former apartheid homelands of Transkei and Ciskei. Just under half, or 40 percent, of the population is unemployed, while the rest earn barely enough income to feed their families.

The nonprofit group Abalimi Bezekhaya is bringing food and wild flora into South Africa's townships—and helping the townships bring fresh produce into the city.

In Xhosa, the most common language found in the area, the word *abalimi* means "the planters." Through partnerships with local grassroots organizations, the aptly named Abalimi Bezekhaya, a nonprofit organization working with residents of these informal settlements, is helping to create a community of planters who can feed the township.

Abalimi Bezekhaya is helping to transform townships into food- and income-generating green spaces in order to alleviate poverty and protect the fragile surrounding ecosystem. Providing training and materials, the organization helps people turn schoolyards and empty plots into gardens. Each garden is run by six to eight farmers who, with support and time, are soon able to produce enough food to feed their families. Abalimi Bezekhaya encourages community members to plant indigenous trees and other flora in township streets to create shade and to increase awareness of the local plant life, much of which is endangered due to urban sprawl.

But Abalimi Bezekhaya isn't just bringing food and wild flora into the townships. It's also helping the townships bring fresh produce to the city. With support from the Ackerman Pick n'Pay Foundation, and in partnership with the South African Institute of Entrepreneurship and the Business Place Philippi, Abalimi Bezekhaya founded Harvest of Hope in 2008. Harvest of Hope purchases surplus crops from 14 farmer groups working in the organization's community plots, boxes the produce, and delivers it to selected schools where parents can purchase the items to take home.

For families in Cape Town, Harvest of Hope means fresh vegetables instead of the older (and often imported) produce available at the grocery store. But for families of the farmers working with the project, it means much more. "To grow these vegetables here, for me—first—is a life," said participating farmer Christina Kaba in a video describing the initiative. "Second, is how you can give to your family without asking anyone for a donation for money or food. Here, you are making money, you are making food."

12. Water from Thin Air

In many parts of sub-Saharan Africa, people are forced to travel long distances and to spend hours at a time collecting the water needed for cooking and drinking from far-away streams or wells. But the residents of Cabazane, South Africa, have found a much less labor-intensive alternative: they use gravity to let water come to them.

With the help of a team of scientists led by Jana Olivier from the University of South Africa's School of Agriculture and Environmental Studies, the residents of Cabazane are using nets strung across a nearby mountain pass to harvest water from the air.

The water from the clouds is very clean—a particularly valuable commodity in an area that previously suffered from water shortages. *(Photo credit: Bernard Pollack)*

At an altitude of 1,600 meters, steel cables held by wood posts support the two layers of shade-cloth nets used to catch tiny droplets of water from the passing mountain fog near Brooks Nek Pass. The droplets create runoff that is captured in gutters beneath the nets. The water is then carried by tubes down the mountainside and to the village. With each square meter of netting providing up to five liters of water daily, Cabazane can collect hundreds of liters on a good day.

Most importantly, the water from the clouds is very clean—a particularly valuable commodity in an area that previously suffered from water shortages. The nearest stream to the village, two kilometers away, is contaminated by animal use. Residents who utilized the stream were often exposed to water- borne diseases. Dams were once used to collect water in the area, but extreme drought has dried up even this source.

Nandi Ntsiko, a resident of Cabazane, noted in an interview that, "having piped water was a pipe dream for us. We were forced to share drinking water with animals in this stream. The situation was dire."

Now, the villagers not only have a steady supply of clean water, but they have enough of it to store in newly constructed tanks. The netting provides the additional benefit of being completely gravity driven. No electricity is needed to power this innovation, making it affordable and environmentally friendly, and the technology is simple enough that maintenance is relatively easy.

Collecting water from the fog is a technique that has been used for nearly 30 years in some mountainous parts of Chile, and the project at Cabazane has been so successful that it has already been replicated in other dry areas of South Africa, including Venda and Limpopo.

13. Staying Tuned for More Innovations

Listen to Radio Fanaka Fana and Radio Jigiya, in the Fana and Zégoua regions of Mali, and you are more likely to hear tips for improving compost piles and soil quality than you are pop music hits or current events. That's because the station is participating in Farm Radio International's Africa Farm Radio Research Initiative (AFRRI), a project to test the viability of using radio as a tool for spreading agricultural information to farmers throughout Africa.

Farm Radio International is a Canada-based nonprofit organization that has partner broadcasters at over 300 radio stations in more than 39 sub-Saharan African countries. Its programs reach an audience of more than 600 million people speaking more than 300 languages, providing listeners with valuable information that is both increasing harvest yields and improving livelihoods.

Although mobile phones, computers, and televisions might seem like more obvious (and increasingly popular) forms of mass communication, the radio is still Africa's least expensive and most widespread communications technology. In Mali, where the soil is often dry and eroded, AFRRI is taking advantage of radio's popularity by working with local leaders and extension officers to present programs that can help farmers improve soil quality. Radio Fanaka Fana and Radio Jigiya—with a combined audience of more than 170,000 listeners—present regular shows promoting the use of compost pits to create organic fertilizer.

A case study for this composting campaign found that farmers in the two radio stations' listening areas were responding to the programs in overwhelming numbers. In Radio Zégoua 's region alone, the share of households that practice improved composting increased from just over 25 percent to more than 89 percent. Farmers reported feeling more comfortable with local extension officers after hearing them on the radio, and, based on word of mouth, communities outside the listening area started requesting programs of their own. One such community even built a homemade antenna so residents could hear the programs being broadcasted in the next region over.

14. Funding a Blue Revolution

As climate change worsens and as freshwater availability grows more erratic, the food security of small-scale farmers throughout Africa will depend increasingly on farmers' water-management abilities. Luckily, the tools for improving water management already exist. But as a 2010 report from the Rockefeller Foundation notes, the key to getting these tools to the people who need them the most will be making sure that the funding, donor, and policymaking communities understand what these tools are and why they need more support.

Ethiopian farmer-priest Kes Malede Abreha was able to develop a water management system on his farm with the help of funding from the global, NGO-initiated organization, Prolinnova. *(Photo credit: Bernard Pollack)*

Many examples exist of simple and inexpensive ways to improve water management for small-scale farmers, and the Rockefeller report highlights several of them. Increased investment in smallholder irrigation, for example, creates greater diversity of water-source options, such as small streams, shallow wells, boreholes, and rainwater storage, and gives farmers and small communities' autonomy over their water supplies. Low-technology irrigation methods are cost-efficient as well, and include surface-irrigation systems such as furrows and small basins, pressurized systems such as sprinklers and drip irrigation, and water-lifting technologies that can be driven by gravity, manual labor, and motorized pumps.

On the ground, countless groups are working to help farmers improve water-management techniques and gain access to improved water-management technologies. Many of these organizations deserve more resources and funding from the donor and policymaking communities in order to alleviate global hunger and poverty.

In Accra, Ghana, the International Water Management Institute (IWMI), a nonprofit organization working in Asia and Africa to improve water and land management for farmers and the environment, received funding from several groups—including the Consultative Group on International Agricultural Research (CGIAR) Challenge Program for Water and Food—to work with urban farmers to develop improved farm wastewater management. Because of a lack of alternatives, farmers often use waste water to irrigate their crops and clean their vegetables. IWMI is working to help these farmers both clean and conserve this water, improving sanitation, crop yields, and livelihoods.

In Zambia, International Development Enterprises (IDE), an organization working to improve the livelihoods of farmers in Asia and Africa through improved agricultural technology and market access, is helping families improve their livelihoods, prepare balanced meals, and educate their children with the introduction of a single technology: the treadle pump. The pump makes irrigating larger pieces of land easier and improves crop yields, allowing farmers to diversify and increase their harvest, while also producing a surplus that can be sold at local markets for a profit.

And in Ethiopia, a farmer-priest named Kes Malede Abreha was able to develop a water-management system on his farm with the help of funding from the global, NGO-initiated organization Prolinnova. Abreha's system has allowed his family to move from a one-room house to a larger home where he is now able to grow a diversity of crops and raise, chickens, cattle, goats, and bees. Abreha is showing farmers in the community how small investments in technology—such as those outlined in the Rockefeller report—can go a long way toward improving a family's quality of life.

