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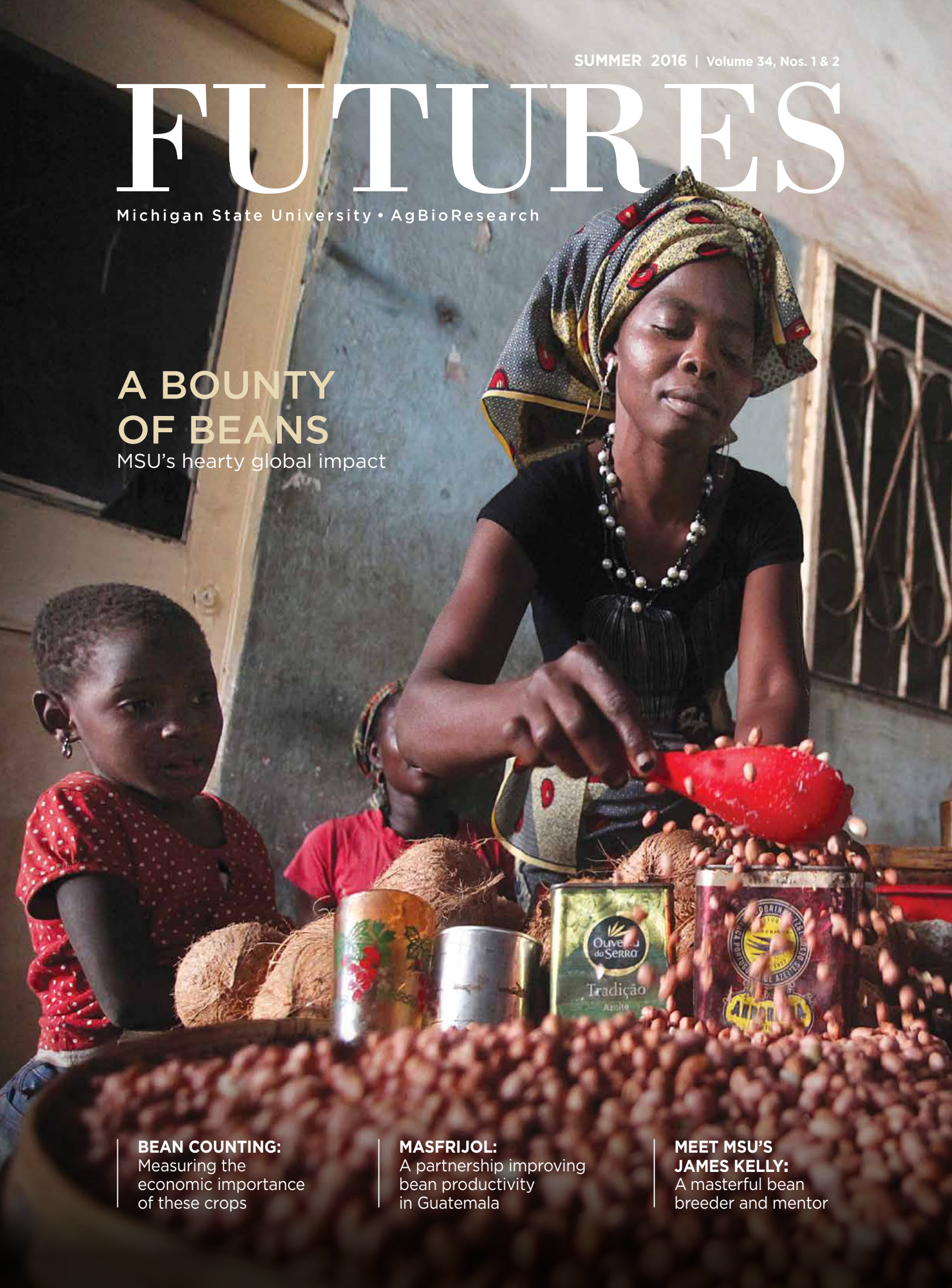
FUTURES

Michigan State University • AgBioResearch



A BOUNTY OF BEANS

MSU's hearty global impact

BEAN COUNTING:
Measuring the economic importance of these crops

MASFRIJOL:
A partnership improving bean productivity in Guatemala

MEET MSU'S JAMES KELLY:
A masterful bean breeder and mentor

FUTURES

GLOBAL PULSES

COVER STORY

About the Cover: *A woman, with her children, selling beans at a local market in Mozambique. Photo taken by Paballo Thekiso for the Food and Agriculture Organization of the United Nations.*

FEATURES

FACULTY & FACILITY

WOMEN FARMERS TEND THEIR BEAN CROP ON A HILLSIDE BY THEIR HOMES IN GUATEMALA

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Experiencing Africa firsthand

I first became acquainted with Africa thumbing through the pages of National Geographic. Striking images of individuals draped in beautiful, bold prints standing along dusty horizons often dotted with exotic wildlife. I wondered what the people were thinking and what their lives were like.

