

# Food for Thought 2

Addressing the world's food insecurity  
through research and extension



FINDING SOLUTIONS TO THE WORLD'S MOST CRITICAL CHALLENGES



# Contents



## We welcome your feedback.

Please let us know what articles in this publication you found most interesting or helpful. Send your comments to Debra Levey Larson at [dlarson@illinois.edu](mailto:dlarson@illinois.edu).

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**H**undreds of millions of persons around the globe suffer from food insecurity—that is, they are uncertain of having, or are unable to get, enough food for their families due to insufficient money or other resources. Hunger is not the only consequence. Food insecurity is associated with numerous health, nutrition, education, and social issues for people of all ages. And although the magnitude is not as great in the United States as it is in developing countries, almost 50 million Americans were food insecure in 2010.

How is the College of ACES responding? The stories in *Food for Thought 2*, a followup to our first *Food for Thought* research publication in 2012, which dealt with health and nutrition, represent some of the research projects and extension efforts that address food security along the food chain in four broad areas:

- Managing natural resources for food production
- Technologies for healthy livestock and greater yields
- Access to food in developing countries
- Access to healthy food in United States urban and rural settings

We hope you gain from these articles a sense of the seriousness of this worldwide problem and what the U of I College of ACES is doing to find solutions.



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## Managing Natural Resources for Food Production

- 4 Agricultural productivity lost to flood damage
- 6 Water's critical role in food security

## Technologies for Healthy Livestock and Greater Yields

- 8 Anti-inflammatory benefits seen when plant extracts fed to sick pigs
- 10 Reduced energy diets mean fewer days to pregnancy for dairy cows
- 12 As resistance rises, entomologists urge integrated pest management
- 13 100 years of University of Illinois Extension
- 14 Genetic improvement behind increased soybean yields

## Access to Food in Developing Countries

- 16 Fertilizer in small doses yields higher returns for less money
- 17 Volunteers sought to train farmers in Africa
- 18 Soy-enriched foods in Haiti
- 19 Sustainable grassroots extension programs
- 20 \$25-million federal grant to increase Africa's food supply through soybean research
- 22 Brazil's dilemma: Abundant grain, inadequate storage
- 24 Documenting grain loss in Brazil's harvesting supply chain
- 26 Preventing postharvest loss with digital tools
- 28 Incentives needed to improve grain markets in India
- 30 Malnourished children are better fed when mothers have network of peers

## Access to Healthy Food in U.S. Urban and Rural Settings

- 32 More Americans going hungry in their golden years
- 34 Food insecurity undermines children's healthy development
- 36 Illinois Extension crosses food deserts
- 37 A fruitful collaboration
- 38 Food bank clients struggle to afford nonfood items
- 40 Identifying obstacles to the growth of U.S. urban agriculture
- 42 4-H youth fight hunger close to home

# Agricultural productivity lost to flood damage

The Cache River Basin, which once included 614,100 acres across six southern Illinois counties, has changed substantially since the ancient Ohio River was re-routed to its current location as a result of glacial meltwaters and seismic activity about 10,000 to 12,000 years ago. Now the basin encompasses, in addition to the slow-moving, meandering Cache River, fertile soils and productive farmlands, deep sand and gravel deposits, sloughs and uplands, and one of the most unique and diverse natural habitats in Illinois and the nation.

According to a University of Illinois study, the region's agricultural lands dodged a bullet due to the timing of the great flood of April 2011, when the Ohio River approached the record high of 332.2 feet above sea level.

"The floodwaters eventually drained back into the Ohio and Upper Mississippi rivers," said U of I researcher Ken Olson, "ultimately leaving approximately 1,000 acres of agricultural land flooded from a backup in the middle and lower Cache River Valley, which flooded the adjacent forest-covered alluvial soils and the slightly higher cultivated soils."

According to Olson, who has studied the effects of that flood extensively, these cultivated soils drained by the middle of June 2011 and were planted to soybeans. When they receded, the floodwaters left a thin silt and clay deposit on the agricultural lands and crop residue. The coatings included significant amounts of soil organic carbon, microbes, and pathogens. After the coatings dried, tillage equipment incorporated them into the topsoil layer of the alluvial soils.



"Because the flooding occurred during the non-growing season for corn and soybeans, the mixing of sediment into the topsoil prior to planting resulted in little significant loss of soil productivity, little soybean damage, and little yield reduction on lands outside the levees along the Mississippi, Cache, and Ohio rivers," Olson said.

Illinois agricultural statistics recorded 2011 harvests of 4,500 fewer acres of corn and 6,500 fewer acres of soybeans in Alexander County. Soybean production was 1.2 million bushels in 2010 but dropped to 865,000 bushels in 2011 due to flooding from both the Ohio and Mississippi rivers and crop and soil damage. The

floodwaters also scoured lands in some places and deposited sand in other locations.

Olson noted that, had winter wheat been planted outside the levees in the fall of 2010, the wheat crop would have drowned. "Illinois farmers are aware of the flooding potential, especially in the winter and early spring, so they don't plant winter wheat on unprotected bottomlands," he said. "Consequently, there was no crop loss outside the levees in April and May of 2011. Local floodwater in the lower Cache River Valley, south of the Mississippi River diversion and dike, could not flow back into the Ohio River. It was blocked by the Cache River levee on the south side and by the closed gate at the

Taken in May 2011, the photo shows a flooded grain terminal on the Mississippi River north of Birds Point, Missouri. The map inset depicts, among other landmarks, the ancient Ohio River Valley and the current Cache River in Illinois.

Ohio River levee. Instead, water backed up and flooded forested and agricultural lands along the lower Cache River and north of the Cache River levee," Olson said.

Olson said that the damage to the land could have been much worse. "Land use changes, diversion ditches and levees, loss of wetlands and flood-holding capacity, internal channelization of the Cache River and tributaries, and an ever-changing climate have altered the hydrology of the valley, redistributed soil

from fields and ditch banks into the river, and transported tons of sediment during flooding events into both the Ohio and Mississippi rivers."

As the 2011 Ohio River floodwater reclaimed its ancient floodway, Olson says, the extent of these hydrologic changes and their social, economic, and environmental impacts have become more apparent. "The Great Flood of 2011 lends urgency to the reevaluation and implementation of the Cache River Watershed

**"Land use changes, diversion ditches and levees, loss of wetlands and flood-holding capacity, internal channelization of the Cache River and tributaries, and an ever-changing climate have altered the hydrology of the valley, redistributed soil from fields and ditch banks into the river, and transported tons of sediment during flooding events into both the Ohio and Mississippi rivers."**

Resource Plan completed in 1995."

He cited nine resource concerns identified in the plan: erosion, open dumping, private property rights, water quality, continuation of government farm conservation programs, Post Creek Cutoff streambank erosion, open flow on the Cache River, dissemination of accurate and timely information throughout the watershed, and the impacts of wildlife on farming and vice versa.

"Most of these concerns still need to be addressed," Olson said. "Since that plan was created, there have been additional compromises and breaches that need to be repaired. As the repair and rebuilding of the valley infrastructure is undertaken, significant investment of human and financial resources will be needed to reduce the impacts of future catastrophic events."

Partial funding for this research was provided by the Iowa Agriculture and Home Economics Experiment Station of the College of Agriculture and Life Sciences at Iowa State University. Additional funding came from the National Great Rivers Research and Education Center.

# Water's critical role in food security

Water plays an indispensable role in achieving food security, and experts in water management agree that effective solutions to the world's water resource problems will require input from multiple disciplines.

Prasanta Kalita, a professor in the Department of Agricultural and Biological Engineering who has done extensive research in water management, said that the agriculture sector faces some of the biggest challenges in water management. According to the Food and Agriculture Organization of the UN, agriculture worldwide uses 70 percent of all water, while in many developing countries the figure is as high as 85 to 90 percent.

"Irrigation projects can have huge losses," said Kalita. "What if we could reduce the waste and produce the same amount of food using 50 percent of the water? Developed countries have made significant advances in irrigation management, so how can we modify the appropriate technology and adopt it in developing countries, where most of the losses occur?"

Kalita said there are other technologies available that aren't being used. "For example, in the United States and Israel, a lot of work has been done on drip irrigation. Why don't people use it? What are the hindrances? We need to investigate those problems." Drip irrigation allows water to reach plant roots by slow trickling, either onto the soil surface or

directly onto the root zone, using a network of valves, pipes, tubing, and emitters.

Water harvesting is another technique considered to have high potential to boost rain-fed agriculture. "We need to look at the hydrological conditions in a given area and develop a system to harvest the rainwater," said Kalita. "That can reduce flooding, erosion, and contamination of the surface water from pesticides and fertilizer runoff."

Kalita has worked with a variety of international organizations to put his water manage-

*U of I researchers hope to help Lebanese producers develop a water allocation model that will enhance agricultural production, using less water, with a system that is environmentally sustainable.*



*Joseph Monical (left), graduate student in agricultural and biological engineering, visits a surface canal outside El Qaa, Lebanon, with colleagues.*

*Below, researcher Prasanta Kalita befriends a local child.*

ment research into practice. In the Middle East Water and Livelihoods Initiative, sponsored by the U.S. Agency for International Development and the International Center for Agricultural Research in the Dry Areas (ICARDA), Illinois was one of six universities working with ICARDA. Each university was encouraged to partner with a research team in Egypt, Iraq, Jordan, Lebanon, Palestine, Syria, or Yemen on work that would help improve livelihoods of the resource-poor in dry areas.



Kalita and two graduate students traveled to Lebanon to develop a water allocation model that would enable communities to enhance their agricultural production, using less water, with a system that was environmentally sustainable.

The research site was in El Qaa, in the upper Orontes basin in northeastern Lebanon. "They get less than 300 millimeters of rain a

**"To truly benefit society, to put a smile on the face of society, we need everybody to work together to solve the problem of food security."**

year, not quite 12 inches, so it's very dry," said Kalita. "The surface had a lot of calcium carbonate rock. If you saw that land here, you'd probably just say, Build something on it—don't try to grow anything. But that's what they have to work with."

To provide irrigation for agricultural production, farmers pumped groundwater, which extensively depleted groundwater levels over the past 30 years. "Because of that," said Kalita, "they were interested in evaluating alternative

cropping and irrigation strategies that would enhance their production and minimize losses to and possibly recharge their groundwater levels."

Joseph Monical, one of Kalita's graduate students, made additional visits to the site to help collect soil and water samples. He documented the collection process as well as pumping and irrigation layouts for the areas they visited.

"One challenge was limited data," said Kalita. "The project partners we talked with were hesitant to rely too heavily on historical data because of their concerns for accuracy, so they wanted to take new measurements that were more viable."

Kalita said the project was very successful. "It allowed us to develop an understanding of the problems of the region, the needs for water management and irrigation, and the available resources. We then had opportunities to develop research questions that addressed some of those problems."

Kalita said his research in water management over time has given him an appreciation for the bigger picture.

