

# WINNING *the* FOOD FIGHT:

## Finding Local Solutions to Global Hunger



Laura Smith '07 shares a poster created by Newfield third-graders with students in Simenya, Kenya. Credit: Linda Poppleton '81

**THE WORLD POPULATION IS EXPECTED TO REACH 9 BILLION BY 2050. BUT WITH 1 BILLION HUNGRY PEOPLE ON EARTH TODAY, HOW WILL WE FEED 9 BILLION?**



It will require both good policies and good science. There is work to be done in water management, soil quality, seeds, fertilizer, livestock production, distribution systems, nutrition, education, women's rights, and a host of other areas. Which are CALS researchers working on? Pretty much all of them.

From Freeville to Faisalabad, we take a look at what's being done by students, faculty and extension specialists on campus and around the world to address some of the most pressing problems facing our growing population.

# GOING LOCAL, ON A GLOBAL SCALE

By Krisy Gashler

It was once unthinkable that our planet could support 7 billion inhabitants. But during the “Green Revolution” of the 1940s to 1970s, researchers found ways to increase yields, decrease losses, and maximize efficiency. Annual milk production per cow has quadrupled in the United States since 1944, for example, and cereal yields in the developing world have tripled.

Cornell and Cornell-educated researchers contributed critical links in the chain of progress that became the Green Revolution.

Plant breeders, who developed new seeds and especially rice varieties, are well known for their research, but “many, many people played roles” in achieving the extraordinary gains of the last century, said Alice Pell, vice provost for international relations.

Along with new plant varieties, new management techniques, and increased use of fertilizer and some pesticides, there was also progress in understanding nutrition, natural resource degradation, and the economics of food systems, Pell said.

“Simply producing food isn’t always sufficient,” she said. “You need to market it, make sure it gets into the hands of the people who need it. You need to make sure the environment isn’t being degraded in order to produce that food. You can’t use a single approach to solve a complicated problem.”

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## TACKLING HUNGER INVOLVES TACKLING POVERTY

Despite these extraordinary advances, so many still go hungry.

“The hunger problem is fundamentally a poverty problem,” said Chris Barrett, the Stephen B. & Janice G. Ashley Professor of Applied Economics and Management and director of the Food Systems and Poverty Reduction Integrative Graduate Education and Research Traineeship program.

Roughly half the countries in Africa don’t produce enough food to meet their needs, and poor people, especially in rural areas, can’t pay for transported food, Barrett said.

“That’s a matter of attending to the pro-

ductivity of poor people so they begin to have control over their own lives,” Barrett said.

“Markets can help us, once people have the means to generate adequate livelihoods for themselves. But when they suffer high rates of illness, have little institutional infrastructure, and virtually no police protection or property rights, it’s very difficult,” he added.

According to Per Pinstrup-Andersen, H. E. Babcock Professor of Food, Nutrition and Public Policy, the main bottleneck is “very low priority to the eradication of poverty and malnutrition by developing country governments.”

Pinstrup-Andersen received the 2001 World Food Prize for his commitment to food policy research to reduce suffering and starvation among poor children.

“What’s needed is public expenditure so that the private sector can operate effectively,” Pinstrup-Andersen said. “And the governments of most developing countries do not prioritize nutrition improvements very highly because the politicians’ children are usually well-nourished.”

Governments of developed countries also share some of the blame, Pinstrup-Andersen said. Market-distorting agricultural policies in the European Union, United States, and Japan make it harder for poor farmers in developing countries to compete, he said.

## THE GLOBAL GRAB FOR LAND

Skyrocketing food prices, climate instability, and declining natural resources have led governments, corporations, and wealthy individuals to size up the world’s farmland as both an investment opportunity and a hedge against food crises and political turbulence.

Often, the losers in this race for land are smallholder farmers, pastoralists, forest dwellers, and commoners, said Philip McMichael, professor in development sociology and international agriculture and rural development, and consultant to the Food and



Girls in Simenya, Kenya, work to create a school farm. Credit: Linda Poppleton '81

Agriculture Organization of the United Nations and La Via Campesina.