Earlier this year, I had the amazing opportunity to visit Africa for the first time. I was there to attend the 2016 Pan-African Grain Legume and World Cowpea Conference in Livingstone, Zambia. (The United Nations has declared 2016 The International Year of the Pulses and hence, the inspiration for this issue of the magazine.) In a land stricken by hunger, poverty and malnutrition, I had the opportunity to meet some of its lovely, kind-hearted people.

One large family graciously opened its home, consisting of small thatched-roof huts void of running water and electricity, to more than 75 conference-goers. They took us on a tour of their farm under the sub-Saharan sun. With knowledge imparted through a U.S. Agency for International Development (USAID) project, the farmer was able to convert his land, once an aquaculture farm, into a successful small-scale cowpea seed operation. Drought conditions had forced the change.

The slight man joked that, due to training and education from USAID, he's now known as the "professor" and his assistants, out in the field, were busy in their "departments." One woman struck up a conversation with a small group of us, wanting to hear about our lives back home. She even asked one young lady to exchange numbers. Yes, cell phones are surprisingly quite common.

Later in the week, I went on a day-long safari in Botswana. Our tour guide, who sported a picture-perfect smile and a sense of humor to match, managed to get us within arms-length of several herds of elephants. He went out of his way, even risking a mud bath of his own, to ensure that we saw as many animals as possible.

Along the busy roadsides, we saw women toting hefty loads atop their heads and small children waving gleefully at our passing vehicles. Even those selling local crafts at the border crossing between Zambia and Botswana joked and laughed as they tried, most of the time unsuccessfully, to make a sale.

And I'll never forget the young taxi driver in Johannesburg, who escorted us directly to the airport terminal and waited close to an hour – without request – to make sure we safely made our flight to Zambia. Not to mention one of the conference organizers who took us into town to see a pharmacist for medication (thankfully, just for itchy bug bites).

Visiting this exquisite continent I began to answer some of the questions I had pondered looking through those magazines many years ago. The people I had the fantastic opportunity to meet cherish life's smallest moments, have a deep appreciation for every morsel of goodness the earth provides (especially beans!) and are individuals from whom we, Americans, can learn so much.

To watch some of my videos from my trip to Africa, visit our YouTube channel. Find us by searching for MSU AgBioResearch.

Holly M. Whetstone

Holly M. Whetstone

BY CAMERON RUDOLPH,
STAFF WRITER

THE LEGUME INNOVATION LABORATORY

"...We want to improve the livelihood of individuals by alleviating hunger and poverty, and we think the Legume Innovation Lab (at Michigan State University) is making real headway in these areas."

- Irvin Widders

PROFESSOR IRVIN WIDDERS, DIRECTOR OF THE MSU LEGUME INNOVATION LAB.

IN DECEMBER 2013, THE GENERAL ASSEMBLY OF THE UNITED NATIONS VOTED TO DECLARE 2016 THE INTERNATIONAL YEAR OF PULSES (IYOP). THE DESIGNATION, WHICH SHEDS LIGHT ON A FOOD SOURCE THAT COULD SLASH HUNGER AND POVERTY, HAS BEEN NEARLY TWO YEARS IN THE MAKING WITH INPUT SPANNING THE GLOBE. BUT WHAT EXACTLY IS A PULSE?

Pulses are the dried seeds that come from many plants in the legume family, according to a definition by Pulse Canada – a sponsor of IYOP. The most common pulses are chickpeas, dried beans, dried peas and lentils — all great sources of fiber, protein, and minerals such as iron, zinc and phosphorus. Pulses, as well as legumes, have the nutrient capacity to transform millions of lives.

Michigan State University (MSU) has a rich history of research on pulses and legumes, dating back to the early 1900s with the establishment of the bean breeding program within the Michigan Agricultural Experiment Station (now called MSU AgBioResearch). Frank Spragg, the program's first breeder, made contributions to bean studies that remain relevant today. His most profound achievement came in 1915 with the development of the first navy bean, called Robust, which delivered consistently high yields.

Ensuing decades would see the introduction of numerous other bean cultivars from MSU and recognition of the university as a leader in this area. During that time, MSU would foray into research on additional leguminous crops. Growing expertise and a commitment to diverse areas of research — such as breeding, genetics, pathology and nutrition, among others — have kept MSU at the pinnacle of legume science.

THE LEGUME INNOVATION LABORATORY AT MSU **HAS A RICH RESEARCH LEGACY** WHICH DATES TO THE EARLY 1900S

"We are fortunate to have some of the world's leading bean and legume scientists at MSU," said Douglas Buhler, MSU assistant vice president for research and graduate studies, and director of MSU AgBioResearch. "The work we do in Michigan on breeding, genetics, pest management and other disciplines transcends geographic boundaries. It's just as applicable in Africa or Latin America as it is here. We benefit tremendously from international collaborations, something our legume scientists do exceptionally well."

One of the university's largest efforts involving legumes — and a major contributor to MSU's international portfolio — occurred in 1980 with the introduction of the Bean/Cowpea Collaborative Research Support Program (CRSP).