"Sometimes we engineers work on one area to solve a specific problem and think that's going to solve the world's problems. That's totally wrong. To solve the interconnected problems of water management and food security, we need everyone—engineers, educators, scientists, social scientists, economists, and policy makers," he concluded. "To truly benefit society, to put a smile on the face of society, we need everybody to work together to solve the problem of food security."

## Anti-inflammatory benefits seen when plant extracts fed to sick pigs



Garlic is used widely in culinary seasoning, in gardens to repel rabbits, and in some cultures to ward off evil. Now researchers believe that garlic plant extracts could boost immunity.

**P**orcine reproductive and respiratory syndrome (PRRS), a viral infection of the lung, is the most expensive and invasive disease for pig producers on a global scale. Though it does not occur on every farm, it is the biggest disease problem in the pig industry, said U of I animal sciences researcher James Pettigrew.

Infection with *E. coli* bacteria has also been a problem historically, and it continues to cause difficulties industry-wide, Pettigrew said. "Either disease can sweep through a farm, so alleviating either one would substantially reduce production costs. Many management practices have been used in the swine

industry, but none can guarantee freedom from disease for pigs," he said.

Consumer concerns about bacterial resistance to antibiotics have prompted the swine industry to seek alternative methods, including special feed additives, to protect the pigs' health. This interest led Pettigrew and his team to explore the potential benefits of selected plant extracts.

The researchers conducted two experiments to test the beneficial effects of adding plant extracts to pig diets to combat PRRS and *E. coli* infection. In both experiments, researchers used four diets in weanling pigs, a control diet and three others that included gar-

lic botanical extracted from garlic, turmeric oleoresin extracted from ginger, or capsi-cum oleoresin from pepper. In both experiments, half of the pigs in each dietary treatment were challenged with either *E. coli* or PRRS virus while the other half were unchallenged.

"We've known for a long time that plant extracts, also called essential oils or botanicals, have certain biological actions," said Yanhong Liu, a doctoral student who led the studies. "For instance, they can act as antioxidants or antimicrobials. We wanted to test whether we could get a benefit from feeding those products in very low doses to pigs that were challenged with these specific diseases."

*E. coli* infection, a bacterial illness of the gut, is marked by diarrhea, decrease in appetite and body weight, and in some cases a higher mortality rate. The disease is especially dangerous after weaning as pigs are adapting to new feed and new environments, Pettigrew said.

**"In production animals, inflammation is costly. Inflammation reduces feed intake, and it diverts nutrients away from growth to the immune system. If we can bring inflammation quickly back down to normal after a challenge, that helps in production."**

The pigs in the study that were challenged with *E. coli* and had been fed any of the three plant extracts had a lower frequency of diarrhea than those fed the control diet. The pigs fed plant extracts were more efficient in feed use than the pigs fed the control diet in the *E. coli*-challenged group, and challenged pigs fed plant extracts had sounder gut morphology compared with the challenged pigs fed the control diet.

Liu noted that even the pigs in the non-challenged group, with a low frequency of mild diarrhea, benefited from the plant extracts. "Because there is a relatively high rate of diarrhea in post-weaning pigs as they are moved

from the mom and started on all solid feed, the extracts could also be used to reduce its occurrence," she said.

Common symptoms of PRRS include fever, lethargy, breathing trouble, loss of appetite, and decreased growth performance. The disease can also lead to spontaneous abortions and higher pre-weaning mortality rates.

After feeding the pigs challenged with the PRRS virus the three diets with plant extracts, the researchers observed that those pigs were more efficient in week 1 and week 2 than the pigs fed the control diet. The pigs continued eating and gaining weight. This was especially true with turmeric, Liu said.

Blood samples from the pigs with the PRRS virus showed that the pigs fed plant extracts also had a lower blood viral load and lower concentrations of inflammatory mediators

than pigs fed the control diet. These observations also suggest that feeding plant extracts could suppress ongoing inflammation and prevent secondary infections.

The researchers believe the benefits resulted from effects on the pigs' immune systems, with the plant extracts reducing the inflammation caused by the *E. coli* bacteria and the PRRS virus.

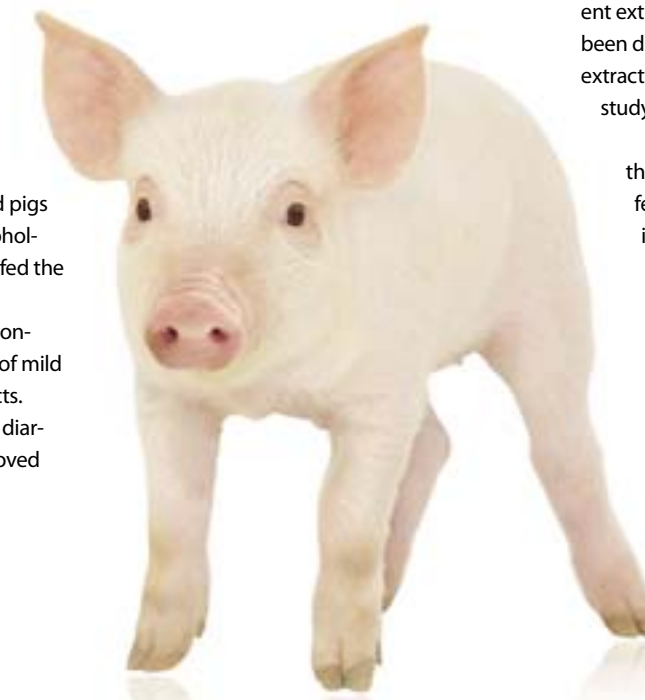
"In production animals, inflammation is costly. Inflammation reduces feed intake, and it diverts nutrients away from growth to the immune system," Pettigrew said. "If we can bring inflammation quickly back down to normal after a challenge, that helps in production."

And by increasing production, food insecurity concerns are also addressed.

Although previous research has looked at using plant extracts in pig diets, Pettigrew said, Liu's study looking at the effects of three different extracts on two different diseases had not been done before. The low concentrations of extract that still produced benefits also set the study apart.

The researchers will continue to study the mechanisms behind the beneficial effects they observed, including conducting gene expression studies. "We want to know the big picture of how these plant extracts affect the challenged and non-challenged pigs," Liu said.

Pancosma SA of Geneva, Switzerland, provided funding for the research.



## Reduced energy diets mean fewer days to pregnancy for dairy cows

**F**or producers in the dairy business, every day after calving before a cow can get pregnant again translates into dollars per day lost or gained.

Researchers at the University of Illinois interested in how nutrition affects reproductive performance in dairy cattle have determined that cows fed a reduced-energy diet not only got pregnant again sooner, but were also healthier and produced the same amount of milk as those fed a high-energy diet.

A previous U of I study comparing cows before calving fed a diet with the recommended energy levels to those fed a diet with reduced energy found that the reduced-energy group performed better after calving.

Phil Cardoso, an animal sciences researcher intrigued by those results, wondered if diet might also be linked to reproductive performance. Using data from seven U of I experiments completed from 1993 to 2010, he constructed a database of 408 cows, with details on diet before calving and physiological status. He also looked at days-to-next-pregnancy after calving, which had not been considered in previous studies.

He found that, on average, cows fed a controlled-energy diet (80 percent of the recommended amount of energy or 100 percent achieved with added fiber) became pregnant about 10 days sooner than cows fed a high-energy diet, an average period of 157 days versus 167 days.

And longer intervals cost money. "In the dairy business, we'd like the cow to calve once a year and for the calving interval to be around 12 to 13 months. To give milk, she needs to calve, so we want her pregnant as soon as possible," Cardoso explained.

"These findings are good for the dairy business," Cardoso said. "Depending on the system of production, producers would save \$2 to \$5 dollars a day per cow if they could shorten the days before the cow can get pregnant again."

Cardoso pointed out that it is commonly accepted among producers that cows fed a controlled-energy diet may not get pregnant. But "that's not true. If anything, they are a little better off," he said.

During the study, cows also lost less in body condition score and had a lower disease incidence because they were eating more. Cardoso explained that the shorter time to pregnancy for cows fed the controlled-energy diet is most likely because they eat more after calving than the cows fed the high-energy diet.

"Just after calving, cows have a negative energy balance," Cardoso said. This is because they cannot consume enough energy to compensate for the fact that they are producing milk.

This negative energy balance, which can be measured by looking at metabolites in the blood, causes cows to lose weight, lowering their body condition score. High levels of the metabolites just before calving or one to two weeks after calving are associated with metabolic disorders and certain diseases, which cause cows to eat less, which in turn affects reproductive performance.

Both groups of cows showed reduced energy consumption around calving due to stress, but with the high-energy diet the drop was four times higher (approximately 30 percent) compared with the controlled-energy diet (only 7 percent).

Cows fed the controlled-energy diet were able to start eating right after calving. "We want the cow to eat as much as possible just after calving because then she's going to be healthier," Cardoso said.



*Animal sciences researcher Phil Cardoso at the U of I dairy barn*

The researchers also noticed that cows fed the controlled-energy diet showed less variation in how much they ate before and after calving. By contrast, the high-energy cows were eating more than they needed before calving.

"Cows and ruminants cannot export lipids well from the liver," said Cardoso. "So any time a large amount of fat is going to the liver, that causes a lot of problems. Glucose levels will be lower, and ketone bodies will form. Feed intake will start to drop, and the cow will start feeling ill."

In a follow-up study that has not yet been published, the researchers tried strategies to

make the cows eat less. One was to give them just 80 percent of what they needed; the other was to increase fiber so the diet would be lower in energy and the cows could eat more. Results for the two strategies were similar.

This study has also prompted a further look at insulin resistance in cows based on energy level in the diet. Cardoso said initial findings show that some cows fed high-energy diets have problems that mimic Type 2 diabetes in humans, but they do not exhibit those issues when fed controlled-energy diets. Like humans, he explained, cows need appropriate insulin levels to remove glucose from the

blood and put it into tissue in the body for metabolism.

"I saw that cows fed high-energy diets were taking longer to get pregnant and getting sicker, and it can be because of insulin problems caused by these diets," he explained. "These animals are insulin-resistant, and controlled-energy diets are best for taking sugar out of the blood the fastest."

By continuing to improve and use inputs more efficiently in dairy cows, savings in costs to producers will help food costs stay affordable for households around the world.

## As resistance rises, entomologists urge integrated pest management



**W**ith a growing list across the Corn Belt of western corn rootworm populations confirmed or suspected of resistance to some Bt corn hybrids, entomologists are encouraging growers to move to an integrated pest management (IPM) approach to address the issue.

"Corn production is incredibly important to Illinois and to this country," said Mike Gray, a U of I entomologist, "and western corn rootworm is a very significant economic insect pest of corn. You've got this Bt technology that's incredibly powerful and important, and this economically critical insect is developing resistance to it."

Looking toward the future food needs in the United States and the world, addressing these issues of resistance is critical.