For leaders of land-rich but capital-poor countries, land leasing and acquisition offers a chance to reduce debt, earn foreign exchange, or receive kick-backs. But by shifting their priorities from domestic production to servicing global demand, they are often unable to feed their own people. International trade rules exacerbate the problem, McMichael said. Nations should be able to consume, rather than trade, their own food, and farming and indigenous peoples should have secure land tenure to encourage environmental stewardship.

“We need to shift to a right-to-food initiative. We need to reinvigorate, restore, and promote smallholder farmers,” McMichael said.

There are up to 500 million small farms around the world, with 2.4 billion people involved in agriculture. Peasants feed at least 70 percent of the world population, McMichael said.

“Farmers have been working their land for decades and centuries. The world is better off betting on these people and supporting them than having investors acquiring land to grow environmentally unsustainable industrial

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crops that are increasingly fungible, depending on relative prices for food, feed, fuel, and biomass crops.”

McMichael said he doesn’t think we can solve these problems with Green Revolution technology, whose abundance was short-term, but whose long-term sustainability is now in question—farming ecologically is key.

“Land grab is simply the tip of the iceberg. I think we really are at the beginning of a long-term historical transition. Development is no longer about improving on the past, but how to manage the future,” McMichael said. “Will it be agribusiness as usual? Or support for stabilizing rural cultures, local knowledge and sustainable farming practices?”

## STARTING WITH STUDENTS IN SIMENYA

In Simenya, Kenya, the high rate of HIV/AIDS has wiped out a generation of farmers—and parents.

As a Cornell undergraduate studying abroad, Laura Smith ’07 saw the devastating consequences first hand: at one school, 20 percent of the students are orphans, and many go hungry.

The school can’t afford a lunch program, and many children have to travel far to attend, so they often leave their houses before breakfast and don’t eat all day.

“One of the things that stuck with me is, how can we teach these kids when they’re hungry?” Smith said.

Smith returned a year later, intent on helping. She sought out the school headmaster and the Simenya village chief and learned what they really needed was a school farm, to provide food for those hungry children and to teach them how to provide for themselves in the future.

Village mothers and grandmothers pitched in to help fund the project and raise money for school fees by making baskets that Smith could sell in the United States, including at Ithaca-area establishments Stella’s Barn and GreenStar.

Upon her return to her hometown of Newfield, Smith launched a non-governmental organization called Growing Hope Together with her sister Erin ’10, her mother Linda ’81, and the support of Newfield Superintendent William Hurley and a startup grant from the United Way Youth Philanthropy Grant program. Through the program, children in Newfield and Simenya are learning about farming and about each other.

Smith, now a Ph.D. student in nutrition, said the 1.5-acre farm in Simenya began with only maize, but with her encouragement and help they’ve added bananas, sweet potatoes, and several local vegetables.

“It doesn’t meet the needs of all the kids in the school yet,” she said, “but it’s a start.”



Above: Laura Smith ’07 with neighborhood children in Simenya, Kenya  
Below: Erin Smith ’10 assists Newfield third-graders by demonstrating correct techniques for transplanting lettuce. Credit: Linda Poppleton ’81



## THE NEXT REVOLUTION

In Bolivia, post-doctoral associates Steve Vanek ’94, MAT ’95, MS ’02, Ph.D. ’10, and Andy Jones, Ph.D. ’11, are taking a multi-disciplinary approach to see how farming and nutrition really interact in areas that suffer from chronic malnutrition.

Vanek, a crop and soil scientist, and Jones, a nutritionist, decided to challenge some assumptions made in each of their disciplines, such as: if a family grows a lot of food, its children will be well-nourished.



Young children taste test a nutritious weaning food newly created by their own mothers during a recipe trial in northern Potosí, Bolivia. Credit: Andrew Jones

Based on a survey of about 300 households, they found this was not necessarily true.

When the researchers asked whether families felt they had enough food, their answers corresponded nicely with the things one might expect: number of acres, animals, and total farm productivity.

However, that didn't necessarily link to whether children were growing adequately, Vanek said.

Better predictors were whether families were growing six different crops instead of three, or how intensively they were managing and fertilizing their land, he said.