INCREASING INTERNATIONAL IMPACT

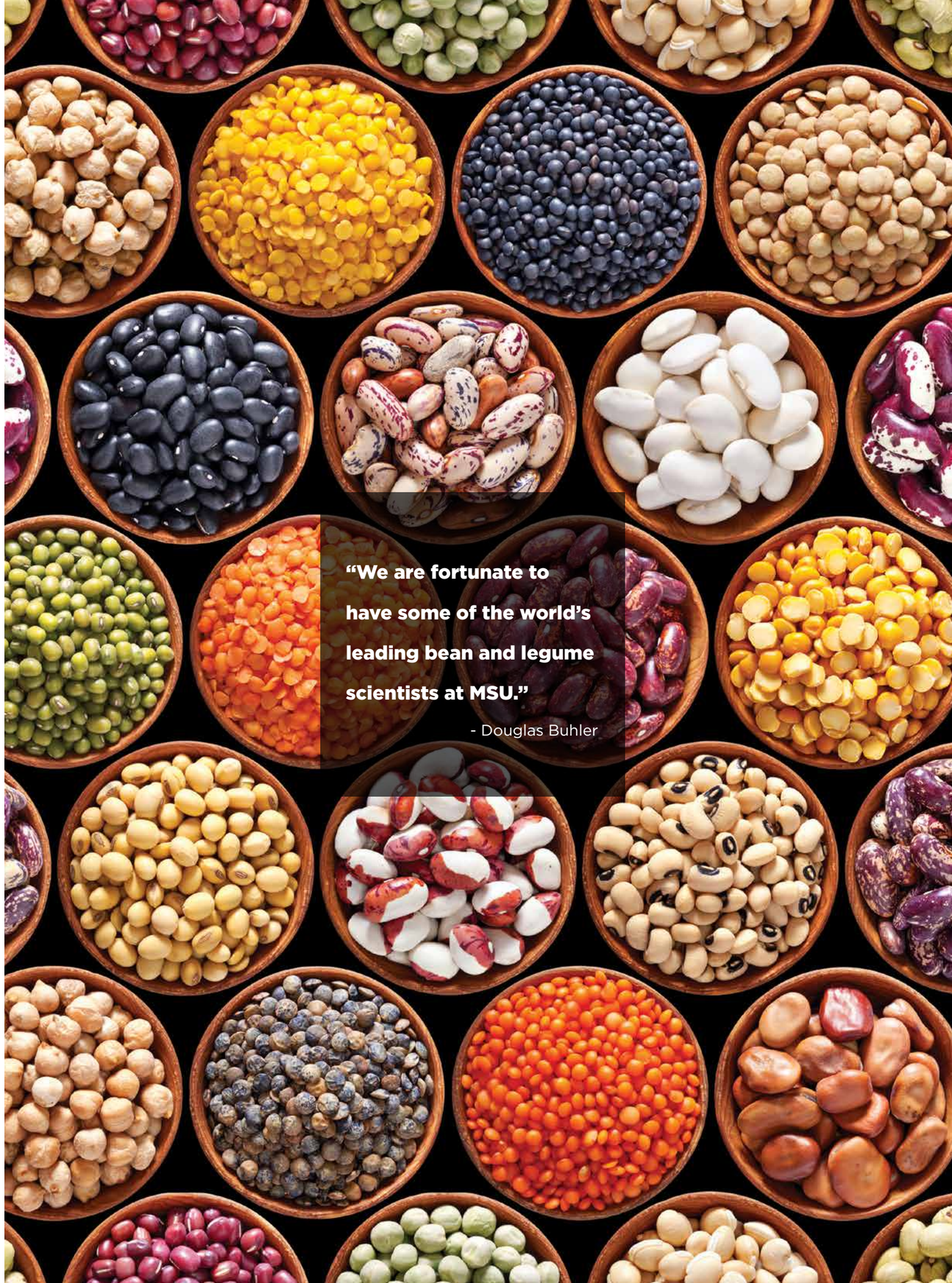
With funding from the U.S. Agency for International Development (USAID), the Bean/Cowpea CRSP has been administered by MSU since its inception. Plant genetics professor Wayne Adams, as well as other MSU faculty members, saw the potential of increasing the profile of legumes as an important food source. Adams became the co-founding director of the Bean/Cowpea CRSP. The program evolved through various titles, from Bean/Cowpea CRSP to the Dry Grain Pulses CRSP. It is now the Feed the Future Innovation Lab for Collaborative Research on Grain Legumes, commonly known as the Legume Innovation Lab (LIL).

LIL, a research and capacity-building program, is part of Feed the Future, a U.S. presidential initiative addressing global hunger and food security. LIL focuses on edible grain legumes — common bean, cowpea, pigeon pea, lima bean and many others. MSU reapplies at the end of each program cycle to keep the LIL housed at the university. The current cycle ends in 2017.