Gray explained that every node of roots destroyed by the corn rootworm is equivalent to a 15 percent yield loss for growers. He added that plant-based bioassays have confirmed resistance in Illinois and Iowa, with suspected cases in many other midwestern states, such as Nebraska and Minnesota.

Since its introduction to the market in 2003 by Monsanto, Bt corn containing the Cry3Bb1 protein has been widely used by growers as a pest management tool. Other products containing insecticidal proteins followed. "Growers and the ag community were very receptive to this technology going back a

*Entomologist Mike Gray, speaking at Agronomy Day on the U of I South Farms, encouraged producers to implement more long-term diversified corn rootworm management tactics to combat resistance development.*

decade ago because the hope was that planting-time soil insecticides could eventually be reduced significantly or eliminated in many cases," Gray said.

"Because it's human nature to want to use something that works very well, growers tended to overuse the technology and not to rotate crops as often or to rotate with Bt hybrids, using that same technology over and

**"The more diversity you can achieve, the better off you are from a pest management perspective when it comes to western corn rootworm."**

over again rather than following an integrated pest management approach. Not surprisingly, resistance developed," Gray said.

"The down side to all of this is the potential that at some point we lose a very effective technology."

Many growers are waiting for the next new technology, which Gray said may not be available until the end of the current decade. Meanwhile, in response to the threat of western corn rootworm resistance to the Cry3Bb1 protein or cross-resistance to other Bt proteins, many growers are increasing their use of planting-time soil insecticides, along with continued use of Bt hybrids, which he said does not optimize the hoped-for human health and environmental benefits.

In a recently published study, Gray and other entomologists trace the development of the resistance and discuss critical on-farm management decisions that must be made now to delay further resistance.



The authors conclude that resistance is still occurring despite a U.S. Environmental Protection Agency requirement that growers plant a refuge to delay or prevent its development. Insufficient planting of the refuge and nonrecessive inheritance of resistance may be to blame. Also, because Bt hybrids registered for corn rootworm are low-dose events, corn rootworm survivors can occur in every field. All of these factors combined help to explain the loss of efficacy of some Bt hybrids targeted at this important pest.

Gray said the first and foremost recommendation to growers is crop rotation—to rotate corn with soybean or another nonhost crop. But because entomologists have seen a segment of resistance to both Bt hybrids and crop rotation, Gray stressed that it is also critical to adopt a more diversified rotation.

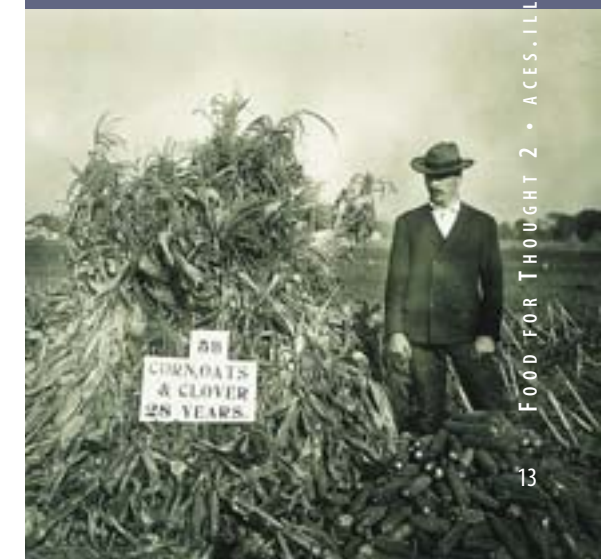
"We grow a lot of corn and soybeans, but not as much alfalfa, oats, or other small grains. It is more profitable to grow corn and soybean, but the more diversity you can achieve, the better off you are from a pest management perspective when it comes to western corn rootworm.

"There is a tremendous financial investment each spring for growers to plant corn or soybean, so many producers see the use of a Bt hybrid and/or a soil insecticide as pest management insurance. They want to protect their investment. I understand that," Gray said. "But it is my duty as an entomologist to make sure producers understand that there are long-term consequences to those approaches, which is the development of resistance if you don't integrate or alternate those practices."

## 100 years of University of Illinois Extension

Illinois might be known for growing clover and cranberries rather than corn and soybeans had farmers a century ago refused recommendations from extension agents of the day to apply lime to the state's highly acidic soil. Because lime is made of calcium carbonate, which is also an ingredient in cement, farmers feared using it, believing that it would make the soil hard. Demonstrations at agricultural experiment stations and on farmers' fields across the state convinced farmers to use lime as an additive to balance soil pH, making it possible to produce abundant crops of corn, soybeans, alfalfa, and other pH-sensitive plants.

The process to produce hybrid corn was created by university scientists and passed on to companies to grow and market the seed to farmers. Extension played a large part in the adoption of hybrid seed by establishing demonstration plots in farmers' fields. Planting these demonstration plots near well-traveled roads gave farmers the opportunity to visit them to observe the difference in disease pressure and ultimately in yield between open-pollinated and hybrid corn.



## Genetic improvement behind increased soybean yields



Soybean improvement through plant breeding has been critical over the years for the success of the crop. In a new study that traces the genetic changes in varieties over the last 80 years of soybean breeding, researchers concluded that increases in yield gains and an increased rate of gains over the years are largely due to the continual release of greater-yielding cultivars by breeders.

"This research in some ways looks back and informs us how soybean varieties have changed. It's useful to document these traits and changes," said Brian Diers, a University of Illinois plant breeder and researcher on the study. "We can show that we really have been successful at increasing yield."

But this study is also about the future of the soybean crop.

"The study has actually created quite a lot of interest among soybean breeders because they want to understand what's happened, and when we look at physiological traits, we can see what has been changed. This gives us clues about what traits we should focus on in breeding for future increases based on what has been inadvertently changed over time as we have selected for yield," he said.

Diers and a multi-institutional team of researchers evaluated historic sets of 60 maturity group (MG) II, 59 MG III, and 49 MG IV soybean varieties, released from 1923 to 2008, in field trials conducted in 17 states and one Canadian province during 2010 and 2011.

The experiments included plant introductions and public cultivars obtained from the USDA Soybean Germplasm Collection housed

at the U of I National Soybean Research Center, as well as from varieties provided by Monsanto, Pioneer, and Syngenta.

In the process of documenting the genetic changes, the researchers observed an increase in yield over the past 80 years that is equivalent to one-third of a bushel per acre per year.

Diers said the researchers estimated that about two-thirds of the yield increases in farmers' fields are due to new varieties introduced by breeders, with the other third due to reasons such as improved agronomic practices.

"When we compare old varieties to new, the new varieties do yield much better. When

**"We are now asking whether breeding for an even longer reproductive period could further increase yields."**

we look at the data more closely, the yield increases have actually accelerated starting in the 1960s and 1970s. It's different for each maturity group, but current yield increases are greater than they were earlier," Diers said.

This research also showed that when compared to old varieties, plants in the new varieties are shorter in height, mature later, lodge less, and have seeds with less protein and greater oil concentration.

"The new varieties tend to mature later within these maturity groups, which is something that theoretically shouldn't happen because we classify these varieties based on

when they mature. So theoretically MG II varieties should mature at the same time now as one back in the 1970s, but this is not the case," Diers said. "Probably over time, people have been selecting varieties that are a little bit later and later, and these changes have accumulated. In some ways, it's not a bad thing, because farmers are planting earlier than they did back in the 1970s, so they actually need varieties now that will mature later than back then. That's not a bad thing."

Another trait reported as having changed over time is earlier flowering time, which has resulted in an expanded reproductive period. "We didn't know that this reproductive period was expanding, and we are now asking whether breeding for an even longer reproductive period could further increase yields. Other studies have looked at the interaction of planting date by year of release and have shown new varieties can utilize earlier planting dates better than old varieties," Diers said.

With soybean being a leading source of protein and oil for human food, animal feed, and other products, global rates of yield will need to increase worldwide for the crop to keep up with future demand.

"Understanding how we've made these changes to date can help us determine how we can further improve yields and increase the rate of gain," Diers said.

Diers plans to study ways to increase the rate of genetic gains using more modern breeding techniques.

"Most of the yield increases are the result of breeders' selecting better combinations of



Brian Diers making a cross between different soybean types in the field.

genes that can allow plants to take sunlight and produce more seed from that sunlight. We don't know what genes breeders are selecting that are resulting in these increases—for example, we don't know where in that pathway from the sunlight hitting the canopy to producing seed this occurs. But breeders, by selecting new varieties that have more yield, are able to make this progress without necessarily understanding the mechanism behind it," Diers said.



## Fertilizer in small doses yields higher returns for less money

Crop yields in the fragile semiarid areas of Zimbabwe have declined over time due to reduced soil fertility resulting from monocropping, lack of fertilizer, and other factors. University of Illinois researchers, in collaboration with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), evaluated a precision farming technique called “microdosing,” its effect on food security, and its ability to improve yield at a low cost to farmers.

“Microdosing involves applying a small, affordable amount of fertilizer with the seed at planting time or as top dressing three to four weeks after emergence,” explained Illinois agricultural economist Alex Winter-Nelson. “So instead of spreading fertilizer over the entire field, microdosing uses fertilizer more efficiently and ultimately improves productivity. Our research shows that smallholder farmers’ investment in microdosing has really unlocked the power of chemical fertilizers in some of the low-rainfall areas of Zimbabwe.”

Training is the key to adoption of the technique. “About 75 percent of households receiving microdosing training used fertilizer in 2011,” said Winter-Nelson. “This compares to less than 25 percent for households that did not receive training. Another way of looking at it is that training in microdosing raised the probability of adoption by 30 to 35 percentage points. Knowledge of microdosing changed people’s attitudes about fertilizer. Those who had training generally disagreed with the common notion that fertilizer is not worth its price or that it burns crops.”

Winter-Nelson said that there are hurdles to overcome, however. “Sustaining and expanding the benefits of microdosing technology will require efforts to ensure that private

agrodealers can stock the product and package it in a manner that smallholder farmers find useful,” he said. “This is complicated by the financial capacities of agrodealers and by difficulty in projecting fertilizer demand, which varies with rainfall.

“We also need to work on extending training to underserved areas and to extension personnel in low-rainfall areas,” he said. “Female-headed households were significantly less likely to adopt microdosing than others, possibly reflecting labor shortages or difficulties accessing fertilizer. Understanding the constraints that female farmers face and adapting

the methods or the training to their circumstances could also help extend adoption of the technique.”

The research data were collected through a structured household survey in eight districts in semiarid areas, with additional information about fertilizer availability and demand gathered from interviews with local extension service providers, non-governmental organizations, and agrodealers. Focus group discussions were also utilized. The household survey asked about assets, cropping patterns, agricultural production, training in microdosing, extension techniques, and fertilizer use and

adoption, with particular attention paid to management practices and output on cereal plots the two previous cropping seasons.