"Healthier soils and more diversity on the farm may also mean more nutritious diets for children, if the right choices are made along the way," Jones said.

## WASTE NOT, WANT NOT?

Food technology is an emerging and critical science in India, a country that produces vast quantities of fruit, vegetables, milk, and grain that are often wasted—or unsafe to eat—because only 2 to 5 percent of the food produced is subjected to safe food handling or processing practices.

Food science professor Syed Rizvi worked with Alok Jha, who came to Cornell in 2006 as a Borlaug Fellow, to establish a center of food science and technology at Banaras Hindu University (BHU). The program awards Ph.D. and master's degrees in food science, and it will begin accepting undergraduates in 2013.

"The program is a valuable resource for farmers in Uttar Pradesh and an important addition to BHU's agricultural curriculum," Jha said. "I was able to apply so many things I learned at Cornell, from curriculum building to extension work, to efficient ways to keep food laboratories clean and safe."

He also invited his Cornell mentors, Rizvi and plant breeding professor KV Raman, to train BHU faculty and staff.

The program, and others like it, are being funded in part through the Feed the Future initiative by the United States Agency for International Development and its Agricultural

Professor Karim-Aly Kassam and Munira Karamkhudoeva, entomologist with the Pamir Biological Institute, interview a local farmer about medicinal plants in the Pamir Mountains of Afghanistan. Credit: Umed Bulbulshoev



Innovation Partnership, launched in February 2011 with Cornell as its lead institute.

## BIOLOGY IS CULTURE

Ecological changes in human habitats affect far more than biology, according to Karim-Aly S. Kassam, Ph.D. '05, international associate professor of environmental and indigenous studies in the Department of Natural Resources and the American Indian Program.

In the Pamir Mountains of Afghanistan and Tajikistan, for example, Kassam is working to help indigenous populations cope with the biological and cultural changes being wrought by climate change.

The warming climate impacts not only which crops farmers can grow and where they can grow them, but it also changes the way these agrarian societies sustain their culture, he said.

"When the seasonal rhythm is disturbed, the cultures are under systemic stress. In the Pamirs, the Gregorian Calendar is used to measure time, but villagers are now plowing, planting and harvesting two weeks earlier, so the festivals associated with these activities are out of sync, too," Kassam said. "People's social cohesion, as well as what they have on the table, being able to feed themselves, comes into question."

By listening to members of the local community, Kassam discovered that prior to the Soviet Union's imposition of the Gregorian

calendar, people in the Pamirs told time using a "Calendar of the Human Body." These habitat-specific, adaptable calendars linked parts of the body with biological, agricultural, and cultural functions, such as changes in the weather, planting, and festivals.

Many details of these calendars had been lost, but Kassam was able to track them down. Along with Cornell graduate student Morgan Ruelle, MS '10, and visiting fellow Umed Bulbulshoev, of the University of Central Asia, Kassam established a collaborative working relationship with communities in the region. They supplemented Russian archival sources and ancient manuscripts with local interviews, and compiled 17 calendars of the human body, which they're making available to people in the Pamirs.

"In order for us to address the concerns that communities have, we need to work with them. In tandem with our knowledge, we need to recognize the relevance of their knowledge," Kassam said.

## ADDRESSING FOOD SAFETY

Much of the world population is dependent on single staple crops, such as corn. In some cases, these foods can be deadly.

Rebecca Nelson, a professor of plant pathology and plant breeding and scientific director of the McKnight Foundation Collaborative Crop Research Program, studies

Researchers and students in CALS are providing logistical and intellectual support for an ambitious national media project, "Food for 9 Billion," which includes public radio and television reports, an interactive website, and educational materials.

**"Our hope is to reach as many ordinary people as we can with a sense of the complexity of the challenge, and also a sense that they might make a difference. So it's not a question of waiting for things to happen, but helping make things happen,"** said Ithaca-based producer Jon Miller.

Find out more at: [periodicals.cals.cornell.edu/feeding](http://periodicals.cals.cornell.edu/feeding)



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carcinogenic mycotoxins, which are poisonous byproducts of fungi.