Irvin Widders has been director of LIL since 2000.

"At MSU, we have visionary leadership by our administration and recognition of the value of international engagement," Widders said. "We gain a great deal when we collaborate with others — accessing genes, germplasm, new technologies, etc. We're one of the leading universities in the country in putting together a cohort of multidisciplinary faculty to support the legume industry and are honored to run the lab through partnership with USAID."

A competitive grants program operated by LIL provided awards to 10 current projects in Africa and Latin America. Each project is led by a researcher from a U.S. university who works alongside other U.S. scientists and researchers from international institutions. Of the 10 initiatives, three are led by MSU faculty members: James Kelly, David Kramer and Mywish Maredia. LIL has also granted associate awards to projects such as MASFRIJOL, an effort led by MSU to enhance bean productivity and improve nutritional outcomes in the Guatemalan highlands *(see related article on page 30)*.



MAKING A DIFFERENCE

Growers in nations such as Guatemala often rely on seeds passed down from ancestors, resulting in poor yields and little resistance to diseases and pests. Through MASFRIJOL, growers have begun planting beans alongside maize in the highlands. As the cornstalks grow, they serve as support for the beans, which climb and wind around them.

Through LIL, plant breeders at North Dakota State University (NDSU) are working to improve climbing bean cultivars adapted to the unique region for both disease and pest resistance. These highly productive varieties — with substantially higher yield potential — can transform agricultural systems in the region and address poor nutrition through increased bean consumption.

"We're breaking ground considering the specialized nature of this project and the little effort devoted to improving climbing beans worldwide," said Juan Osorno, an associate professor and dry bean breeder/geneticist at NDSU. "Not only are we introducing new varieties, we're executing a long-term plan that trains Guatemalan breeders to increase productivity moving forward. The structure provided by the Legume Innovation Lab is wonderful and has allowed me to focus on the science and capacity building rather than the administrative part of a project like this."

ADOPTION CHALLENGES

Better access to new seeds is critical, but changing centuries-old farming methods can be a monumental task. New recommendations must take into account the motivation for current management, which may include cultural or social factors. It must also be financially beneficial.

Economic benefits of legumes don't just manifest at the market. Legumes reduce the need for synthetic nitrogen

WIDDERS BELIEVES THAT THE IMPACT OF LIL — ON MSU AND THE GLOBAL COMMUNITY **— IS TRULY IMMEASURABLE**

application because they use a process called nitrogen fixation to convert atmospheric nitrogen into a crucial plant growth element. Educating growers in developing countries on the role of legumes in a healthy cropping system improves food security, nutrition and operational sustainability.

Also through LIL, researchers at Iowa State University are exploring challenges in Mozambique and Uganda, where declining soil quality is the primary constraint to increasing productivity of common bean, a vital source of income and food security. Alternative management strategies are necessary, but adoption by local farmers has been low.

The project aims to assess the soil in these regions and collect data on farmers' decision making. Additional objectives include improving the farmers' ability to make observations on soil characteristics and improving soil fertility.

HEALTH BENEFITS

Improved legume production has significant human health implications. LIL invests in research that studies the impacts on nutrition from adding legumes to the diet, especially in young children. Across Africa, environmental enteric dysfunction (EED) poses a considerable risk for children and usually develops within the first three years of life. EED is a chronic inflammatory gut condition that results in malabsorption of nutrients and stunting.

In two LIL studies underway in Malawi by faculty members from Washington University in St. Louis and the University of Malawi College of Medicine, infants are fed a porridge containing bean or cowpea flour for either six months or a year. At regular intervals, infant growth, biomarkers for gut health and bacterial ecology in feces are measured. The ongoing research is already suggesting that intestinal inflammation can be reduced and nutrient absorption can be improved by eating legumes.

COMBAT HUNGER & POVERTY

"We're looking at how our efforts can function at the intersection of agriculture, food and human health, both domestically and internationally," Buhler said. "The product of much of the research done by LIL fits right in with that objective. These are interests of ours that put us at the cutting edge of science and at the same time address a real-world problem."

Widders believes that the true impact of LIL — on MSU and the global community — is immeasurable.

"Poverty and the lack of access to food are some of the greatest causes of strife around the word," Widders said. "Legumes can address both of these issues because they are nutritious and profitable to produce. We want to improve the livelihood of individuals by alleviating hunger and poverty, and we think the Legume Innovation Lab is making real headway in these areas."