“What was particularly encouraging from the data is that, when comparing the costs of research, development, and promotion of microdosing in Zimbabwe to the gains achieved through a 30 percent adoption rate and an estimated productivity effect, the data suggest an internal rate of return on the investment in microdosing of over 40 percent,” Winter-Nelson said. “And that’s a good motivation to continue to try to get more farmers in Zimbabwe to try microdosing.”



## Volunteers sought to train farmers in Africa

A partnership has been developed among Catholic Relief Services, the U of I College of ACES, and four other institutions to conduct a USAID Farmer-to-Farmer program that connects farmers in the United States with others in the East African nations of Ethiopia, Tanzania, Kenya, and Uganda for training and technical assistance.

“Catholic Relief Services will work with grassroots organizations to identify specific farmers in their East Africa region to assess their needs,” said Rolin Oliver Ferguson, international programs coordinator in the Department of Agricultural and Consumer Economics. “Our role will be to help locate knowledgeable volunteers who will travel to Africa and provide training.”

Ferguson said that the volunteers may be individuals, growers, and producers with specific expertise; Master Gardeners; and university personnel.

The Farmer-to-Farmer program has four goals: to improve household livelihoods and nutrition; to help link small farmers to value chains; to strengthen communities’ resilience to shocks such as droughts; and to preserve and enhance natural resources.

## Soy-enriched foods in Haiti

Three decades ago, Haiti imported only 19 percent of its food and produced enough rice to export. But today, 80 percent of Haiti's rice—and half of all its food—is imported. Haiti in general and the mountain villages in particular have long suffered from chronic hunger. Child malnutrition rates have been high for years. The United Nations World Food Program reports that nearly a fourth of Haiti's children suffer from malnutrition.

Despite having the most malnourished children in the Western hemisphere and numerous obstacles to overcome, Haiti has seen great progress related to soy.

The U of I National Soybean Research Laboratory (NSRL) provides nutritional support in areas around the world that face extreme challenges of malnutrition, including Haiti, and develops innovative processing techniques involving soy. NSRL also educates people in developing countries about the advantages of a soy-enriched diet and promotes the health benefits of eating soy.

In 2010, the Illinois Soybean Association, along with NSRL and the World Initiative for Soy in Human Health, shipped a container of dehydrated soup mixes containing textured soy protein to Haiti following the devastating earthquake in January that year.

"Since then, these organizations have collaborated on various additional projects in Haiti," said Bridget Owen, associate director for NSRL. "Health and nutrition fairs for school-age children have provided unique opportunities for students, teachers, parents, and school administrators to learn about soy protein as well as the importance of a nutritious and balanced diet, taught in a setting that is enjoyable,



Women in Haiti who participated in hands-on soy cooking workshops learned innovative ways to use soy and boost the protein level of local dishes while maintaining traditional flavors.

entertaining, and enlightening for all who participate."

Owen recounted a highlight of one of the nutrition fairs—a solo performance by a Haitian girl who had composed a song about soy and sang it on stage to express her appreciation.

NSRL coordinates soybean research, outreach, and education in the areas of production, nutrition, and international development and strives to

find ways to increase yield and improve quality. NSRL has a long history of applying the value of soy in animal nutrition, in industrial applications, and for human consumption. The organization seeks to connect cost-effective and highly nutritious soy protein to the global challenge of hunger and malnutrition through sustainable solutions in early childhood nutrition, school feeding programs, economic development, and technical assistance.



NSRL is partially funded by Illinois Soybean Association checkoff dollars and works with numerous partners to increase the use of soy around the world. NSRL is also a key partner in the Soybean Innovation Lab, a recently funded multimillion-dollar USAID project at the University of Illinois.

For more information, visit [nsrl.illinois.edu](http://nsrl.illinois.edu).

## Sustainable grassroots extension programs

Effectively meeting the food security and economic development needs of resource-poor men and women farmers in Africa, Asia, the Middle East, Eastern Europe, and Central America requires significant changes in extension systems, U of I agricultural economist Paul McNamara believes. "New approaches need to draw on the full breadth of resources in public, private, and civil society organizations and utilize advanced information and communications technologies in order to make a real difference," he said.

McNamara is the director of Modernizing Extension and Advisory Services (MEAS), a five-year initiative funded by USAID to lead strategic analysis of the activities and investments needed to strengthen pluralistic extension systems in developing countries.

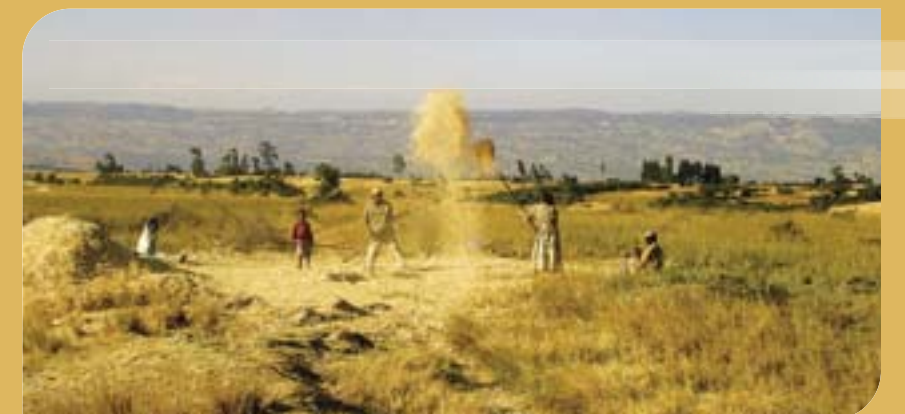
McNamara described three main components that form the foundation for the MEAS extension efforts:

- **Teach**—MEAS is working to disseminate user-friendly materials for training programs that promote new strategies and modern approaches to rural extension and advisory service delivery.
- **Learn**—Good practices and lessons learned are documented through success stories, case studies, evaluations, pilot projects, and action research.
- **Apply**—With assistance from selected public and private host-country organizations, MEAS is designing modern extension and advisory services programs for the analysis, design, evaluation, and reform of rural extension and advisory services.

"Our goal is to help transform and modernize these extension systems so they can play a key role in increasing farm incomes and enhancing the livelihoods of the rural poor, especially farm women," McNamara said. "A key aspect to the success of extension in developing countries is to encourage strong participation and collaboration so that programs will be sustainable and make a difference long-term."

McNamara said that the applied research and country-level assessments MEAS has conducted over the past three years demonstrate the importance of sustainable extension and advisory services for increasing the incomes of smallholder farmers and raising agricultural productivity.

"Examples of effective channels of service delivery exist in the public sector, through private-sector organizations including cooperatives and agricultural businesses, as well as non-governmental organizations and civil society groups," he said. "Across these organizational forms, farmer voice and input into program design and delivery relate directly to program effectiveness."



## \$25-million federal grant to increase Africa's food supply through soybean research

*A Ghanaian woman packages Weanimix, a local porridge weaning product fortified with soy protein, for resale as part of a microenterprise program.*



In 2013, the College of ACES received a \$25-million federal grant to lead a consortium of universities and non-governmental organizations working to increase the food supply in Africa by improving soybean yields in five countries on the continent. The five-year grant, administered by the U.S. Agency for International Development (USAID), will be led by U of I agricultural economist Peter Goldsmith, who has 13 years of experience conducting research in similar latitudes in South America.

The project is part of Feed the Future ([www.feedthefuture.gov](http://www.feedthefuture.gov)), the U.S. government's global hunger and food security initiative.

"The people living in the poverty band in the lower latitudes of Africa struggle with low-productivity crops, isolation from markets, and access to low-cost sources of protein and oil," said Goldsmith. "There has also been a research void in soy production among developing countries. We've already seen soy as an economic engine creating agroindustrial growth in Latin America. That's the beauty of a highly productive commercial crop such as soybean. This

**"People know how to grow and cook with the native legumes, but the productivity, versatility, and quality and levels of protein are low compared with soy."**

research will work to find answers to questions about soy in these protein-deficient countries, from selecting the best seeds for that area and climate to establishing markets and environmental sustainability."

The consortium, officially named the Feed the Future Innovation Laboratory for Soybean Value Chain Research, will provide replicable research to identify, adapt, and deploy soybean germplasm; educate current and future breeders; define best practices for production and seed management; and identify barriers to adoption, especially for women. The project will also build and operate the Tropical Soybean Information Portal, a virtual interactive community that brings together all the latest research to support researchers, the private sector, non-

governmental organizations, policy makers, and the USAID missions. The group will conduct its research in the sub-Saharan African countries of Ghana, Mozambique, Zambia, Malawi, and Ethiopia.

Because soy must be processed, one aspect of the research that will get a special focus is soy's value chain—finding ways to connect growers with processors and markets. Poor infrastructure and distance to markets plague many regions of the developing world. The USDA Soybean Germplasm Collection at the U of I will be leveraged to identify new high-yielding soybean varieties that are adapted to low-latitude environments. Researchers will also work to develop cultivars that are resistant to rust and bacteria pustule, can more efficiently fix nitrogen, can better tolerate the low phosphorus common in tropical soils, and can be easily processed for household as well as livestock consumption.

"There is a high demand for poultry and animal feed in developing countries," Goldsmith added. Soybean's primary use is as a high-quality protein source for livestock. "That's another aspect

of this research that fits the legacy of the University of Illinois. Illinois crop and animal scientists were instrumental in developing a nutritious corn-soy diet for pigs and poultry."

Goldsmith said that poultry in these sub-Saharan regions are typically not fed formal grain and soybean meal diets; consequently the chickens have very slow growth, which in turn provides low returns to farmers. A second phase of the project would focus research on poultry nutrition so that producers can raise healthier chickens and have an opportunity to scale up their poultry operation. For example, Goldsmith said, one option might be the use of small-scale extruders working like a local grist mill, where small farmers can bring their soy to have it processed and blended with maize and micronutrients for chicken feed.

The U of I's National Soybean Research Laboratory has been a global leader in the use of

soy for human nutrition in developing countries. "There are already established traditions for starchy foods such as cassava, rice, and maize, as well as for native legumes such as cowpea and chickpea," Goldsmith said. "People know how to grow and cook with the native legumes, but the productivity, versatility, and quality and levels of protein are low compared with soy."

U of I contributors to the USAID project include Brian Diers and Randy Nelson, breeding research; Craig Gundersen, Bridget Owen, and Marilyn Nash, human nutrition; Rita Mumm, breeder training and education; Jeremy Guest, environmental impacts of soybean; and Courtney Tamimie, project manager.

"This research-for-development design will provide the research foundation that can readily be adopted by the development community to boost soybean production and improve the nutrition and market linkages for smallholder

farmers, which in turn will raise incomes, increase food security, and improve household nutrition," said Robert Hauser, dean of the College of ACES.

Other key partners in the consortium are Mississippi State University; the University of Missouri; the International Institute for Tropical Agriculture; Catholic Relief Services; Technoserve; the International Fertilizer Development Council; the University of Georgia; the University of Maryland, Eastern Shore; and Delaware State University.