In one area in Western Kenya, she found that 60 percent of maize samples contained fumonisin over the legal limit. Fumonisin has been shown to stunt growth, cause cancer, and lead to developmental defects.

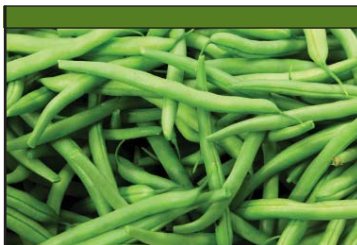
An important tool to reduce mycotoxins and to combat a host of other productivity-sapping diseases is genetic resistance. Nelson’s lab conducts field studies in Aurora, N.Y., and in Africa, to identify natural genetic variants of maize genes that can protect crops and reduce losses and health burdens.

“I was born at a time when there was a lot of excitement about dealing with the problem of world hunger,” Nelson said. “Then I grew up with a lot of cynicism that science would save the world.”

But she remains hopeful when she sees the work being done by her colleagues and her students.

“There’s a lot of fantastic energy and commitment here,” she said. “I’m filled with hope because I see the creativity and fighting spirit of the next generation. If you care, you can make a huge difference.”

## THE SCIENCE OF NUTRITIOUS, PRODUCTIVE PLANTS



### Green Beans

are Kenya’s most important horticultural export, earning farmers five to 10 times more than the dry beans they traditionally grow. However, they can currently only be grown at high altitudes, where the climate is more temperate but land is harder to come by. Susceptibility to high temperatures and bean rust fungus have been further barriers to the expansion of this lucrative market. By tapping traits in varieties developed in Cornell’s breeding program, Phillip Griffiths has been able to offer some solutions and create new opportunities for low altitude farmers. He now hopes to apply lessons learned while combatting black rot in New York cabbage to another important African vegetable, sukuma wiki.



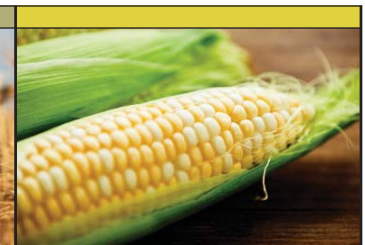
### Rice

breeder Susan McCouch, Ph.D. ’90, is a pioneer in using wild rice varieties to enhance the performance of modern, high-yielding cultivars and preserve the diversity of the crop. The System of Rice Intensification (SRI) International Network and Resource Center, also based at Cornell, advocates for the increased productivity and sustainability of irrigated rice through changes in the management of plants, soil, water, and nutrients. SRI researchers have found that simple methods such as transplanting seedlings at the right time, spacing them farther apart, and keeping soil aerated can lead to twice as much yield and up to 50 percent less water. Similar practices are now being adopted for other crops, including wheat, sugarcane and millet.



### Wheat

yields need to increase one ton per hectare by 2020 to keep pace with the growing population. Rising temperatures and new, virulent diseases like Ug99 pose additional challenges and are already exerting pressure on developing countries, where wheat provides 20 percent of the daily protein intake for the average person. Luckily, enhanced breeding techniques, such as the shuttle breeding practiced by adjunct professor Ravi Singh and the molecular marker work done by geneticist Mark Sorrells, are helping to create new durable, disease resistant varieties that will also increase yields. And the Durable Rust Resistance in Wheat project, based at Cornell under the leadership of Ronnie Coffman Ph.D. ’71, continues to lead an international effort to mitigate the threat.



### Corn

is essential to the diets of hundreds of millions of people in developing countries, yet the staple often does not provide a sufficient supply of vitamin A; this, in turn, can lead to health problems like xerophthalmia, an eye disease that afflicts some 40 million children. Corn contains carotenoids, such as beta-carotene, which our bodies convert to vitamin A, but very few varieties have naturally high carotenoid levels. Edward Buckler, an adjunct professor of plant breeding and genetics, has discovered two genes in corn linked to higher beta-carotene levels; certain variants of those genes could increase provitamin A levels up to 16-fold. He is also studying the flowering time of corn, which affects the crop’s adaption to different environments across the globe, and drought tolerance.