To learn more about the LIL, visit legumelab.msu.edu. ❖

COMBATTING HUNGER & POVERTY

Upper left:
Women in a Rwandan street market

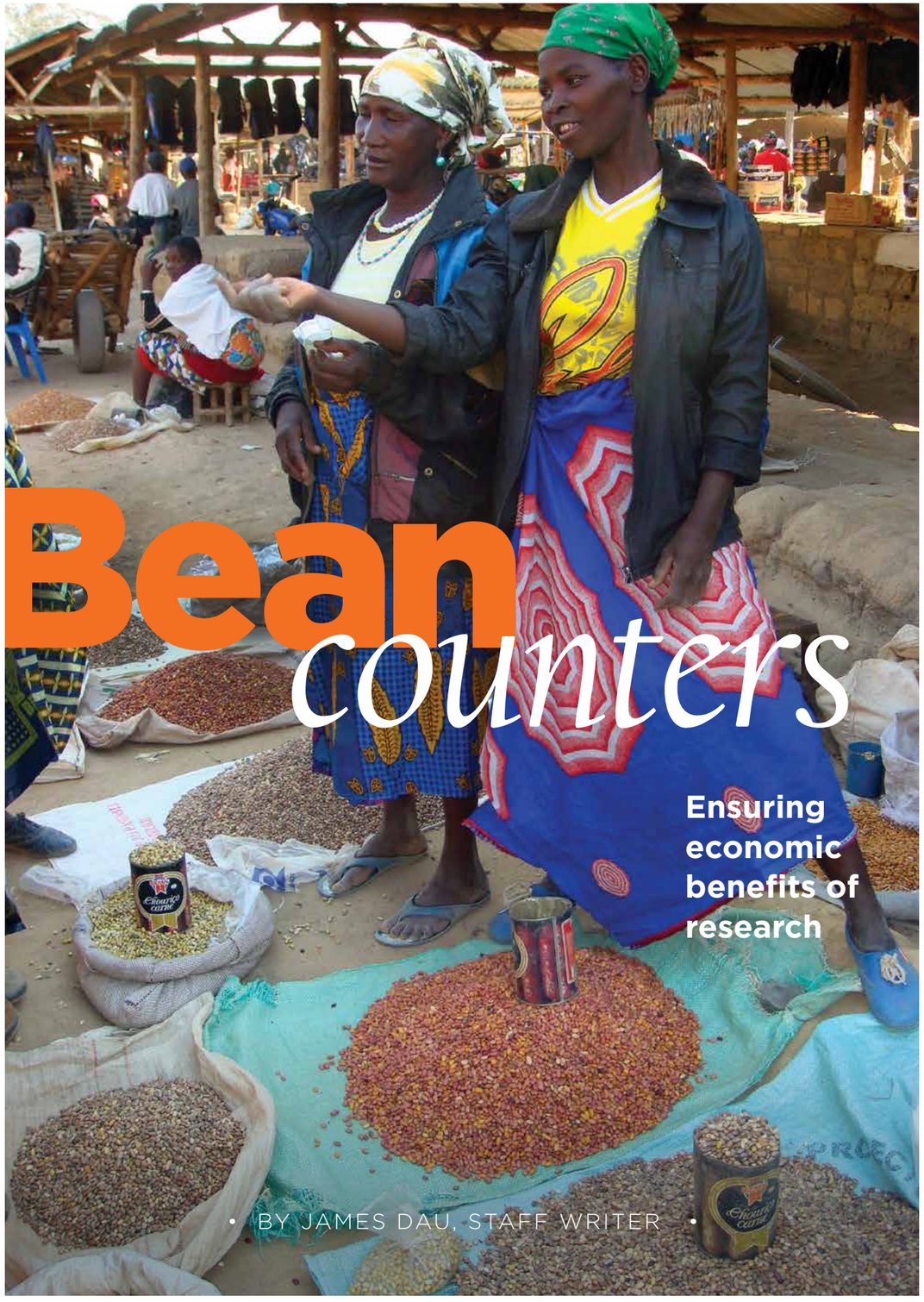
Upper right:
Bean fields in Rwanda

Middle right:
Juan Osorno (right) and collaborators

Lower right:
Woman farmer in Guatemala

Lower left:
Guatemalan climbing beans with maize

Middle left:
Irvin Widders in a Guatamalan street market



Bean counters

Ensuring economic benefits of research

• BY JAMES DAU, STAFF WRITER •

HIGHER YIELDS, IMPROVED RESISTANCE TO PESTS AND DISEASES, RESILIENCE TO UNFAVORABLE CLIMATIC CONDITIONS AND IMPROVED NUTRITIONAL CONTENT ARE GOALS OF WORLDWIDE BEAN BREEDING AND DISSEMINATION PROGRAMS. BUT TESTING AND RELEASING NEW CULTIVARS AND GETTING THEM INTO HANDS OF GROWERS TAKE TIME AND MONEY.

Ensuring that research hits its mark is one function of the Feed the Future Innovation Lab for Collaborative Research on Grain Legumes, or Legume Innovation Lab (LIL), at Michigan State University (MSU). LIL scientists return to communities where their research was conducted to assess its long-term payoffs.

Cynthia Donovan, LIL deputy director and MSU AgBioResearch agricultural economist, said scientists generally anticipate impact as they begin crafting a plan for a research project.

"Prior to doing the science, you need to know what the endgame is," she said. "Whether it's reducing crop losses, reducing the health effects of pesticides, reducing seed costs or improving nutrition, all of those will factor into your impact over the long run."