*A chef examines soy flour provided by the U of I National Soybean Research Laboratory during a training at the Universidade Eduardo Mondlane in Maputo, Mozambique. Attendees learned how to incorporate soy products into local and traditional Mozambican foods.*



## Brazil's dilemma: Abundant grain, inadequate storage

A tropical climate that allows for farming year-round would seem to be a tremendous economic advantage, but for corn and soybean farmers in the Brazilian state of Mato Grosso it also poses a problem—an abundance of grain followed by about a 10 percent postharvest loss, in part due to a lack of storage.

“There is a 34 percent undercapacity of soybean storage, and the situation is aggravated by the rapidly increasing production of second-crop maize,” said agricultural economist Peter Goldsmith. “The worst situation occurs in northern Mato Grosso, with a simulation of a full-maize second crop. The potential for a succession crop is great, and current levels of storage are low. There is clear evidence of a shortage of storage, particularly private and cooperative, as grain production rises in the state,” he said.

Goldsmith's research on the problem was the first to employ GIS software to map the coordinates of commercial, cooperative, and private grain storage facilities in Mato Grosso.

“To find the areas with the most and the least congestion,” Goldsmith said, “we created GIS coordinates for every facility, mapped them, and then overlaid current production with how much there would be if farmers were to produce and store a second corn crop on 100 percent of the bean crop.”

The study focused on storage facilities with capacity greater than 50,000 metric tons, mapping the state's 2,143 private, cooperative, and commercial units.

“As an example of what we found, one region in the northern part of the state is under capacity by about 6.9 million metric tons,”

Goldsmith said. “That's 270 million bushels. If a typical grain bin holds about 50,000 bushels, that's equivalent to 5,420 grain bins. The area just south is another region that is 5 million metric tons under capacity.”

Goldsmith said that the information will help determine the best, most convenient locations for additional storage.

“Losses occur in three situations—when grain is left standing in the field after a harvest; during the short haul when grain falls off of the truck in transportation from the field to either storage or commercial sale; and through loss of private storage,” he said. “Short-haul loss is fairly trivial in the United States, but it is significant in developing countries that lack infrastructure. Roads are either unpaved or are full of potholes and in very poor condition. Commercial trucks used for hauling grain are also not in the best shape, so there's a 3 percent loss of grain that falls off the truck.”

The nature of nonstop, year-round farming in the tropics contributes to the loss. “Farmers have to harvest soybeans during the rainy season, because if they wait until the end of the rainy season to plant corn, the corn won't get pollinated due to the onset of the dry season,” Goldsmith said. “There are also significant issues of quality and direct gain and loss due to harvesting at very high moisture levels. And the urgency brought on by the seasonal timing makes harvesting go very fast. Speed is important, because you've got to get the beans out to get the corn in. A farmer might sacrifice soybeans to get the corn planted. And the equipment is in constant demand and kept far from the farmstead, so combines and trucks don't

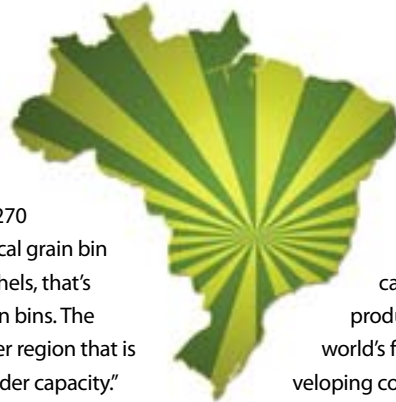
get maintained properly.”

Goldsmith said that tropical regions of the globe will be producing more and more of the world's food, so helping farmers in developing countries such as Brazil create more efficient ways to harvest, transport, and store their crops is a step toward ensuring enough grain to feed and fuel the world.

“This is where the available ground is located,” Goldsmith said. “It's been difficult to know how to farm it in the past. The low organic matter and highly acidic soils that are under significant pest pressure make it a difficult area in which to produce crops, but the Brazilians have figured out how to do it and do it very well.

“They are part of the global market, at the frontier of agricultural production systems,” he said. “Places like Mato Grosso are at the margin where the food gap can be closed. In most temperate regions of the world, grain productivity is already high, so increasing output to meet rising demand is more incremental. The big changes are happening in the low-latitude regions of South America and Africa. As a scientifically relevant university, we need to understand the tremendous changes under way in the global agribusiness scene, which currently happens to be in western Brazil.

*This private storage facility (right) in central Mato Grosso stores its own production and dries and stores grain for neighbors. All of the heat used for drying comes from burning timber. The need for soybean drying is great because harvest increasingly occurs during the rainy season, when moisture levels in the grain can exceed 20 percent.*



## Documenting grain loss in Brazil's harvesting supply chain



Documenting grain losses at different stages of the supply chain provides an important baseline for measuring improvements of grain quality. Researchers in the Department of Agricultural and Biological Engineering (ABE) are collaborating with three universities in Brazil to measure and document postharvest losses of soybeans and corn.

Mary-Grace Danao, assistant professor in ABE, Richard Gates, professor in ABE, and Marvin Paulsen, professor emeritus in ABE, are investigators for the project. The Brazilian partners include Rodrigo Zandonadi and Solenir Ruffato from the Federal University of Mato Grosso, Daniel Marçal de Queiroz and Francisco Pinto from the Federal University of Viçosa, and Darly Sena from the Federal University of Goiás.

Their efforts include determining the extent and cost of harvest losses for farmers in the major soybean- and corn-growing states, studying the logistics of handling and transporting the grain, measuring transportation conditions as grains move from farm to storage, assessing fan efficiencies in large concrete *graneleiros*, and testing and developing best management practices using hermetic storage bags for grain storage.

The team's most recent effort has been studying handling and transportation losses. Chris Wilhelmi, an ABE graduate student, has focused on developing a system to monitor GPS coordinates, time, temperature, relative humidity, and carbon dioxide buildup in grain in trucks during transport. With the help of Jonnas De Marchi, an undergraduate student in agricultural engineering at Federal University of Mato Grosso, Wilhelmi installed

*Chris Wilhelmi (top), a graduate student in agricultural and biological engineering, works with a trucker in Mato Grosso, Brazil, to adjust one of the monitoring probes installed in a grain truck.*



*Researchers Richard Gates and Mary-Grace Danao, with graduate student Chris Wilhelmi working in the lab behind them.*

several monitoring probes in 23 trucks during the soybean harvest in Sinop, Mato Grosso.

"We monitored 44 trips from farm to storage made by these trucks," said Danao. "We also collected soybean samples at the time of loading at the farm and at the time of unloading at the storage facility. All soybean samples were analyzed according to a Brazilian grain classification system. We are currently analyzing our measurements to see if certain handling practices and transportation conditions are related to—or, more importantly, causing—quality changes in the beans as they move from one point of the supply chain to the next."

Preliminary analyses of the data showed soybean harvest moisture between 11 and 26 percent. For the 10 farms the team visited, distances to the storage facility ranged from 5 to 125 km, with an average of 39 km (24 miles). Most of the roads traveled were unpaved. The transportation duration from loading to unloading ranged from 30 minutes to 27 hours. Duration was not related to distance, as it included the time trucks waited at the farm to finish loading, or the total time spent by fully loaded trucks sitting idle at the farm or at the storage facility waiting to unload the beans.

"We're hoping to see some patterns that help us provide practical guidelines for handling and transportation that improve efficiencies and are conducive to the Brazilian system," said Danao. "For example, it would be good if we could advise how much time a farmer has to get high-moisture soybeans to a storage facility for cleaning and drying that ensures minimum quality losses. We can also identify areas between the farm and storage facility where farmers can make an investment or change in practice to handle the grain more efficiently."

Danao said the team hopes to expand the work in transportation and to address storage systems in the next couple of years. The team develops measurement protocols and technologies that are applicable to other regions of the world where agronomic practices, climate, and challenges are similar. "As the global demand for food increases," she concluded, "it's imperative that we find efficient and safe ways to harvest, transport, and store our grains."

The research is funded by the Archer Daniels Midland Institute for the Prevention of Postharvest Loss, and Danao is administering the grant.

## Preventing postharvest loss with digital tools



(Far left) Jute bags used for grain storage.

Researchers hope traditional local harvesting systems in countries such as India and Brazil can be improved with the use of digital tools.

Biological engineer Luis Rodriguez is one of several researchers working to reduce postharvest loss through modeling and decision analysis support systems. Rodriguez is also a faculty member of the Archer Daniels Midland (ADM) Institute for the Prevention of Postharvest Loss, which is funding his project.

Postharvest loss is a measurable reduction in product quantity or quality during any of the various phases of the postharvest system. Such loss is a significant problem, particularly in developing countries, because it inhibits the efficiency of delivering sufficient quantities of safe foods to ever-increasing populations.

Rodriguez is working with Yanfeng Ouyang, an associate professor in the U of I Department of Civil and Environmental Engineer-

ing, and Yogendra Shastri, formerly a visiting research assistant professor with the U of I Energy Biosciences Institute and currently an assistant professor in the Indian Institute of Technology in Mumbai.

"Worldwide, we've seen numbers as high as 30 percent of grain being lost before it gets to the consumer," said Rodriguez. "That provides us with a huge opportunity. If we can capture even 10 percent of that grain, think how many mouths we can feed."

"Our immediate objective is to lay the foundation for educators, practitioners, and policy makers to address postharvest loss in countries such as India and Brazil. Our work will develop the platform and modeling framework for using Concurrent Science,

Engineering, and Technology [ConSEnT] tools to prevent postharvest losses." The ConSEnT tools are being facilitated through the CyberGIS Center for Advanced Digital and Spatial Studies at Illinois.

The ConSEnT approach will deploy three key strategies. First, a permanent informatics platform will be developed and made available to investigators, providing a common database foundation for research in holistic systems.

Second, holistic modeling and analysis will be performed to leverage the data in the informatics database. Models will be modular and flexible in their design to facilitate their application to a wide array of systems and scenarios.

Finally, given successful models and analyses, decision support will provide analytical

tools for direct implementation in problem solving. Rodriguez said ConSEnT tools have been used successfully in areas such as controlled environment crop production and biomass feedstock production for bioenergy.

"We are at the beginning stages of this project. Our task is to look at each of those steps with some level of detail, so we can help identify new solutions that would reduce the amount of grain lost. We're starting in India because we see their system as a more complex problem. The farms are smaller and more spread out, and the number of handlers along the supply chain is large, from harvest to storage to transportation."

Rodriguez said one of the initial challenges is to develop a network of people who will

help researchers understand the local system and validate the data they collect. "Our project is primarily about good models and analyses, but we can't spend all our time at the computer, working with the mathematics. We need people who can validate our perspective on the ground truth in these systems. Professor Shastri in Mumbai will help us as we reach out, not just to other academics but to governmental and nongovernmental agencies as well.

"We'll be doing similar work in Brazil," Rodriguez continued. "In a couple of years, if we've established those networks, we'll be able to use systems analysis to find some key leverage points where we might improve the system in the short term, then turn that back around into new research projects where ei-

ther new technology or new practices will be developed."