15. Turning Agriculture into Gold

Before Kenya's independence, the economy of the Migori District in the southwest was driven by the Macalder Mining Company, the area's largest employer. When the company shut down in 1966, it left behind a lot of abandoned land—and a lot of unemployed miners. These miners, some of whom bought up land from the closed mining company, continued, for the most part, to mine for gold. But the work became increasingly dangerous as gold deposits shrunk over time and as miners were forced to go deep into abandoned mines to look for what little gold was left.

To improve livelihoods, CNFA provided improved seeds and fertilizers, as well as training in new methods of farming. *(Photo credit: Bernard Pollack)*

Many of the miners were poor in gold but rich in land. Yet without proper training and an appreciation for the business potential of farming, they continued to return to the empty mines despite dwindling profits.

In 2007, CNFA, a nonprofit organization that emphasizes access to the private sector as a means of improving livelihoods and creating economic growth, and its Kenya affiliate Agriculture Market Development Trust (AGMARK), set out to help miners develop new skills and improve their livelihoods.

CNFA provided improved seeds and fertilizers as well as training in new methods of farming. It also connected farmers with input suppliers and markets for their produce. The organization connected one miner-turned-farmer, James Adiang, with the Ministry of Agriculture, which advised him to start growing tomatoes, watermelon, kale, butternut, beans, soybeans, green grains, bananas, and potatoes. In just over two years' time, Adiang was able to purchase more land and livestock, as well as take up beekeeping.

"I became a gold miner on a full-time basis for over 10 years and, frankly speaking, it was like chasing after the wind because there was nothing I could show off," Adiang said in a CNFA case study. "Occasionally I used to get some unrefined gold particles, which I sold to gold agents or brokers at a price of between 150 and 500 [Kenyan] shillings. The hope of someday digging big pieces of gold and instantaneously becoming rich is what kept me coming back and digging for all those years."

Now Adiang sees the promise of financial security in agriculture—and he is sharing his new knowledge with the community. He has hosted CNFA-facilitated field days and demonstrations on his farm and hopes to use the business training he's received to become an agrodealer, providing farm inputs and information for the local area.

Adiang envisions that he can help his community, through education and demonstration, "to embrace agriculture as a better and sustainable alternative" to gold mining and as a means to improve livelihood, food security, and household income.

16. Handling Pests with Care Instead of Pesticide

During 1975–76, Name Name, like most Cambodian farmers at the time, grew vegetables and rice to feed the soldiers of the Lon Nol regime. Using his bare hands, Name mixed and applied DDT, Folidol, Phostrin, Kontrin, and other chemicals to keep pests away from his crops. As a result, he suffered from strange and uncomfortable physical symptoms. Sometimes, he was unable to move or feel his hands and lower arms, and he experienced pain in his lungs and heart. His short-term memory was also affected. These symptoms often persisted for up to six months following exposure to the chemicals.

When the regime ended, Name went back to farming for himself and his family, and he decided to do so without using any of the harmful chemical fertilizers that he realized were so dangerous to his health. With training from organizations supported by the United Nations Food and Agriculture Organization (FAO) and its Regional Vegetable IPM Program in Asia—in addition to some of his own research—Name learned how to prepare botanical insecticides and organic composts using animal wastes and other materials available on his farm. He is now able to avoid expensive and dangerous insecticides almost completely.

This alternative approach, known as Integrated Pest Management (IPM), combines various strategies and practices to grow healthy crops, reduce damage from pests, and minimize the use of artificial inputs. The FAO Regional IPM Program uses informal farmer training schools, facilitated by extension staff or other local farmers, to help train and implement field experiments. Local farmers learn new techniques from each other—and also develop their own methods through facilitated field experiments—to minimize the use of chemical inputs on their farms.

In addition to raising animals and growing vegetables and rice, Name produces several varieties of mushrooms organically, which he sells at local markets. Although he does not yet receive a higher price for his organic produce, his crops are marketed as being chemical-free to an increasingly conscious consumer base. Name hopes that as awareness about the dangers of many chemical fertilizers increases, so will the value of his crops.

For now, Name is happy to be producing enough food to feed his family and to provide a significant portion of their income, without endangering his own health or the health of those who enjoy his crops.

17. Getting to the Market

For many farmers, an abundant harvest is only the first step toward feeding their families and earning an income. Vegetables ripening in the field—or even harvested and stored nearby—are still a long way from the market where they can be sold for a profit.

With his donkey cart, Sudanese farmer Abdall Omer Saeedo is not only able to cart his produce to market twice a week; he can also easily bring back whatever he is unable to sell. *(Photo credit: Bernard Pollack)*

One farmer in Sudan's Kebkabiya province, Abdall Omer Saeedo, has to travel 10 kilometers twice a week to the nearest market to sell his vegetables and green fodder. Without a cart, truck, or other means of transporting a large amount of goods efficiently, he wasn't able to make enough money to cover his production and packing costs, let alone the cost of seeds for the next season, education for his children, and other household needs. And after making it to market with his 10 sacks and five bags of produce on the back of his donkey, he was still at risk for loss if he wasn't able to sell it all. Instead of dealing with the hassle of trying to pack it back home again, he would throw away whatever wasn't sold.

Saeedo sought the help of Practical Action, a development nonprofit that uses technology to help people gain access to basic services such as clean water and sanitation to improve food production and incomes. Working with local metal workers, the organization designed a donkey cart for him. Now, Saeedo is not only able to cart his produce to market twice a week, but he can also easily bring back whatever he is unable to sell. His income has increased along with the quality and quantity of his product, which is no longer lost or destroyed by travel time and conditions.

Practical Action's transportation innovations are helping to improve farmer livelihoods throughout sub-Saharan Africa and around the world. In Kenya, the organization introduced bicycle taxis as a way for people to earn a living as well as an energy-efficient means to transport people from place to place. In Nepal, Practical Action's bicycle ambulances carry sick or injured people from remote areas to hospitals safely and comfortably. And in Sri Lanka, the group's bicycle trailers—capable of carrying loads of up to 200 kilograms—are used to transport goods to market, people to hospitals, and even books to local communities.

18. For Pest Control, Following Nature's Lead

It might feel counterintuitive, but the more varieties of vegetables, plants, and insects that are included in a garden, the less vulnerable any single crop becomes. Mans Lanting of ETC Foundation India wrote in *LEISA Magazine* in 2007 that the best method of approaching pest control is to learn to live in harmony with pests instead of trying to fight them. By harnessing the natural state of vegetation and pests, a farmer can create "a system in which no component can easily dominate" and in which soil and crop quality is greatly improved.

The more varieties of vegetables, plants, and insects that are included in a garden, the less vulnerable any single crop becomes.

In other words, the tendency for traditional farming to give preference to specific crops, to plant in clean rows, to weed out any invasive plants, and to use chemicals to prevent pests and disease is actually creating a need for these pesticides and fertilizers. Soil fertility decreases when crops are harvested, and growing a single crop means that the soil is further stripped of nutrients with each season, requiring the use of inputs that, according to Lanting, lead to an imbalance in plant nutrition and increase vulnerability to pests and diseases. This introduces the need for pesticides, which cost more money and create toxic runoff that can damage the local environment.

The result is a self-perpetuating war against infertile soil and a burgeoning pest population. Instead, Lanting recommends taking an alternative approach, mimicking the diversity that takes place in nature and creating a garden that relies on natural systems to provide nutrients as well as pest and disease control.

Farm biodiversity can be improved by integrating border crops, trees, and animals. Farmers can also include "trap crops"—crops that attract insects away from the main crop—which include Indian mustard, sunflower, marigold, soybeans, and French beans, as well as crops that promote insect predators such as pulses for beetles, okra for lace wing, and coriander, sorghum, and maize for *trichogramma* (small wasps). Visual barriers can be used to help "hide" crops from pests. The diamond-backed moth, for example, has to be able to see cabbage in order to find it—and destroy it—before a harvest.

Many of these techniques are being implemented at Enaleni Farm, a demonstration farm run by Richard Haigh in Durban, South Africa. Haigh cultivates traditional maize varieties that are resistant to drought, climate change, and disease, and he practices push-pull agriculture, which uses alternating intercropping of plants that repel pests with ones that attract pests in order to increase yields. He also applies animal manure and compost for fertilizer. Haigh likes to say that his farm isn't organic, but rather an example of how agro-ecological methods can work.

Using these methods, a farmer will have a garden with at least 10 crops, creating an ecosystem that resembles one found in nature. The soil is more fertile, and the insects and diseases are distracted and preyed upon so that their impact is less concentrated. In a sense, a farmer needs to let the garden get wild in order to protect it from the wild.