Mywish Maredia, professor of international development in the MSU Department of Agricultural, Food and Resource Economics, began working with long-term economic assessments over 20 years ago when she conducted research for her Ph.D.

"We were looking at the impact of agricultural research in developing countries that was funded publicly and through international research centers," she said. "Ensuring that research projects remained accountable to their stakeholders was the focus then, but the announcement of the United Nations' Millennium Development Goals (MDGs) made the assessments a global priority."

Announced in 2000, the MDGs identified a new global effort to eradicate the world's most pressing societal concerns – extreme hunger and poverty, universal primary education, gender equality, child mortality, maternal health, major diseases such as HIV and malaria, environmental sustainability and global cooperation.

Maredia, who became associate director of the Bean/Cowpea Collaborative Research Support Program (now known as LIL) that same year, announced a new global focus based on the MDGs, advising that the impact assessments become an important means of monitoring progress.

"It's one thing to set a goal, but it is quite another to work toward achieving it," Maredia said. "The MDGs brought a considerable global investment into many projects, and we needed ways to monitor ourselves so that we were sure our work's focus remained where it should."

A major hurdle, however, is that the adoption of new technologies such as improved varieties can take as many as six to 10 years. This significant chunk of time makes assessments difficult and requires a great deal of foresight from the scientists.

To measure the scale of a project's impact, the researcher first needs to have a benchmark with which to compare it. In most cases, this means conducting surveys before the project begins and following up with the same households afterward to see what, if anything, has changed.

This is particularly crucial in legume and other biotechnology research projects because effectiveness depends on being able to deliver the end products (i.e., improved seeds and other inputs, innovative practices) to growers.

"It takes many seasons and years of partnership and collaboration with members of the public and private sectors to produce a new variety and get it in farmers' fields," Maredia said. "It's a long-term process to transfer research from labs to farms, and longer still before you see farmers implement the technology at scale. You want to see the kind of impact that the research you invested in 10 years ago has had on the livelihoods of the people for whom you developed it."

MSU professor of Agricultural, Food, and Resource Economics Cynthia Donovan.

"I realize it's important to develop robust rural economies, and grain legumes are an intrinsic part of that."

– Cynthia Donovan

A LEGACY OF HIGH-IMPACT RESEARCH

LIL has conducted long-term economic impact assessments around the world, providing statistical evidence to demonstrate the importance of legume research.

An assessment published in January 2013 revealed that cowpea varieties developed by LIL scientists accounted for approximately 42 percent of the total planting area in Senegal's three largest cowpea-growing regions and contributed $78.6 million in economic value.

"The high adoption rate, combined with improvements in yield, led to overall welfare benefits significantly exceeding research, development and extension costs," Maredia explained. "The findings indicated not only the success of our distribution of the technology but also of cowpea's suitability to the region."

Between 1990 and 2010, LIL scientists released 90 varieties of beans, including 45 small red bean cultivars, to growers in the Central American nations of Honduras, El Salvador, Nicaragua and Costa Rica. An impact assessment from July 2012 revealed that the red bean varieties accounted for 67 percent of the total bean area, generating over $350 million.

"Central America has a major market for beans, so to see our work have that kind of impact there is really amazing," Donovan said. "The project boosted not only agriculture itself but also the seed production industries around the local communities. This is the kind of research we like to do, the kind that shows Congress the importance of continuing to support these efforts."

Though they're useful for summarizing the effects of research projects, the impact assessments have several other uses. They are invaluable data-driven resources that scientists can use to help determine the direction of future research.

"Breeders often emphasize increasing crop yield, but impact assessments have shown that isn't always the feature most valuable in certain communities," Donovan said. "In some cases, high-yield bean varieties don't see high adoption rates in the field because they may not meet consumer needs so the market is limited. By conducting impact assessment surveys, we're able to look beyond single objectives like yield and see the whole picture."

THE IMPACT OF IMPACT ASSESSMENTS

Impact assessments are especially important for legumes, a crop group historically undervalued despite its significant role in health and nutrition.

"Impact assessments are critically important for showing the value of legumes," Donovan said. "In the past, not showing their impact has done their economic and dietary importance a disservice, and this is a way to correct that."

Studying the role of legumes in national economies has convinced many of their importance.

"Grain legumes are particularly important crops in all the countries I've worked in," Donovan added. "In one form or another, they're key for providing protein and income to humans and nitrogen to soils. Watching the dynamics of the trade and employment sectors of these economies, I realize it's important to develop robust rural economies, and grain legumes are an intrinsic part of that." ❖

Mywish Maredia, professor of international development in the MSU Department of Agricultural, Food and Resource Economics, began working with long-term economic assessments over 20 years ago when she conducted research for her Ph.D.

ECONOMIC IMPACT OF THE LEGUME INNOVATION LABORATORY (LIL)

Released 28 bean varieties in **Honduras**, **Nicaragua**, **El Salvador** and **Costa Rica**, which have improved crop yields by approximately 50 percent.