Rodriguez said he also hopes to leverage the current investment from the ADM institute to generate funds from agencies and organizations such as NSF, USDA, USAID, or even the Gates or Rockefeller Foundation. "That would give us the opportunity to expand our efforts beyond India and Brazil.

"Postharvest loss boils down to food security," he concluded. "Populations are increasing around the world, and every single person deserves to be fed in a fair, affordable, and reliable manner. Food security is one of the biggest challenges out there, and we should be a part of meeting it."

## Incentives needed to improve grain markets in India

Even after India's agricultural reforms of 2002–03, grain markets are still pretty sticky for the country's wheat, rice, and pearl millet farmers. Two U of I agricultural economists analyzed the infrastructure of interstate trade for food-grain crops in three Indian states and found that grain farmers are unable to cash in on India's market reforms and take advantage of a price difference between two or more markets.

"We wanted to see if there was more integration in the markets since the 2002 reforms," said Kathy Baylis. "We were surprised at how little we saw. Apparently there are still many regulations in place. A lot of the wholesale

**"What we found in India is a huge disincentive to invest in on-farm storage, because even if farmers could store their grain for six months or so, they wouldn't be able to sell it then."**

markets are only open right around harvest. There is a strong incentive to sell at harvest because otherwise you'd have to travel to Delhi or another major city.

"The ADM Institute for the Prevention of Postharvest Loss, which provided the funding for this research, is interested in storage. What we found in India is a huge disincentive to invest in on-farm storage, because even if farmers could store their grain for six months or so, they wouldn't be able to sell it then."

Baylis explained that prior to the reforms of the early 2000s, it was difficult in India to transport grain across state lines. The reforms

made that easier and also expanded the number of people who could purchase and trade grain. Farmers used to have to go through a long, arduous process to become certified. The reforms eliminated some of those issues, but other problems still plague the system.

"Some people may think of this as only an engineering problem," Baylis said, "where we just need to develop a really good place for farmers to store grain. But if there isn't an incentive to store grain—to sell later for a better price—the extra storage won't help farm income."

According to Baylis and her colleague Mindy Mallory, although India still needs some serious policy reform, small innovations could be facilitated to encourage more independent traders to get into the market.



"Anecdotally we heard that in places where there were more active traders, farmers were able to benefit from this market arbitrage potential," Baylis said. "They weren't stuck looking at their own local market. If they worked with a trader, they could keep an eye on what's happening in the city and sell their grain two or three months after harvest."

Baylis said that fruit and vegetable crops, which are highly perishable, tend to have less regulation than grains and oilseeds. Because they don't go through the government markets, traders are making investments to get the food from the farmer to the city.

"Parallel systems are going on," Baylis said. "One is regulated, very structured, and

not very efficient. The other is unregulated and in some cases works well; in other cases, it is also a mess. For vegetable crops, if farmers don't have those linkages, they really can't sell perishable products. There's a massive lack of cold storage in India, for example."

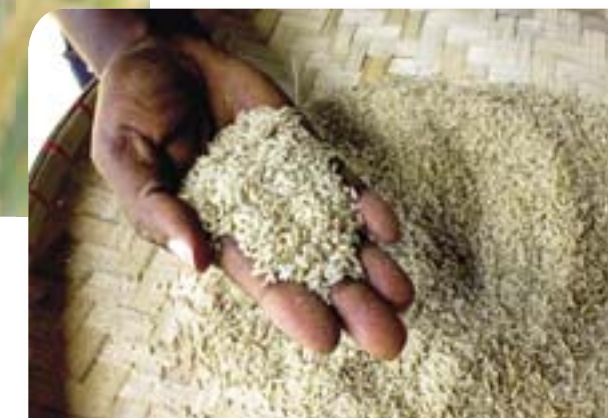
As an economist, Baylis said, she studies how policy can create headaches, whether for farmers or on the consumer end of the supply chain.

"Global food security is often seen as a production issue, but often it's not just lack of water or access to the right seeds," she said. "There has been evidence that major famines were due not to a lack of food production but to other institutional or economic crises.

"Some people on the outside look at the postharvest loss in India and say we need to develop a better mousetrap—better storage. Our point is that if you don't have the right policy and economic incentives, even the best mousetrap still won't help."



Agricultural economist Kathy Baylis



## Malnourished children are better fed when mothers have network of peers

Women in rural India who did vocational training learned more than just life skills. A recent U of I study found that mothers who participated in a program designed to educate and empower women gained a network of peers that led to greater bargaining strength in the home and significantly increased their children's consumption of rice and dairy.

"Prior to participating in *Mahila Samakhya*, which loosely translates to 'women of equal value,' most attenders reported regularly communicating with fewer than five women outside their families," said economist Kathy Baylis.

"Some of the women initially said things like, 'I never knew anybody like me could work outside of the home' and 'I never knew anyone like me could stand up to her husband.' But after participating in the program, even if they didn't go out and use the vocational training in jobs, they felt that they had a little more right to say, 'No, I think this is how we should be spending our money in our household.' Women were exerting more of a say over household resources."

In India, over 40 percent of children under the age of five suffer from malnutrition. This is despite the fact that per capita income has more than doubled since the mid-1990s and agricultural production is at an all-time high, with large buffer stocks of cereals sitting in government granaries.



"There's evidence that if women have more bargaining power in the household," Baylis said, "particularly in developing countries where cash is very tight, quite often more resources go toward the kids. So, to test that hypothesis, we went into homes with bowls and asked, 'How many bowls of rice this size did your kids eat yesterday?'"

"Not only do we see evidence that more food is going to kids after the training, but more is going to girls in particular, which is good because they tend to be the least powerful persons in the household. When times are tight, the girls' food is usually what's cut back."

In the study, 487 women were surveyed from six of 13 districts in Uttarakhand, four with the program and two without. Baylis said that the study shows that women who are

**"More [food] is going to girls in particular, which is good because they tend to be the least powerful persons in the household.**

**When times are tight, the girls' food is usually what's cut back."**

more empowered, educated, and mobile can actually change village culture.

"Participants told us that before joining the program they couldn't work, had little contact outside the family, and had little say in the resources allocated to their children," Baylis said. "Their identity was always subsumed in their husband's, brother's, father's, or in-laws' identity. But after participating in *Mahila Samakhya*,



women realized they have their own identity, they can work if they want to, and they can influence household and community decisions."

Baylis said that local men sometimes resist the program and prevent their wives from participating. As a result, initially only a few women may participate, but as others see the benefits, they muster up the courage to participate despite family opposition.

"In this area of India, domestic violence is a huge problem," Baylis said. "In a couple of the villages, we heard of support groups where

women would go knock on doors and threaten to expose men if they didn't stop the violent behavior."

Baylis explained that the program is run through a branch of the Indian central government. A worker talks to people in the villages to get a sense for where people might be receptive and what their interests are—for example, if they'd like nutritional education or particular job skills.

"It's a very powerful program, but it is also very difficult to analyze, because it looks

slightly different in each location. But the idea is the same—to bring together women in the village with some training and set up a support group," Baylis said.

This study is one of the first to study how peer networks affect female bargaining power and child welfare and one of the first evaluations of the *Mahila Samakhya* program since it began in 1995. The findings were shared with those who run the program to help them see what's working and what could be expanded.



## More Americans going hungry in their golden years

It may come as a surprise that in a country as wealthy as the United States, one in 12 seniors does not have access to adequate food due to lack of money or other financial resources. These seniors are food insecure. Recent research at the University of Illinois using data from the National Health and Nutrition Examination Survey revealed that seniors who are dealing with hunger also face negative health and nutrition consequences.

"In 2011, 8.35 percent of Americans over age 60 faced the threat of hunger—that translates to 4.8 million people," said Craig Gundersen, Soybean Industry Endowed Professor in Agricultural Strategy and executive director of the National Soybean Research Laboratory, who led the data analysis.

Hand in hand with hunger goes a lower intake of calories, vitamins, and other nutrients, which puts people at risk for a wide variety of ailments.

"Compared with adults their age who are food secure, seniors who are food insecure reported more diabetes, high cholesterol, high blood pressure, heart attacks, gum disease, and a host of other health problems," Gundersen said. "In addition, food-insecure seniors have worse general health outcomes, more limitations in daily activity, and a higher likelihood of depression.

While other studies have examined the health consequences of food insecurity among seniors, they didn't use nationally representative data sets. This research provides the most complete portrait of health and food insecurity among older Americans.

Because of the extensive data, the study was able to compare seniors over the age of 60

to those ages 50 to 59. This afforded the researchers a snapshot of what that slightly younger group had to look forward to as they entered their "golden" years. Those in their 50s already mirrored statistics for nutrients and health similar to their older counterparts.

Family structure also played a role in seniors' food security. "Food insecurity rates were almost three times as high among seniors if grandchildren were present in the home," Gundersen said. "And such seniors with grandchildren in the house had lower nutrient intakes than those without grandchildren. We think this may be because adults in households with grandchildren are foregoing healthy diets in order to make sure their grandchildren have enough to eat."



Craig Gundersen is a member of the technical advisory group for Feeding America and the lead researcher on the organization's Map the Meal Gap project.

Gundersen recommends that policy makers and program administrators pursue efforts to increase participation in the Supplemental Nutrition Assistance Program, or SNAP (formerly known as the Food Stamp Program), with a particular emphasis on older adults.

"SNAP is a great social safety net, and with some additional improvements it could be even more successful at reducing the number of food-insecure households," Gundersen said. "We already know that SNAP leads to reductions in food insecurity and poverty, and there is no evidence that it leads to increases in obesity. We need to make it easier for people to apply for the program, to recertify once they're in it, and to increase benefits, especially for those at the lower end of the benefits structure."

One discovery surprising to Gundersen is that about half of poor households in the United States are food secure, despite having low incomes. "One reason is perhaps that, along with other factors, they may just be better financial managers," he said. And although it may appear to come naturally to some people to be responsible financially, there is evidence that financial management skills can be taught. "Using coupons, shopping at large-scale supermarkets, and buying in bulk can save households money on food," he said.

Gundersen said that the SNAP-Ed program provides some education in financial management. "About 70 percent of SNAP households have at least one person who is working, but for them, it may be hard to find the time to take classes."

Food pantries and other programs offering emergency food assistance play an important role in the effort to alleviate food insecurity.

"A lot of SNAP recipients are from poor households who just run out of money or SNAP benefits at the end of the month," Gundersen said. "Food pantries can tide people over until the next month. And about a third of food-insecure households have high enough incomes that they are ineligible for any of the other food assistance programs. The only place they can go for help is to food pantries, so it's really important that we have those available."

Food insecurity climbed rapidly in 2007–08 and has now evened out at a high level, Gundersen said. "Even though we're on the other side of the great recession, we haven't seen declines in food insecurity."