19. Makutano Junction

The last place most of us look to for useful information is television soap operas. But "Makutano Junction," a Kenya-produced soap opera set in the fictional town of the same name, is not your average TV drama. Broadcasted in Kenya, Uganda, Tanzania, and throughout English-speaking Africa on Digital Satellite Television (DSTV), Makutano Junction doesn't deal with the evil twins, amnesia, and dark family secrets typical of U.S. daytime dramas. Instead, the show's plot lines revolve around more grounded (although no less dramatic) subjects such as access to health care and education, sustainable income-generation, and citizens' rights.

Funded by the U.K. Department for International Development, produced by the Mediae Trust, and broadcasted by the Kenya Broadcast Corporation, the show was originally designed in 2004 to be a 13-part drama. But Makutano Junction has since developed into a six-season TV phenomenon, with more than 7 million viewers in Kenya alone. Its website provides all the information one might expect from a television show site, including episode summaries and character profiles. It also features "extras" on themes from specific episodes and encourages viewers to text the producers for more information.

Seed soaking works by essentially tricking the seed into thinking it has been planted, allowing it to soak up in one day as much water as it would in a week in the soil. *(Photo credit: Bernard Pollack)*

In Episode 8 of Season 6, which aired in 2008, the character Maspeedy gets into trouble for soaking seeds. Seed soaking works by essentially "tricking" the seed into thinking it has been planted, allowing it to soak up as much water in one day as it would in one week in the soil. This speeds up germination and significantly shortens the time between planting and growth, leading to a vegetable harvest in a quick amount of time.

But the other characters in the show are unfamiliar with this practice, and when they discover Maspeedy's project, they have him thrown in jail because they are convinced that he is brewing alcohol illegally. After some plot twists and a little slapstick humor involving two trouble-making characters who attempt to drink the water to get drunk, the truth comes to light, and Maspeedy is released from jail. He then teaches the rest of the town the simple technique of soaking seeds to speed plant-growth time.

After the episode aired in May 2008, thousands of viewers sent texts to Mediae requesting more information about seed-soaking techniques. These viewers were sent a pamphlet with detailed instructions on how to soak their own seeds. Follow-up calls—which were part of a study to test the effectiveness of the show's messaging—revealed that 95 percent of those who had texted for more information found the pamphlets helpful. And 57 percent had tried out seed soaking even before the pamphlet arrived, based solely on the information provided on the show. Ninety-four percent said that they had shared the information with up to five other people.

By peppering the drama-infused lives of its characters with demonstrations of agricultural practices, trips to the doctor for tuberculosis tests, and Kenyan history, Makutano Junction serves to both entertain and provide reliable information for families throughout sub-Saharan Africa. This is soap opera drama that people can actually relate to—and learn from.

20. Beating the Heat to Reduce Post-Harvest Waste

For a farmer in a hot country like Sudan, a big harvest can end up being a big waste. A fresh tomato off the vine will last only about two days in the stifling heat, while carrots and okra might last only four days. Despite being highly capable of producing abundant harvests, without any means to store and preserve crops, farmers in Sudan are at risk for hunger and starvation. They are also losing money that could be made selling surplus produce at markets, if they only had a way to keep vegetables longer.

Practical Action, a development nonprofit that uses technology to help people gain access to basic services like clean water and sanitation and to improve food production and incomes, provides a simple solution to this problem in the form of homemade clay refrigerators. These refrigerators, called *zeer pots*, can be built from mud, clay, water, and sand. A farmer uses mud molds to create two pots of different sizes. Once dry, the small pot is fitted into the larger pot, and the space between them is filled with sand. By placing this structure on an iron stand to allow for air flow, and by adding water to the sand between the pots daily, a farmer can use evaporation to keep the pots—and their contents—cool.

In a *zeer pot*, tomatoes and carrots can last up to 20 days, while okra will last 17 days. This can make a huge difference for a small-scale farmer who is trying to feed his or her family. Farmer Hawa Abbas, featured in a Practical Action case study, used to regularly expect to lose half her crop to the inescapable heat. But now, *zeer pots* "keep our vegetables fresh for three to four weeks, depending on the type of crop," she said. "They are very good in a hot climate such as ours where fruit and vegetables get spoiled in one day."

Practical Action provides trainings and demonstrations to teach small-scale farmers how to make and use the pots in developing regions such as Sudan and Darfur. An instruction manual on how to make the pots can be found on the organization's website.

21. Fighting Global Malnutrition Locally

Every year, 5 million children worldwide die from malnutrition-related causes, including immune system deficiency, increased risk of infection, decreased bone density, and starvation. But a variety of efforts in Africa and elsewhere are hoping to turn things around.

Ghana's New Frontier Farmers and Processor group processes the leaves of moringa trees into powder that can be manufactured into formula for malnourished children. *(Photo credit: Bernard Pollack)*

In the Democratic Republic of the Congo (DRC), a country that has struggled with internal conflict, food shortages, and poverty, thousands of lives are threatened by acute malnutrition. When a child is brought to one of the Ministry of Health's regional Stabilization Centers, run with support from the global humanitarian organization Action Against Hunger, he or she receives rations of specially formulated Ready-to-Use Therapeutic Foods (RUTF). RUTF—such as Plumpy'nut, a peanut butter-based food produced by the French company Nutriset—is infused with vitamins and minerals and is used to quickly rehabilitate children suffering from malnutrition.

RUTF is pre-packaged and requires no preparation or refrigeration. It can be administered at home, enabling families to avoid having to travel to far-off medical centers or to pay for long, expensive hospital stays. It is also very effective. After about 40 days of 2–3 servings of RUTF per day, a child can reach a healthy weight. During the 2005 food crisis in Niger's Maradi region, the nonprofit organization Doctors Without Borders treated 40,000 severely malnourished children using RUTF and saw a recovery rate of 90 percent.

In addition to obtaining Plumpy'nut from UNICEF or directly from Nutriset, Action Against Hunger purchases it from Amwili, a company that partners with Nutriset and is based in the DRC's second largest city, Lubumbashi. By providing a local source of RUTF, Amwili frees the treatment centers from dependency on European supplies. Local production also improves livelihoods by creating jobs, and many organizations worldwide are linking local farmers to RUTF production to provide an improved, consistent source of income.

In Haiti, the Zanmi Agrikol Program, run by the local organization Partners in Health, is improving agricultural capacity and household food security—as well as treating malnutrition—by training and contracting with peanut farmers who provide the ingredients for locally produced RUTF. The project currently provides malnutrition treatment and prevention for some 5,000 children; agriculture training and support to 1,240 families; and has contracts with more than 100 local peanut farmers.

Haiti's Meds & Food for Kids relies on local ingredients and producers to make its own brand of RUTF, called *Medika Manba* or "Peanut Butter Medicine." The organization saw a significant increase in demand for Medika Manba after the devastating earthquake of January 2010. Many malnourished children were treated with the locally made RUTF, which provided the additional benefit of helping to restore Haiti's fragile economy.

Companies such as Nutriset in France and Valid International in the United Kingdom offer instruction manuals for local production of their RUTF products and partner with local producers in countries across sub-Saharan Africa that are struggling with malnutrition. Action Against Hunger, for example, also purchases Plumpy'nut from a producer in Nairobi, Kenya, called INSTA—a partner of Valid International—to distribute RUTF to its programs throughout East Africa.

In Ghana, the New Frontier Farmers and Processor group processes the leaves of moringa trees, which are high in protein and other valuable nutrients, into powder that can be manufactured into formula for malnourished children. This effort, along with other crop-processing projects, is helping to add value to crops and improve the livelihoods of nearly 5,000 participating small-scale farmers.

22. Locally Produced Crops for Locally Consumed Products

In Zambia, sorghum—a drought-resistant cereal that thrives in the country—once was considered a "poor man's crop," shunned by small-scale farmers who preferred the more commercially viable maize. But, according to an article in the June 2010 issue of *Farming Matters*, one Zambian brewery is changing the way local farmers think about sorghum.

While most clear beers such as lagers and pilsners are brewed using expensive imported malts, Zambian Breweries' Eagle Lager is made from sorghum. A subsidiary of South Africa-based SABMiller, Zambian Breweries purchases the grain from local farmers, increasing farmers' income and providing local grocery stores with an affordable lager.