28 bean varieties

42 percent of Senegal's cowpea land uses LIL-developed varieties, valued at approximately $78.6 million.

$78.6 million

LIL-developed small red bean and red mottled bean varieties have generated over $359 million in Ecuador and Central America, where they occupy 67 percent of small red beans and 50 percent of red mottled beans.

$359+ million in Ecuador & CA

Approximately 30 percent of cowpeas in **Benin, Burkina Faso, Cameroon, Mali, Niger, Nigeria** and **Senegal are protected from pests using LIL-developed double-and triple-bagging technology,** representing savings of an estimated **$295 million.**

$295 million

In **2014**, LIL scientists released a **bush bean variety to farmers in the Guatemalan highlands** that **doubled**, and in some cases **tripled, their annual yield.**

3x annual yields

LIL researchers **trained over 600 women** farmers from Ghana **in pest, disease and drought management practices.**

600+ trained

LIL researchers trained **496 producers** from **Senegal** in **seed production and postharvest practices.**

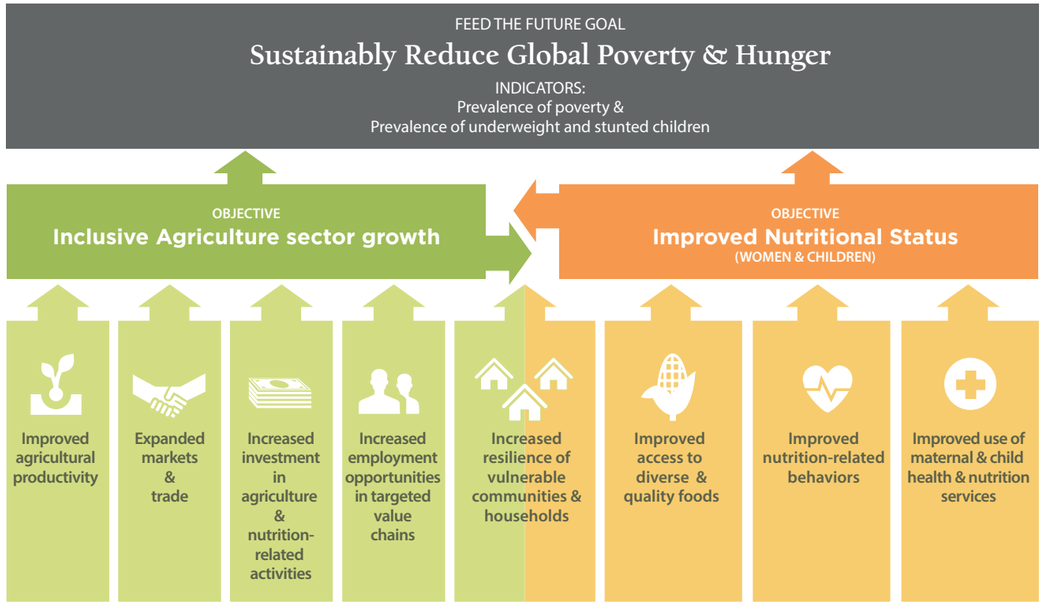
496 trained

PULLING PEOPLE FROM POVERTY TO PROSPERITY

Feed the Future initiatives reinvest in agriculture

Threshing pigeonpea in a village in Shan State of Myanmar. The whole plant is harvested, then it's beaten over a mat or sheet so that the pods split open and the grain falls out. The grains are gathered and winnowed to get the dust off.
Photo by Duncan Boughton

BY ABBY LYNN RUBLEY
Contributing Writer



FINANCIAL TURMOIL IN 2007 AND 2008 PUSHED MILLIONS OF PEOPLE WORLDWIDE TO THE EDGE OF POVERTY. FUEL AND FOOD PRICES HAD HIT ALL-TIME HIGHS, CATAPULTING BASIC STAPLES SUCH AS RICE, BEANS AND WHEAT BEYOND THE REACH OF MANY VULNERABLE PEOPLE.

This spike in costs arrived on the heels of a 30-year decline in agricultural investment and served as a wake-up call to policymakers. Clearly, more needed to be done to address the symptoms of food insecurity and break the cycle of poverty, hunger and crisis.

Reinvesting in agriculture was key. Under the Bush administration, the United States allocated resources to boost agricultural productivity, strengthen supply chains, and promote sound market-based principles for agricultural development and regional trade. This built on efforts underway by leaders in Africa to invest in and revitalize agriculture as a means for pulling residents out of poverty.

Then in 2010, under the direction of President Obama, the U.S. State Department officially launched the Feed the Future initiative, with implementation of the program through the U.S. Agency for International Development (USAID). The main objectives are to:

- Advance global agricultural development.
- Increase food production and food security.
- Improve nutrition and decrease stunting, particularly for vulnerable populations such as women and children.