## Food insecurity undermines children's healthy development



In 2012, approximately 15 percent of the U.S. population had limited or uncertain access to adequate food, and the consequences to children's healthy development can be enormous, said Barbara H. Fiese, Pampered Chef Endowed Chair in Family Resiliency.

Children in food-insecure households are at increased risk for problems in multiple arenas. Physical problems can include low birth weight, birth defects, compromised immunity, and anemia. Academic problems may show up as lower standardized test scores, smaller increases in math and reading scores in kindergarten through grade 3, and grade retention. Psychosocial difficulties can include more symptoms of anxiety and depression and more aggressive behavior in school, Fiese said.

Why so many complications? "When growing children don't receive the proper nutrients at the right time, there are potential consequences for brain development. Children may also experience the onset of chronic health problems at a young age, setting them on a path toward poor health early in life," she added.

Hungry children are frequently unable to pay attention in school, and that inattention is often perceived as a behavior problem. In fact, food-insecure children may develop learning problems as a result of a lack of proper nutrition, Fiese said.

Food insecurity affects children in different ways at different ages. "In the first three years of life, poor nutrition can put children at risk for developmental delays. Between three and eight years of age, food insecurity is associated with a poorer physical quality of life. In the teen years, food-insecure students are more likely to be suspended from school, and they may have difficulty getting along with others."

Nearly half of low-income female-headed households with children are food insecure, Fiese said. And mothers in these homes are more likely to be depressed, making them less sensitive and more emotionally unavailable and inconsistent as parents. The unpredictability of food availability makes for more erratic daily environments, she added.

Fiese stressed the importance of fully funding the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the National School Lunch Program, and the Child and Adult Care Food Program (CACFP), which provides subsidies to child-care providers in low-income settings.

Private food assistance programs, such as food pantries, soup kitchens, and weekend feeding programs, are also essential tools in meeting the needs of hungry children, she said.

"The Family Resiliency Center partnered with Eastern Illinois Foodbank and Feeding America in evaluating the local Backpack Program, a weekend feeding program for children who may go hungry over the weekend," Fiese



said. "This is part of a larger effort started by a school nurse in Arkansas who noticed that kids were going hungry on days when they were not in school. Now the program is administered through hundreds of food banks across America."

The evaluation was conducted when the local program had grown to 1,200 children. The researchers found that school personnel were very good at identifying the kids most likely to go hungry over the weekend. Three-fourths of the families in the program were food insecure, and more than half of those were very food insecure—way above the national average.

"The other thing we found was that the food in the backpacks is being used to extend family meals, not so much as snacks for the kids," Fiese said. "For example, a can of ravioli is likely to be added to a pasta dish for the entire family. This tells us that we really need to start addressing hunger as a family phenomenon, not just as a child need."

No matter where you live, there are food-insecure families in your community, she noted. "Your next-door neighbor could be hungry, and you wouldn't necessarily know it. When people lose their jobs, their difficulties can be hidden from sight."



Barbara Fiese (left) with a University of Illinois student

## Illinois Extension crosses food deserts



Unlike the Sahara or Mojave, you won't find the names of these deserts on a map, but they exist all the same. In Rock Island, Illinois, experts have identified two food deserts, areas without a major or full-service grocery store within a half-mile or a reasonable walking distance.

"A food desert is a geographic area where affordable and healthy food is difficult to obtain, particularly for people who don't have access to transportation. Instead of major grocery stores with many fruit and vegetable choices, we see a high concentration of convenience stores that take LINC and SNAP cards [food stamps] but have few healthy foods to offer," said Betty Gavin, a SNAP-Ed program educator with U of I Extension.

Thanks to a USDA grant, residents of the Rock Island food deserts can now travel by bus to major grocery stores, en route receiving nutrition education, recipes, sample grocery

lists, tips on stretching their food dollars, and food samples.

"We have this captive audience on the bus, so we're going to teach them how to make healthier choices and get more nutrition for their money," Gavin said.

In a three-hour window, food-insecure residents board a bus for free transportation to a retail outlet that offers more variety and less expensive products. Extension educators hope to soon add grocery store "tours" in which they will teach about nutrition labels and how to compare unit prices, among other topics.

"We hope to get participants to try foods they haven't eaten before. The goal is to give people with a limited budget access to a variety of fruits and vegetables at a more reasonable rate than they may find in a local convenience store," Gavin said.

Extension staff have marketed the new service through free newspapers and shop-

ping circulars in both English and Spanish, WIC offices, churches, food pantries, and other partner agencies. So far the program has received enthusiastic support.

"On the bus ride back, when the experience is fresh in the minds of our riders, we ask for their feedback so we can learn what other information our shoppers are interested in and how we can improve the program," said Kristin Bogdonas, a U of I Extension nutrition and wellness educator.

According to the educators, hunger and access to healthy food choices are problems in Rock Island, where a high percentage of school students receive free and reduced lunches.

"This is a new program, and we'd like to see it continue to be funded here. The information we gather could also be useful to other communities in developing their own programs," said Gavin.

## A fruitful collaboration

When the Beginning Farmers program at the U of I St. Charles Research Station harvested last year's fruits and vegetables, they found themselves with an overabundance of healthful and delicious produce after they had marketed their crops. Not to worry—U of I Extension staff put the food to good use in the nutrition education programs they are conducting for low-income, food-insecure Kane County residents.

"It was a unique opportunity to introduce people to vegetables and fruit that came right off the farm—fresh-picked foods they hadn't tried before. Many people in our classes shy away from vegetables because they think they don't like them, but they were surprised at the sweetness of this produce and how good it tasted," said Jennifer McCaffrey, an assistant dean for family and consumer sciences in the U of I Office of Extension and Outreach.

Last year, 600,000 Illinois residents participated in the Illinois Nutrition Education Program, funded through SNAP, the USDA's Supplemental Nutrition Assistance Program. Extension markets the classes to disadvantaged families and often partners with other agencies and organizations, including food pantries, to reach people in need.

"We're very good at meeting people where they are, and participants appreciate being able to taste these unfamiliar foods and learn how to prepare them," McCaffrey said.

In 2014, Master Gardeners in Kane County will plant specific fruits and vegetables that are

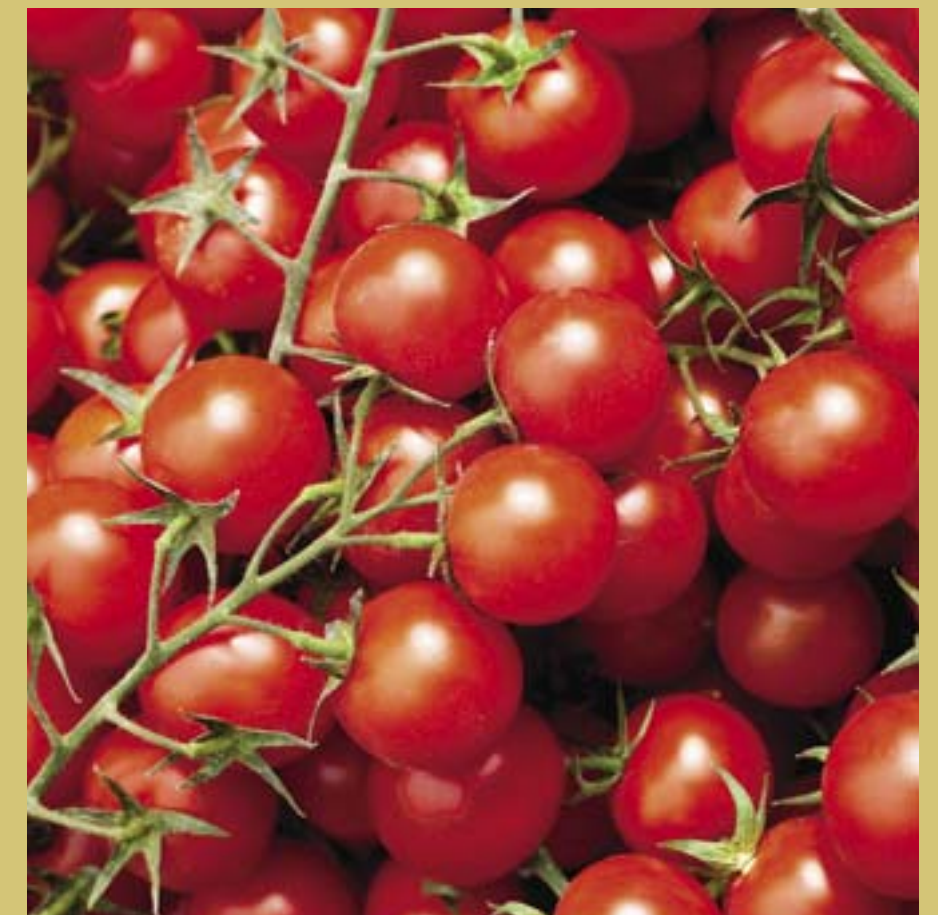
needed in the SNAP education program, and a new group of Beginning Farmers will experience what it takes to produce and market quality fruits and vegetables for commercial sale.

The USDA-funded program, "Preparing a New Generation of Illinois Fruit and Vegetable Farmers," is headed by U of I crop sciences professor Rick Weinzierl. Beginning Farmers offers one year of classroom, hands-on, and in-field instruction to agricultural producers who are interested in diversifying to fruit or vegetable production. Their farming experience can range from none to less than five years.

Classes are held three Saturdays a month, rotating among three Illinois locations—the

U of I campus in Urbana-Champaign, Dixon Springs Agricultural Center in Simpson, and the Kane County Extension office in St. Charles. Classes in Spanish are being added at sites at Harvard, Kankakee, and Cobden. USDA funding will allow the program to be offered to three one-year cohorts of students.

"As a land-grant university, the U of I has a three-pronged mission: research, teaching, and extension," McCaffrey said. "It seems fitting that fruits and vegetables grown by aspiring farmers in classes at the St. Charles Research Station should be used by Extension's nutrition and wellness educators in their programming to food-insecure families."



## Food bank clients struggle to afford nonfood items

Many food-insecure families struggle as well to afford basic nonfood goods such as personal care, cleaning, and baby-care products, according to a new University of Illinois study.

"These families often make tradeoffs with other living expenses and employ coping strategies in an effort to secure such household items as toilet paper, toothpaste, soap, or disposable diapers. What's more, nearly three in four low-income families have cut back on food in the past year in order to afford these essential nonfood items," said Barbara H. Fiese, Pampered Chef Endowed Chair in Family Resiliency.

Over 33 million people in the U.S. use food pantries to supplement their basic food needs, Fiese said, with one in three low-income families experiencing difficulty in affording basic household items. Of these families, 82 percent live in households with low or very low food security, meaning they cannot afford enough food to feed their family.

The researchers used the Red Cross disaster relief list to help food pantry clients identify the personal household products they found

most essential to daily living, then asked them about the consequences of going without these products and the strategies they used to secure them. About a third of the households were headed by single parents, and most households lived on less than \$800 a month, Fiese said.