To help farmers partner with the brewery, the Cooperative League of the United States of America (CLUSA), with funding from the U.S. Agency for International Development (USAID) and the International Fund for Agricultural Development (IFAD), provides loans for farmers' start-up expenses, as well as agricultural training to make sure that the crops meet the brewery's quality standards. With CLUSA's support, the brewery gets a consistent supply of sorghum to produce its beer, and farmers gain access to a secure market, a fixed price for their crop, and a consistent income.

To produce larger yields of high-quality sorghum, CLUSA and the brewery encourage farmers to use conservation agriculture, a combination of simple techniques such as minimal or zero-tillage, ground cover, crop rotation, and inter-planting. Such methods can reduce the need for outside inputs, including artificial fertilizer, pesticides, and herbicides. And conservation agriculture benefits the other crops the farmers grow by helping to improve soil fertility, control pests and weeds, and improve water management. In Zambia, maize yields have increased 75 percent and cotton yields 60 percent thanks to the technique.

Although Zambia Breweries' collaboration with local farmers is a success story, not all partnerships between large companies and small farmers go so well. Without appropriate regulation, companies may take advantage of a monopoly situation; farmers can become indebted to the company and lose control of their farms and crops; and a big financial incentive to grow a specific crop can threaten overall crop diversity.

In Zambia, however, more than 4,500 small-scale farmers in 14 districts are now seeing an increase in their incomes due to their contracts with Zambia Breweries. Recognizing the significance of this opportunity, the Zambian government recently lowered taxes on Eagle Lager to encourage the brewery to continue working with local farmers. Meanwhile, parent company SABMiller is trying to form similar partnerships with sorghum farmers in Mozambique, Tanzania, Uganda, and Zimbabwe.

23. Using Digital Technology to Connect and Empower Young Farmers

At the Rural Development Foundation's primary school in the village of Kalleda in India's Andhra Pradesh state, students carry gardening tools in addition to their notebooks and pencils. The students work in the school's garden, cultivating rice, lentils, corn, and cotton that are used to prepare the daily meals or are sold to the village and to other schools. Students also take turns tending a field of marigolds and selling the flowers in Kalleda. All of the profit goes back to the school.

But the students also carry another important tool: a camera.

The cameras were provided by Bridges to Understanding (Bridges), a Seattle-based nonprofit that uses digital technology to empower and connect children around the world. Students participating in the Bridges curriculum are taught to use cameras and editing software to develop stories about their communities and cultures. These narrated photo slideshows are then shared with the Bridges online community, which includes schools in seven countries: Azerbaijan, Cambodia, Guatemala, India, Peru, South Africa, and the United States.

For many of the students, it is the first time they have held a camera. "When I first asked my students if they thought they could ever design, shoot, and edit their own film, they just shook their heads and said, 'there's no way,'" says Elizabeth Sewell, Bridges program coordinator at the Kalleda school.

But not only did Sewell's students successfully conceptualize, shoot, and edit a video about local water pollution, they also are participating in an online discussion about their school garden with students at the Aki Kurose school in Seattle. The U.S. students are learning to grow corn, squash, and beans using traditional Native American practices. They also volunteer at a local food bank—a foreign concept to the students at Kalleda. "Thank you for your post about your school garden and information about your food bank," Sewell's students wrote. "We had never heard of a food bank before your post. We like the idea of a place where people can get free food."

Sewell explains that having a conversation about farming with students in Seattle helps students at Kalleda "realize what makes their community unique, but also that there are other kids out there dealing with similar issues, providing a model or inspiration for alternatives and creating a global sense of solidarity in facing these problems."

According to Sewell, the Bridges video project gives students a concrete and achievable goal to strive toward as they grapple with larger questions about their role as "agents of change" in their community and the world.

"At first, the prospect of designing, shooting, and editing a movie seems insurmountable, but then they produce these beautiful films," says Sewell. "And then you knock down that barrier, you show them what they are capable of doing. And then they can start to approach other larger—and more institutional—problems the same way. Suddenly, in their own eyes, there are no limits to what they can achieve."

24. Messages from One Farmer to Another

Roughly 80 percent of the world's rice is grown by smallholder farmers in developing countries, according to the International Rice Research Institute (IRRI). From Bangladesh to Benin, these farmers are continuously developing and testing new methods to improve rice production—from using flotation to sort seeds, to parboiling, a process that removes impurities and reduces grain breakage. The Benin-based Africa Rice Centre (AfricaRice) has developed a simple solution to help farmers share this knowledge: farmer-to-farmer videos.

Working with researchers, rice farmers, and processors, AfricaRice has developed a series of videos to instruct farmers in the developing world. Topics include: seed sorting (manually and by flotation), seed drying, and seed preservation in Bangladesh; rice quality and parboiling in Benin; land preparation for rice planting in Burkina Faso; and seedbed preparation, transplanting, weeding, and soil fertility management in Mali.

Farmers in Guinea, for example, have watched videos of Bangladeshi women who developed solutions to improve their farm-saved rice seed. "The farmers pay a lot of attention to the quality of their seed that they store for the next season," explains Louis Béavogui, a researcher at the Institut de Recherche Agronomique de Guinée (IRAG). "Watching the videos on seed has stimulated them to start looking for local solutions to common problems that farmers face. It is by drawing on local knowledge that sustainable solutions can often be found, at almost no cost."

To pique interest in the project, AfricaRice researchers approach farmers with videos on topics that are relevant to that particular region. And the researchers involve farmers in the production of the videos from the very beginning, soliciting their input about which methods should be highlighted. Edith Dah Tossounon, chair of a rice-processing group in southern Benin, was one of the many women who demonstrated how to parboil rice in a video.

The strong presence of women in the videos helps local nongovernmental organizations (NGOs) and extension offices—which tend to employ mostly male agents—to engage women's groups. A survey of 160 women in Central Benin compared the use of video with conventional training workshops and found that the videos reached 74 percent of women, versus 27 percent for conventional training. Women who watched the videos later worked with NGOs to formulate requests for training in how to build improved cook stoves. They also sought financial assistance to buy inputs such as paddy rice and improved parboilers that allow rice to stay above the water during steaming, preserving nutritional value.

More than 95 percent of the women who watched the videos adopted the practices of drying their rice on tarpaulins and removing their shoes before stirring the rice to preserve cleanliness and avoid contamination—compared to about 50 percent of the women who received only traditional training. Moreover, illiterate woman could learn easily from the simple language and clear visuals of the videos.

"By giving rural women a voice through video, and disseminating these videos through grassroots organizations and rural radio stations," AfricaRice believes that it can "overcome local power structures and reduce conflict at the community level," according to the organization.

By 2009, 11 rice videos were available to communities in Africa. AfricaRice partners have translated the videos into more than 30 African languages and held open-air screenings. More than 500 organizations and 130,000 farmers are involved. Dissemination has been most successful through farmer associations, where initial distribution to nine associations led to making the videos available to 167 farmer organizations and their members. Farmers spontaneously organize video screenings, taking the initiative to find audiovisual equipment and to gather community members around an available television.

AfricaRice also explored how the videos could complement existing rural radio to enhance learning, build connections, and share information. In collaboration with Farm Radio International, the videos were transcribed for radio programs, which also provided information about how to obtain the videos. The scripts were sent to more than 300 rural radio stations, making the videos more widely known and allowing previously unconnected stakeholders to explore common interests.

25. Using Livestock to Rebuild and Preserve Communities

For pastoralist communities such as the well-known Maasai in Kenya, livestock keeping is more than just an important source of food and income. It's a way of life that has been a part of their cultures and traditions for hundreds of years.

In Rwanda, Heifer International is helping farmers use livestock to rebuild their homes and improve their income after the devastating genocide that occurred 15 years ago. *(Photo credit: Bernard Pollack)*

But in the face of drought, the loss of traditional grazing grounds, and outside pressures to cross-breed native cattle with exotic breeds, pastoralists are struggling to feed their families and preserve their cultures.

The key to maintaining the pastoralist way of life, at least in Kenya, may also be the key to preserving the country's livestock genetic biodiversity and improving local food security. "Governments need to recognize that pastoralists are the best keepers of genetic diversity," says Jacob Wanyama, coordinator with the Nairobi-based African LIFE Network, an organization that works to improve the rights of pastoralist communities in Eastern Africa.

Wanyama explains that Anikole cattle, a breed indigenous to the region, are not only "beautiful to look at," but are also one of the "highest quality" breeds because they can survive in extremely harsh, dry conditions—a trait that is more important than the size or milk production of the cattle, particularly as climate change takes a bigger hold on Africa. Moreover, indigenous breeds do not require expensive feed and inputs, such as antibiotics, to keep them healthy.

And Anikole cattle represent more than just a consistent and reliable source of food; they also help preserve the pastoralist culture and way of life. Most pastoralists recognize that their children may migrate to cities instead of continuing the nomadic herding lifestyle. But the preservation of Anikole cattle and other indigenous breeds will allow those who choose to stay to feed and support their families and communities for years to come.

Two organizations in Mozambique similarly promote livestock as a means for food security and other benefits. The International Rural Poultry Center of the Kyeema Foundation and the International Crops Research Institute for the Semi-Arid Tropics are partnering to help farmers—most of them women—raise chickens on their farms.

Because women are often the primary caregivers for family members with HIV/AIDS, they need easy, low-cost sources of food and income. Raising free-range poultry generally requires few outside inputs and very little maintenance, and the birds can forage for insects and eat kitchen scraps instead of expensive grains. In turn, they provide meat and eggs for household use or sale; pest control; and manure for fertilizer. (

In Rwanda, the global nonprofit Heifer International is helping farmers use livestock to rebuild their homes and improve their incomes after the devastating genocide of the 1990s. Heifer began working in Rwanda in 2000, introducing a South African dairy breed known for its high milk production because, according to program manager Dennis Karamuzi, "no stock of good [dairy cow] genes" was left in the country.

Karamuzi says that the animals prove "that even poor farmers can take care of high-producing cows." Heifer has certain conditions for receiving cows, such as requiring farmers to build pens and to dedicate part of their land to pasture. Many Rwandans, who were accustomed to letting their animals graze freely on grass, were skeptical. But as they began seeing the results of Heifer's training, they became more interested in working with the group.

The cows don't only provide milk (an important source of protein) and income to Rwandan families. They also provide manure, a fertilizer for crops that is now also a source of biogas for cooking as part of the National Biogas Program. And the livestock give families a sense of security as they, and the entire country, continue to recover and rebuild.

26. Improving Farmer Livelihoods with Conservation

In May 2010, *New York Times* columnist Nicholas Kristof published an op-ed about Gabon, a country in west-central Africa where the rights of farmers are frequently in conflict with wildlife conservation efforts. He quotes one young village chief, Evelyne Kinga, as saying that she doesn't like elephants because they eat her cassava plants, and that she personally doesn't benefit from rich ecotourists who come to the nearby parks.

In Botswana, the Mokolodi Wildlife Reserve is doing more than just teaching students and the community about conserving and protecting wildlife and the environment, they're also educating students about permaculture. *(Photo credit: Bernard Pollack)*

But it doesn't have to be this way, says Raoul du Toit, director of the Rhino Conservation Trust in Zimbabwe. His organization works closely with farmers and communities to help them recognize that protecting wildlife can be in their own best interest.

du Toit promotes "landscape-level planning," a broader approach that takes into account the needs of wildlife, the environment, and farming communities. Rather than relying on development agencies and governments to decide where cattle fences should go or where farmers should plant their crops, local communities and stakeholders need to be part of the process, du Toit says. Development aid should then follow what local stakeholders need and perceive.

The Rhino Conservation Trust provides classroom materials as well, so that students can learn the connections between sustainable agriculture and wildlife conservation at an early age.

And du Toit is not alone in his efforts to improve the lives of farmers in addition to protecting wildlife. In Tanzania, the Jane Goodall Institute (JGI) started as a center to research and protect wild chimpanzee populations in what is now, thanks to JGI's efforts, Gombe National Park. But by the early 1990s, the organization realized that to be successful, it would have to start addressing the needs of local communities. As fast as JGI would plant trees to rebuild the forest, community members would chop them down because they needed the wood for fuel and charcoal.

So JGI started working with communities to develop government-mandated land use plans, in addition to encouraging soil erosion prevention practices, agroforestry, and production of value-added products such as coffee and palm oil. "These are services [that] people require in order to appreciate the environment," says Pancras Ngalason Executive Director of JGI Tanzania. He explains that such tools will ultimately help not only to protect the chimps and other wildlife, but also to build healthy and economically viable communities.

In Botswana, the Mokolodi Wildlife Reserve is doing more than just teaching students and the community about protecting wildlife and the environment. It is also educating students about permaculture. The Reserve's Education Center grows indigenous vegetables, recycles water for irrigation, and uses organic fertilizers—including elephant dung—to demonstrate ways to grow nutritious food with very little water or chemical inputs.

When school groups come to learn about the animals, the reserve teaches them about sustainable agriculture as well. Using the garden as a classroom for teaching students about composting, intercropping, water harvesting, and organic agriculture, the reserve helps draw the connection between the importance of environmentally sustainable agriculture practices and the conservation of elephants, giraffes, impala, and other animals and birds living in the area.

27. Feeding Communities by Feeding Women

At a U.S. House of Representatives Hunger Caucus briefing in April 2010, panelist Cheryl Morden with the International Fund for Agricultural Development (IFAD) observed that in the global struggle to alleviate hunger and poverty, there is a "big pay-off in focusing on women." But, she warned, "neglect them, and you'll end up doing harm."

Research has shown that when women's incomes are improved, the entire community benefits. *(Photo credit: Bernard Pollack)*

Women farmers produce more than half of the food grown in the world, and roughly 1.6 billion women depend on agriculture for their livelihoods. But women often are unable to benefit from general agriculture funding because they face institutional and cultural barriers, including lack of access to land, credit, and education. Worldwide, women receive only about 5 percent of agriculture extension services and own about 2 percent of land.

But research has shown that when women's incomes are improved, and when women have better access to resources such as education, infrastructure, credit, and health care, they tend to invest more in the nutrition, education, and health of their families, triggering a cascade of benefits that can extend to the entire community.

Kibera, sub-Saharan Africa's largest slum in Nairobi, Kenya, is home to anywhere from 700,000 to 1 million people. Despite the many challenges they face, women farmers, using training and seeds provided by the French organization Solidarités, are growing vegetables in sacks filled with dirt. More than 1,000 women are producing food in this way, and during Kenya's 2007–08 food crises, when conflict in Nairobi prevented food from coming into the area, most residents did not go hungry because of the large numbers of these "vertical farms."

In Zambia, Veronica Sianchenga, a farmer living in Kabuyu Village, saw improvements in her family's quality of life when she began irrigating her farm with the Mosi-o-Tunya ("Pump that Thunders"), a pressure pump that she purchased from International Development Enterprises (IDE). In much of sub-Saharan Africa, the task of gathering water—which can require up to eight hours of labor a day in the driest regions—usually falls to women. Sianchenga observes that her children are eating healthier, with more vegetables in their diet, and that she is enjoying increased independence. "Now we are not relying only on our husbands, because we are now able to do our own projects and to assist our husbands, to make our families look better, eat better, clothe better—even to have a house."

In Rwanda, the Farmers of the Future Initiative (FOFI) helps to empower young girls and other students by integrating school gardens and agriculture training into primary school curriculums. More than 60 percent of Rwanda's students return to rural areas to farm for a living after graduating instead of continuing on to secondary school or university. Although both boys and girls benefit from the FOFI training, it is especially important for young girls to learn these skills so that they can avoid dependence on men for food and financial security and also share what they learn, says project coordinator Josephine Tuyishimire.

By "passing these skills to future generations"—typically, the children under their care— these women foster the development of future farmers who are prepared to feed themselves and who are similarly self-sufficient and empowered, says Tuyishimire.

28. Turning the School Yard into a Classroom

In Rwanda, more than 85 percent of the population depends on small-scale agriculture for their livelihood. And the majority of primary school students—roughly 60 percent—will return to rural areas to make their living, instead of continuing on to secondary or vocational school or university.

While maintaining the school gardens, students experimented and were trained in farming techniques that emphasize the preservation of natural resources as much as they do crop production.
(Photo credit: Bernard Pollack)

With that in mind, in 2007, the organization CARE International designed the Farmers of the Future Initiative (FOFI), a three-year project that integrates training in modern and environmentally sustainable agriculture into the primary school curriculum—with the goal of making traditional schooling more relevant to the average Rwandan student.