"These parents really struggled to get personal hygiene and household cleaning products, sometimes even giving up prescription medication to afford them. They may have resorted to taking toilet paper from public places. Other coping strategies include watering down products to make them last longer, substituting one product for another, not paying bills, and simply going without," she added.

Three themes recurred in the interviews: a battle to retain personal respect, being a good parent, and keeping the family healthy, Fiese said.

"Parents didn't want their children to be thought of as dirty or unclean because they didn't have access to laundry detergent or toothbrushes and toothpaste. They also feared being judged for not taking care of their kids and worried that they might be turned in for neglect."

Fiese emphasized that being unable to attend to basic needs such as ensuring oral health care, providing clean clothes, and keeping a clean home creates a health risk for children.

For families with infants and toddlers, adequate sources of diapers were important. Although some food pantries had diapers, participants reported that they sometimes had to

travel from pantry to pantry to get enough to meet their needs.

Laundry detergent was another pricey item, with many families saying that they go without or only do laundry occasionally. "We can only afford to do laundry once a month," said one respondent.

Although participants said they might borrow from others to make ends meet at the end of the month, they found it embarrassing, and those feelings took a toll on them. "It gets overwhelming and stressful, and it's degrading," one mother said.

The results of the interviews done in this east-central Illinois study have been used to design a larger, nationally representative phone survey as well as to help food banks assess their clients' concerns regarding household product needs.

"The interviews shed light on the often complicated decisions that families have to make in balancing the need to feed their children, purchase household supplies for healthy living, and pay for medical expenses," Fiese said. "Clearly these are not easy decisions, and the choices can have serious consequences for multiple members of the household."

These interviews contributed to the national study, "In Short Supply: American Families Struggle to Secure Everyday Essentials," made possible by funding from Proctor & Gamble, a long-standing partner and donor to Feeding America, the nation's leading domestic hunger-relief organization.



## Identifying obstacles to the growth of U.S. urban agriculture

Urban agriculture is an emerging sector in the local food economy, but it faces some threats. U of I researchers have identified the main impediments to its growth and have set forth research questions that scientists must tackle to ensure its economic and environmental sustainability.

Sam Wortman, a researcher in urban food production, and Sarah Taylor Lovell, a researcher in landscape agroecology, recently published a report discussing the environmental challenges in urban agriculture, such as soil contamination and remediation, altered microclimates and atmospheric pollutants in urban ecosystems, and safety of urban water resources.

Both Wortman and Lovell have focused much of their research attention on Chicago neighborhoods, which have an abundance of both urban gardens and vacant lots, they said.

“There is a huge opportunity for economic growth, but there’s no industry there yet to step in and carry this movement. That’s our role as a land-grant university—to help grow the urban agriculture movement through science-based research and information,” Lovell said. “That’s why the U of I in central Illinois is so interested in what’s going on in Chicago.”

Both researchers have ongoing studies looking at some of the environmental threats discussed in the review.

Soil contamination, especially by lead, may be the most serious threat to healthy food production in the urban environment, according to the report. High traffic in urban areas causes contaminants to build up in the soil, and higher lead levels are often found in soil in older neighborhoods, where houses were built before lead was removed from paint.

Because current strategies for soil remediation are intensive and can be cost prohibitive, Wortman said, he is looking at alternatives to address the limited availability of uncontaminated land where food can be grown as well. One project looks at growing in raised beds and selecting appropriate compost for areas where soil is highly contaminated.

Other soil management projects include looking at high-tunnel fruit and vegetable production versus open-field environments and growing hydroponically, as well as studying how to increase productivity for community gardeners using cover crops.

“Less than 5 percent of urban farmers use cover crops. Rural farmers know their benefits but may not use them for economic reasons,

**“There is a strong urban heat-island effect in Chicago, so [we predict] crops like tomatoes and peppers will do really well as you get closer to downtown.”**

but many community gardeners don’t know what a great way it would be for them to build fertility and organic matter. It’s a shame that cover crops are not used more,” Wortman said.

City-related contaminants create concern not only regarding urban soil but also for the urban atmospheric environment.

In another study, Wortman is observing the effects of atmospheric pollutants and altered microclimatic conditions on vegetable crop physiology in Chicago neighborhoods. Six research stations have been positioned along a



latitudinal transect stretching from Garfield Park Conservatory on the east to sites farther west near Brookfield Zoo, Wheaton, and St. Charles.

Wortman established common soil lots across these six sites and is looking at how CO<sub>2</sub>, ozone, temperature, relative humidity, wind, and light intensity influence a wide range of crops.

“There is a strong urban heat-island effect in Chicago, so our hypothesis is that warm-season crops like tomatoes and peppers will do really well as you get closer to downtown Chicago,” Wortman said. “In the rural areas, we expect cool-season crops will do better. We find that outside of the city we see the most ozone damage, the worst being at St. Charles.

This is interesting because the city is the source of ozone.

“This is our flagship project, and it’s been the most fruitful,” he added.

Lovell’s work has focused mainly on the ecological and cultural functions of urban agriculture. In Chicago, she and her team have done extensive mapping of community and



backyard gardens and have looked at different methods of growing food used in the city’s various ethnic communities.

“We’re trying to bring natural and social sciences together to gain an understanding of the cultural differences in how food is grown and the different types of crops produced, and consider how all this contributes to community food security,” Lovell said.

Lovell is also looking at vacant land in these communities and determining if farming is the most appropriate use of that land.

“We need to think about how we plan an agricultural infrastructure that’s sustainable over time—one that can be knitted in to the green space of the city as a long-term planning goal, not just a transient land use,” Lovell said.

Both Lovell and Wortman said lack of funding sources for community gardening programs and individual urban farmers is also a roadblock for the growth of urban agriculture. Without a strong industry component behind urban farming, Lovell said, funding will remain a major challenge.

“If urban agriculture is going to move toward being a more profitable, environmentally sound system,” Wortman said, “ecologists, hydrologists, horticulturalists, environmental scientists, and others will need to take up this issue. Otherwise it will continue to be just a nice concept that academics like to talk about. We’ve got to get out there and get our hands dirty and figure out the real challenges and how to solve them.”

## 4-H youth fight hunger close to home

Throughout Illinois, 4-H members are finding ways to fight hunger in their communities. "Feeding and Growing Our Communities," an Illinois 4-H project coordinated by youth development specialist Bill Million, was funded by the Howard G. Buffett Foundation. The project challenged 4-H members to recognize the impacts of hunger and food insecurity in their communities and encouraged participation in an initiative to grow produce locally.

A number of counties accepted the challenge and organized community gardens. They grew produce and donated it to families in need and to other organizations serving families facing food insecurity. These 4-H groups participated in hunger-fighting initiatives:

- **Hamilton County 4-H Gift Garden.** More than 100 youth and 30 adults provided almost 500 hours of service and harvested over 2,000 pounds of produce, with 450 pounds being donated to the Heritage Woods and Hungry Hearts organizations.
- **McLean County Olympia Pacesetters 4-H Club.** Eighteen youth and four adults volunteered 130 hours of service and harvested over 245 pounds of produce. More than 70 individuals benefited from the produce, which was donated to a local food pantry.
- **Monroe County 4-H Federation Gift Garden.** Forty hours of service resulted in 75 pounds of produce harvested. Eighty percent of that produce went to senior centers and food pantries, with 35 families reached.
- **Peoria County New Directions 4-H Club.** Ninety youth hours and 150 adult hours provided 150 pounds of produce donated to the South Side Mission, which serves approximately 100 families. Another 50



pounds of produce was donated to individual families.

- **Kendall County Rural King 4-H Club.** "Generations of families" volunteered 75 hours of service and donated 600 pounds of produce to the local food pantry, which serves 500 families.
- **Sangamon County Harambee** ("Let's Pull Together" in Swahili). In the Unity of Faith garden, 150 hours of volunteer service yielded more than 50 pounds of produce, which was distributed to more than 50 community members.
- **Rock Island County 4-H Hunger Ambassadors.** A core group of passionate teens organized Franklin Field, an immigrant community garden in Rock Island, as a summer project. It grew into a year-round program for teens that includes youth gardening, serving meals to the hungry, assisting at food pantries, and sponsoring a meal-packaging event.

The Feeding and Growing Our Communities project also gave 4-H members the opportunity to work with Illini Fighting Hunger, a U of I student organization affiliated with the Wesley Foundation. This not-for-profit enlists

the aid of community groups to package meals, which are then distributed to local food pantries and other entities serving families in need. 4-H youth from Boone, DeKalb, Logan, Menard, Ogle, Rock Island, Sangamon, and St. Clair counties packaged more than 63,000 meals of a soy-fortified rice casserole mix.

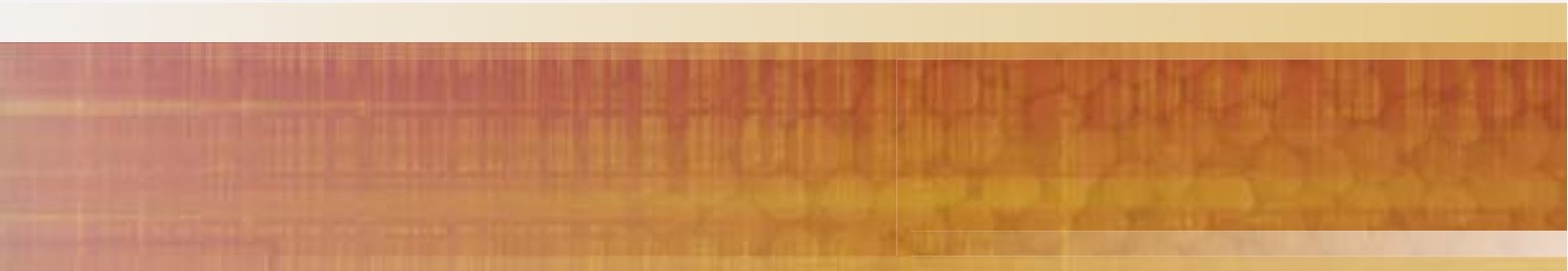
The experience seemed to impact the 4-H members as much as the people they helped. "Hunger is closer than you think," said Million. "It becomes very real when you see the difference your help makes. Some youth were surprised to find out there are many senior citizens who struggle to afford fresh produce. It was a real eye-opener for them to learn that some children may not have food available to them on the weekends."

Plans for year two include engaging more youth in learning how to grow fresh produce to supplement families in need through 4-H Challenge Grants that target youth community gardens.

"With new funding received from Evelyn Brandt Thomas through the Illinois 4-H Foundation, we are planning to expand our program in 2014," said Million. "Our plans include introducing youth to community-supported agriculture [CSA] ventures as they become engaged in programs teaching food preparation, safety, and budgeting skills and utilizing locally grown produce from CSAs, community youth gardens, and local farmers markets.

"Our goal in 4-H is to involve youth in their community and, most importantly, to leave the community better off than they found it. If we can teach youth to recognize need in their community and respond to it," he concluded, "hopefully that will create adults who will do the same thing."





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