The project started with 27 pilot schools in nine districts. Each school received funding from CARE to invest in a school garden or farm. After one year, half of the profits from the garden went back to the school's agriculture program, while the rest was used to help another school, called a "satellite" school, start its own garden. By the end of three-year initiative, there were 28 satellite schools, each with its own garden started with the help of another school.

While maintaining the school gardens, the students experiment and are trained in farming techniques that emphasize not only crop production, but also the preservation of natural resources—such as agroforestry, intercropping, mulching and compost, and non-chemical methods of pest and disease control.

According to Josephine Tuyishimire, a FOFI project coordinator, the school gardens also benefit students' parents and their local community. As parents learn new farming techniques from their children, their neighbors learn from them. "The population surrounding FOFI schools copied [the farming techniques] and replicated them at home."

One orphan from Cyanika primary school in Nyamagabe District, who lives on his own, used irrigation and intercropping techniques that he learned at school to start his own small garden. With the help of a teacher at the school he gained access to a local market to sell his vegetables and eventually earned enough money to purchase his own land. With the additional security of land ownership, he continues to generate more income by selling his produce.

Helping students be self-sufficient is especially beneficial for young women, who are often kept out of school but who can be "empowered in this project," says Tuyishimire. "In the future, they become self-reliant and less dependent on their male counterparts as breadwinners." And women share their knowledge with their children, "passing these skills to future generations" to create future farmers who are educated in a way that allows them to better care for themselves and their families.

29. Reducing Wastewater Contamination Starts with a Conversation

In Accra, Ghana, most homes do not have indoor plumbing or sewage systems. Instead, households dispose of waste in the same ditches and streams that urban farmers use to irrigate the crops they sell at local markets. The use of waste water on farms presents a significant health risk and has been banned by the government. But because many farmers lack access to clean sources of water, they have few alternatives for irrigating their crops.

In 2005, the International Water Management Institute (IWMI), a nonprofit organization working in Asia and Africa to improve water and land management for farmers and the environment, received funding from several groups, including the Consultative Group on International Agricultural Research (CGIAR) Challenge Program for Water and Food, to work with urban farmers in Ghana to develop improved farm wastewater management.

"Ideally, we would start at the city level to address wastewater treatment through infrastructure," says Ben Keraita, an irrigation and water engineer and researcher with IWMI. "But there is no money or support for a big project like that. So we start with the farmers to find affordable, small, and simple ways to reduce the risk of contamination."

Starting with the farmers is critical for another reason, Keraita explains. "There are too many different kinds of interventions when it comes to reducing the risk of contamination from waste water, and farmers do not react well to having new techniques pushed upon them." Instead, Keraita and other project coordinators used their existing relationships with local farmers to call a meeting to discuss the problem and hear potential solutions. "Farmers know that the waste water is a problem and have lots of their own ideas about how to address it."

Keraita's team created a list of innovations suggested by farmers and also introduced a few of their own, exposing the farmers to best practices from around the world. "Nothing we introduced was invented on the spot, and many are simple enough to be adopted immediately, like avoiding stepping into irrigation water and stirring up sediment that might contain contaminants by putting down a plank to walk on instead," Keraita explains. Farmers are then asked to volunteer to adopt the practices that they think will be most effective, keeping track of their work daily so that an assessment can be made of the innovation at harvest time.

"If farmers don't like a technique, then we suggest doing another trial with a new technique," Keraita says. "And we invite other farmers to view the harvest and the weighing of the crops so that they can give each other feedback and learn from the experiments of others."

Based on these group discussions and trials, urban farmers in Accra are now irrigating with water that is collected in "waste sedimentation ponds"—ponds built specifically to allow sediment to sink to the bottom so the cleaner water can be skimmed from the top—and with simple containers of filtered water. Some are also using drip irrigation kits produced by International Development Enterprises (IDE), enabling them to use water more precisely and to conserve clean water.

30. Reducing the Things They Carry

The majority of farmers in sub-Saharan Africa—up to 80 percent in some areas—are women. The average female farmer in the region is responsible not only for growing food but also for collecting water and firewood, putting in a 16-hour workday.

Deforestation and drought brought on by climate change have further increased women's time spent working the land, gathering firewood, or collecting water for bathing, cooking, and cleaning. Many women in Africa lack access to resources and technologies that might make these tasks easier, such as improved hoes, planters, and grinding mills; rainwater harvesting systems; and lightweight transport devices.

In Kenya, the organization Practical Action has introduced a fireless cooker to reduce household dependence on wood charcoal and other forms of fuel. Made easily by hand at home, fireless cookers use insulation to store the heat from traditional cook fires, making it possible to cook foods over a longer period of time. Meals placed in a fireless cooker in the morning are baked and ready to eat later in the day, reducing the need to continuously fuel traditional fires.

Meanwhile, biogas units fueled with livestock manure can save, on average, 10 hours of labor per week that otherwise would be spent collecting wood or other combustibles. The Rwandan government, recognizes the value of this time savings, hopes to have 15,000 households nationwide using biogas by 2012, and is subsidizing the installation costs.

The Mosi-o-Tunya ("Pump that Thunders") pressure pump, produced by International Development Enterprises (IDE), sits on top of a well and is operated by foot. The pump's light weight makes it easy to operate as well as to transport on foot or bike. Veronica Sianchenga, a farmer living in Zambia's Kabuyu Village explains how, in addition to improving her family's diet and income, the pump has given her more independence: "Now we are not relying only on our husbands, because we are now able to do our own projects and to assist our husbands, to make our families look better, eat better, clothe better—even to have a house."

In Ethiopia, Catholic Relief Services (CRS) helped women living in the rural lowlands near Ajo reduce their daily burdens and improve their incomes and livelihoods by creating a milk marketing group. Before the USAID-funded project was implemented, women were carrying 1–2 liters of milk for seven or eight hours to sell at the nearest market in Dire Dawa. The milk would sell for only some 20 U.S. cents a liter, and after spending the night in town, the women returned home only to make the same trip again days later, forcing them to neglect their homes and gardens. Now, the women take turns selling each other's milk at the market, each making the long trip only once every 10 days and keeping all of the day's profits, putting some of the money into savings and using the rest to pay for food, school, and household supplies.

31. Slow and Steady Irrigation Wins the Race

After Elizabeth Samhembere's husband passed away in 2004, she struggled to feed her family. As a small-scale farmer in Zimbabwe, Samhembere had trouble getting water to her crops, and her children were too young to help with the labor-intensive task of irrigating the vegetables and strawberries she grew.

"I was making a paltry Z$80,000 (81 U.S. cents) per week from selling small and miserable-looking strawberries, and that did not improve my livelihood," Samhembere explained in an interview for International Development Enterprises (IDE). "I continued living from hand to mouth."

But Samhembere's crop—and income—improved significantly in 2005, when she received a donated drip kit, seeds, and fertilizer through the Micro-Irrigation for Vulnerable Households project of IDE, an organization that works to alleviate poverty and hunger in Asia and Africa through technology and market access for small farmers.

Drip irrigation delivers water and fertilizer directly to the roots of plants through systems of plastic tubing that have small holes and other restrictive outlets. By distributing these inputs slowly and regularly, drip irrigation conserves up to 50 percent more water than traditional methods, IDE estimates. The water and fertilizer also are more easily absorbed by the soil and plants, reducing the risks of erosion and nutrient depletion. Usually operated by gravity, drip irrigation saves both the time and labor that otherwise would be needed to water crops, leading to larger harvest yields.

Since installing her own drip kit, Samhembere has seen her income rise to 1–4 million Zimbabwe dollars (US$10–40) per week. Both the quality and quantity of her strawberry harvest have improved, and she was able to expand her crop diversity by adding peas, carrots, and tomatoes to her garden. With training from the Zimbabwe Women's Bureau, Samhembere is also generating income by selling jam she makes from her strawberries.

Samhembere's family is eating better, both from the garden and because of the profit she makes from selling her produce. She no longer worries about going into debt or needing to borrow money to make ends meet. "I am able to send my children to school with the income I now generate from the garden," she said.

32. Access to Water Improves Quality of Life for Women and Children

In sub-Saharan Africa, improved access to water means more than simply basic survival. For families that depend on agriculture for food and income, it means the difference between barely scraping by and eating balanced meals, affording education, and owning a home.

In sub-Saharan Africa, improved access to water means more than simply basic survival for families that depend on agriculture for both food and income.
(Photo credit: Bernard Pollack)

In Zambia, the majority of children drop out of school by the seventh grade because their families can no longer afford it. But Peter Chakanyuka and his wife are able to pay "school fees every three months for our six children," thanks to a treadle pump the family purchased with the help of International Development Enterprises (IDE). IDE works to improve the livelihoods of farmers in Asia and Africa through improved agricultural technology and market access. "Our life is much better and we eat more food variety than before," says Mrs. Chakanyuka.

In Nepal, IDE found that installing Multiple Use Water Systems (MUS) reduced the labor needed for water collection, improved sanitation, and empowered women. The systems collect water from springs and deliver it downhill—using gravity—to a domestic water tank and separate irrigation tank. The tanks provide a consistent source of water for drinking, cooking, and bathing, as well as a shared water source for irrigation.

As in many sub-Saharan African countries, in Nepal the task of gathering water usually falls to women, and the reduction in labor for water collection has allowed women to become more involved in the business side of a community's agriculture effort. Increased crop production and diversity have improved household diets as well, ensuring that women and children are eating more vegetables.

Veronica Sianchenga, a farmer living in Kabuyu Village in Zambia, saw similar improvements to her family's quality of life when she began irrigating her farm with the Mosi-o-Tunya ("Pump that Thunders"), a pressure pump that she purchased through IDE. The pump is manufactured in Zambia, creating local jobs and keeping the technology affordable for small-scale farmers. The Mosi-o-Tunya is lightweight, is operated easily by both men and women, and can be transported on foot or by bike.

Sianchenga explains that her children are eating healthier, with more vegetables in their diet, and that she too is enjoying increased independence. "Now we are not relying only on our husbands, because we are now able to do our own projects and to assist our husbands, to make our families look better, eat better, clothe better—even to have a house."

33. Investing in Better Food Storage in Africa

Cowpeas are an important staple food in western Africa, providing protein to millions of people. Unlike commercialized maize crops, cowpeas are indigenous to the region and have adapted to local growing conditions, making them an ideal source of nutrition.

Ensuring that the legume makes it from the field to farmers' bowls, however, is a real challenge in Niger and elsewhere. Cowpeas grow only a few months out of the year, and storing large amounts of the crop can be difficult because of pests.

But that's changing, thanks to a simple storage bag developed by Purdue University.

The bags, called Purdue Improved Cowpea Storage, or PICS, are hermetically sealed, preventing oxygen and pests from contaminating the cowpeas. According to former Purdue President Martin C. Jischke, "The method is simple, safe, inexpensive and very effective, which means that getting the right information to these people will reap tremendous benefits."

Although many farmers are at first skeptical that the large storage bags will protect cowpeas throughout the year, seeing is believing. In each village, the bags are filled with cowpeas, and then, four to six months later, PICS holds an Open-the-Bag event, enabling the farmers to see that the legumes are undamaged and ready to eat. In addition to protecting the cowpeas from pests, the PICS bags save farmers money on expensive pesticides.

With support from the Bill and Melinda Gates Foundation, the PICS project hopes to reach 28,000 villages across Africa by 2011—not only in Niger, but also in Benin, Burkina Faso, Cameroon, Chad, Ghana, Mali, Nigeria, Senegal, and Togo.

34. Winrock International and Sylva Banda Professional Catering Services Limited

Sylvia Banda started Sylva Professional Catering Services Limited in 1986, even though as recently as the 1980s Zambian women weren't allowed to own their own businesses or be eligible for loans. She began her business by serving food she cooked and brought from home at what she calls a "standing buffet," because she didn't have enough money for tables and chairs.

But not having furniture didn't stop Banda's business from taking off. She made nearly US$100 in just the first few days. With her husband listed as proprietor of the business because land rights are limited (if not inaccessible) to women in Zambia, Banda was able to grow her small buffet into three subsidiary businesses.

Sylva Professional Catering Services Limited is dedicated to creating, selling, and serving nutritious foods made from indigenous and traditional products purchased from local farmers and merchants. Banda provides work for 73 people and has developed partnerships with local development organizations, using her financial and popular success to become a proponent of farmer and employee training. She calls it "economic emancipation."

Banda's success has benefited not just her own family, but the wider community as well. And her positive impact is being extended further still with the help of Winrock International, a global nonprofit organization that addresses rural development and sustainable resource management through education and empowerment programs. Winrock is making Banda's case study available as a resource and model for potential entrepreneurs around the world—as well as the policymakers and nongovernmental organizations that support them.

More information about Banda's work and other projects focused on sustainable food, improving livelihoods, and preserving local food traditions can be found on the website of Community Food Enterprise, a partnership between the Wallace Center at Winrock International and the Business Alliance for Local Living Communities (BALLE).

35. Reducing Food Waste

In parts of sub-Saharan Africa, where more than 265 million people are hungry, more than a quarter of the food produced goes bad before it can be eaten because of poor harvest or storage techniques, severe weather, or disease and pests. In the United States, on the other hand, food is being thrown away by the millions of tons, contributing to 12 percent of total waste and putting stress on already bursting landfills. This waste also contributes to the emission of greenhouse gases: landfills are one of the biggest sources of U.S. methane, accounting for 34 percent of domestic emissions.

(Photo credit Bernard Pollock)

To prevent the loss of crops after they are harvested, the United Nations Food and Agriculture Organization (FAO) is implementing projects to provide education and technology to farmers. In Kenya, the FAO partnered with the Ministry of Agriculture to train farmers to take steps to reduce maize crop losses to mycotoxin, a poisonous and devastating byproduct of fungi growth.

In Afghanistan, the FAO provided metallic silos to roughly 18,000 households to improve post-harvest storage. Farmers use the silos to store cereal grains and legumes, protecting these crops from weather and pests. As a result, post-harvest losses have dropped from between 15 and 20 percent to less than 1 or 2 percent.

Recognizing the need to protect Africa's harvests from weather, disease, pests, and poor storage quality, the African Ministerial Council on Science & Technology is promoting research to analyze and promote technologies and techniques to prevent post-harvest waste and improve food processing.

In the United States, the Florida-based organization ECHO (Educational Concerns For Hunger Organization) collects innovations of all kinds to help farmers at all stages of cultivation, including after the harvest. Making these innovations accessible to farmers around the world is ECHO's mission, and the group provides demonstrations of post-harvest loss prevention techniques that are both simple and affordable.

The United States is making progress in waste reduction as well. In 2009, San Francisco became the first U.S. city to mandate that all households separate out both their recycling and compost from their garbage. The Department of the Environment expects this single piece of legislation to result in a 90 percent decrease in household waste in local landfills.

Food collection organizations such as New York City's City Harvest collect food that otherwise would be thrown away from restaurants, grocery stores, and cafeterias and then deliver it free of charge to local food providers serving low-income families and the homeless.

Minimizing greenhouse gas emissions is a central theme of ongoing climate change negotiations, as global emissions reach record highs. With landfills producing large amounts of methane, and with food prices on the rise worldwide, the reduction of food waste is an inescapable necessity for people everywhere, from restaurant owners in New York City to maize farmers outside of Nairobi, Kenya.

36. Zero Tillage

In agriculture, sometimes less is more, especially when it comes to soil quality. Monoculture crops such as corn and soybeans rely heavily on tractors for tilling the soil. Although this and other soil-management practices have raised yields over the last 60 years, they have also done considerable damage. Over-turning dirt can lead to dryness and erosion, expediting the loss of soil nutrients that crops need to thrive.

"Zero tillage," on the other hand, helps retain soil moisture, prevent erosion, and conserve nutrients. In this technique, farmers cover the soil with remains from the previous season's crops as well as any additional organic matter, such as animal dung. They then plant their seeds in the untilled soil in drilled holes or narrow ditches.

In Argentina, according to the International Food Policy Research Institute (IFPRI) report *Millions Fed: Proven Successes in Agricultural Development*, the use of zero tillage in soybean cultivation has led to an estimated gain of US$4.7 billion since 1991. And between 1993 and 1999, zero-tillage farming led to the creation of some 200,000 farming and extension-related jobs in the country.

In the Indo-Gangetic plains of northeastern India, rice and wheat cultivation increased following the development of zero-tillage drills in the 1990s. The affordability and accessibility of the technology, which creates holes in untilled soil, led to widespread use of the technique in the area, where zero or reduced tilling is now used for one-fifth to one-fourth of wheat production. According to *Millions Fed*, farmers were able to increase their incomes $97 per hectare because of improved production and the reduced cost and time for soil preparation.

According to a 2004 study from the United Nations Food and Agriculture Organization (FAO) and the International Fund for Agricultural Development (IFAD), farmers in Tanzania who used tools made specifically for zero-tillage agriculture saved 75 percent of the time usually spent on land clearing and field preparation. Elsewhere in east Africa, the FAO is partnering with the African Conservation Tillage Network to implement a three-year conservation agriculture project that connects some 4,000 farmers in Kenya and Tanzania with farmers in Brazil to gain education and extension directly from those who have benefited from this "less-is-more" method of planting.

37. Milk Processing

Livestock is an important source of food, income, and culture for many people in sub-Saharan Africa. Keeping livestock can also be a means of preserving local genetic diversity and a defense against climate change.

In Kenya, for example, the dairy sector alone accounts for 14 percent of the agricultural gross domestic product (GDP), and smallholder farmers produce some 80 percent of the country's marketed milk. The ability to process dairy is an essential defense against losing money on spoiled milk, and processing milk also ensures access to its nutritional benefits while reducing the risks of food borne illness.

In Nairobi, Kenya, farmer Margaret Njeri Ndimu has seen an increase in her income by selling her goat's milk in plastic bags sealed with candle wax. *(Photo credit: Bernard Pollack)*

Although milk is a top commodity, its journey to the market is not always an easy one, especially when the market is hours away, as in most of sub-Saharan Africa. Unpasteurized milk can spoil easily by the time it gets to market, making pasteurization, which involves heating the milk to a specific temperature to kill pathogenic bacteria, a necessity. Reducing the amount of harmful bacteria means that the milk won't spoil as fast before it is sold, increasing farmers' income and consumer base.

In Nairobi, Kenya, farmer Margaret Njeri Ndimu has seen an increase in her income by selling her goat's milk in plastic bags sealed with candle wax. This simple method of processing, which Ndimu learned through a Mazingira Institute training program, makes it easier for her to manage and sell her milk, enabling customers to buy small quantities of the perishable product in portable containers.

According to the Meridian Institute report *Innovations for Agricultural Value Chains in Africa*, unpasteurized milk is more popular with consumers than pasteurized milk because of the significant cost difference. And many dairy farmers are unable to afford pasteurization or to gain access to facilities that could pasteurize their milk, even if they had a consumer base that could afford to purchase it.

A project implemented by the United Nations Food and Agriculture Organization (FAO) and the World Health Organization (WHO) promotes use of the "lactoperoxidase system" (LP-s), in which an antibacterial compound is mixed into unpasteurized milk, allowing farmers to keep it safe for longer periods. With the application of LP-s, milk will last 5–6 days in refrigeration (at around 4 degrees Celsius) and up to 4–7 hours at high temperatures (31–35 degrees Celsius), allowing the farmer time to transport the milk to market.

An East Africa Dairy Development Project (EADD) initiative recognizes the benefits farmers see when they gain access to improved processing and preservation of their dairy. It encourages farmers to join cooperatives, so that instead of processing the milk alone, members can turn to group-owned and -run milk collection centers, significantly reducing the financial burden of the process. The refrigerated milk is then transported to a processing facility and sent to market. EADD's projects in Kenya, Rwanda, and Uganda provide training and extension as well.

Proper milk processing isn't important only for health reasons. Finding ways to preserve a product as perishable as milk makes it more marketable and increases income, improving livelihoods for smallholder dairy farmers and their families.

38. Banking on the Harvest

In the Maradi area of south-central Niger, where 70 percent of the population lives below the poverty line, the months before the harvest are called "the hunger season." From mid-July to mid-September, food supplies are at their lowest, and most families eat only one meal a day.

Every week during the pre-harvest season, poor farmers receive cereal as a credit. At the end of the season, farmers can pay back the loan with their own crops with 25 percent interest—an interest rate that the villagers picked on their own. *(Photo credit: Bernard Pollack)*

Since the 1960s, Africa's entire Sahel region, a semi-arid strip of land that includes Burkina Faso, Chad, Eritrea, Mali, Mauritania, Niger, Nigeria, Senegal, and Sudan, has experienced increasingly extreme drought and hunger. In Niger's Maradi area, which was hit especially hard, local cereal harvests have declined by nearly a third. Strained or empty grain reserves cause many families to sell their tools, seeds, and livestock to raise money for food and the next planting. Farmers with nothing to sell are forced to work for others to earn an income. Some even leave their homes in search of work in other villages, leaving their wives and children to tend to the farm and home.

But with the help of the International Fund for Agricultural Development (IFAD), many Maradi women are taking food security into their own hands. In response to the 2005 food crisis, when severe locust attacks and drought put 3.5 million Sahel residents at risk of starvation, IFAD's Project for the Promotion of Local Initiative for Development in Aguie helped to create a new kind of bank, run entirely by women, that dispenses loans in the form of cereal instead of money.

Called the *soudure*, or "pre-harvest," bank, the project is based on exchange. Every week during the pre-harvest season, poor farmers receive cereal as a credit. At the end of the season, they can pay back the loan with their own crops, plus 25 percent interest—an interest rate that the villagers picked on their own.

The banks have already made a huge difference. Today, Niger is home to some 168 soudure banks managed by over 50,000 women and storing more than 2,800 tons of millet—enough to feed 350,000 people for at least a month. During the 2008 global food-price crisis, when 90 percent of Niger's population was at risk for starvation, villages with a soudure bank were able to sustain themselves through the harshest period of the year.

One bank client, Rabia Ada, is quoted on the IFAD project Web site as saying: "from the bank, I had 56 kilograms of millet that helped us cope for one month and gave us something to eat other than just leafy vegetables." Another client, Nana Ayouba, adds: "if we didn't have the banks, our alternative strategies would have been to borrow from our neighbors or to send the men away in search of jobs."

The banks also help to empower women who are otherwise left out of communitywide organizations and decision making. In their new roles as bank managers, with the support of their husbands, women can now play an integral role in improving local food security, diets, and livelihoods.

39. Getting the Most from Crops, in the Field and at the Market

In Cameroon, one of the foods that grows best is cassava, a starch-filled root crop. But farmers struggle with low yields because of infestation by pests and diseases that damage crops, making each harvest more labor-intensive than the crops are worth.

IITA, in partnership with the Cameroon Government National Program for Roots and Tuber Development (PNDRT), is developing and introducing improved varieties of cassava with resistance to major pests and diseases to help increase production.
(Photo credit: Bernard Pollack)

"Farmers are spending more on planting materials and field maintenance to grow cassava, and they are unable to make a profit from the poor harvests," says Emmanuel Njukwe, Chief of Service for the Crop Improvement and Utilization Unit at the International Institute of Tropical Agriculture (IITA). "They are fighting an expensive battle against pests and diseases."

To make this battle a little less labor-intensive and costly, and to increase production, IITA, in partnership with the Cameroon Government National Program for Roots and Tuber Development (PNDRT), is developing and introducing improved varieties of cassava that are resistant to major pests and diseases. The two organizations are also training farmers in post- harvest processing techniques to improve quality and add value to marketable products, while also connecting farmers to high-paying enterprises and markets.

"Once we identify varieties of cassava that we think will benefit local growers, we work closely with farmers to identify and select the new varieties and ensure that the new varieties meet farmers' needs," Njukwe says. Groups of farmers participating in a field test of a new IITA variety compare it with their best local variety. "The farmers then pick the variety they like best," continues Njukwe. "They tell us what they like and don't like, and then we help train them to get the most out of those varieties, in the field and at the market."

One of the farmer groups that received training and materials to process cassava into flour is now connected to a bakery that uses the flour to make cakes. Being able to grow and process cassava as a group, Njukwe explains, helps reduce production costs for individual farmers. "When we train the farmers to process their crop, it makes it easier for them to transport and store the product, and to sell it to larger consumers like a business to improve their livelihoods."

IITA encourages different farmer groups to specialize in different processing options or storage techniques, and to then work together. A group that specializes in processing cassava into flour, for example, can reach out to another group that specializes in storage and utilization for support and services. In this way, the farmer groups create financially beneficial links to one other, in addition to the links to the market that IITA also helps cultivate.

"The model we want to use is to promote the smallholder farmers," Njukwe says. "Right now, many farmers do not earn high income from cassava production. But the potentials are there to change all of that. We give them the information, the training, and the crop varieties they need to do that. But we do it with the help of the farmers, in every step of the process."