The priorities of Michigan State University (MSU) align closely with those of Feed the Future. MSU President Lou Anna K. Simon said there is a high economic payoff from agricultural research when farmers adopt technologies and other innovations. That is why MSU researchers work closely, not only with commodity organizations in Michigan, but also with farmers around the globe.

"Providing practical solutions to everyday challenges, especially those in agriculture, will reap dividends for everyone in the long run," Simon said. "Much of what we discover in our research can be applied elsewhere, here at home and around the world."

Under Feed the Future, 24 innovation laboratories were created. These endeavors tap into the scientific excellence of more than 65 U.S. colleges and universities, including MSU. The

pioneer land-grant university is home to two Feed the Future labs: the Feed the Future Innovation Lab for Collaborative Research on Grain Legumes (Legume Innovation Lab or LIL) and the Feed the Future Innovation Lab for Food Security Policy (Food Security Policy Lab). Total funding for LIL, including associate awards, is $35 million; and for the Food Security Policy Lab, $70 million.

The labs at MSU, one of the most highly funded universities engaged in the global development of food security, work to develop climate-resilient crops and livestock that tolerate warmer climates, better withstand drought, and resist pests and diseases. In mid-2015, Feed the Future announced an investment of $140 million in a series of partnerships over the next three years. These partnerships are expected to deliver climate-resilient seeds and associated technologies to 11 million family farms across Africa.

Rob Bertram, chief scientist for the Bureau for Food Security at the USAID, said the professional skills of researchers and the effectiveness of their respective institutions are critical to the development and adaptation of innovations that drive long-term agricultural productivity and sustainability.

"Working in partnership with universities such as MSU was and continues to be a top priority of Feed the Future," Bertram said. "MSU knows how to do this work and does it well, as evidenced by the continued success of their projects."

A well-stocked pulse traders warehouse in Myanmar in the Far East.

Gretchen Neisler, director of the Center for Global Connections in Food, Agriculture and Natural Resources (CGC) at MSU, said MSU was successful in securing the two innovation laboratories because of its roster of world-renowned agricultural researchers with proven track records.

"MSU's success has been apparent in our ability to both adequately use our skill base and understand the needs of the people in developing countries," Neisler said.

An interview with villagers in the Delta area of Myanmar to better understand the problems they face in agriculture.

The world population is expected to grow from 7 billion to 9 billion by 2050, and global hunger and chronic malnutrition/undernutrition are expected to increase even faster, especially in developing countries. According to the USAID, worldwide food demand will increase by 40 percent to 70 percent by 2050 depending on income growth and chronic health issues in developing countries. Feed the Future is a key step in addressing those needs.

Feed the Future is focusing on 19 countries, selected on the basis of:

- Level of need.
- Opportunity for partnership.
- Potential for agricultural growth.
- Opportunity for regional synergy.
- Resource availability.

The USAID has a six-pronged approach to making the focus countries food-secure:

1. Climate-smart development. Feed the Future and partners such as MSU are working with farmers, governments and researchers to assess the effects of potential climate change on food production while helping farmers mitigate any damage that might occur as a result of climate change.

2. Gender integration. There is a focus on helping women — who do the bulk of food production in developing countries — gain access to land and other needed resources. The goal is to find a way to not only recognize them for their contributions but also find ways to better support their work.

3. Improved nutrition. With a major focus on the first 1,000 days of life, Feed the Future is putting significant resources into improving the nutrition of women and children in developing countries. MSU's MASFRIJOL project which is focused on increasing the protein intake the of the world's most malnourished people in the Western Highlands of Guatemala is a perfect example of this work.

4. Increased agricultural production. Recent studies suggest that every 1 percent increase in agricultural income per capita reduces the number of people living in extreme poverty by between 0.6 and 1.8 percent. Feed the Future strives to increase agricultural production and the incomes of both men and women in rural areas who rely on agriculture for their livelihoods.

5. Engagement with the private sector. This speaks to core business interests while also addressing critical development objectives. These "win-win" partnerships advance the impact of sustainable development and foster private-sector-led growth in emerging markets, a critical step in reducing poverty, fighting hunger and improving nutrition.

6. Research and capacity building. Given the challenges associated with providing sufficient food for a growing population, research and capacity building in agriculture and nutrition are necessary to increase food security and help developing countries feed themselves.

In countries supported by Feed the Future and other large-scale U.S. government efforts, local capacity to support food security, agricultural productivity and good nutrition continues to grow stronger. In 2014, Feed the Future had:

- Supported more than $500 million in new agricultural sales, a 200 percent increase over the previous year.
- Increased the number of individuals trained in improving agriculture and food security by 40 percent.
- Increased new agriculture-related public-private partnerships by 90 percent.
- Increased the number of people trained to support child health and nutrition by 150 percent.

During the same timeframe, Feed the Future also reached more than 12 million children with nutrition interventions and helped nearly 7 million farmers gain access to new tools or technologies such as high-yielding seeds, fertilizer application, soil conservation and water management. These increases represent the maturation and full mobilization of the initiative through its many partnerships with host-country governments, the private sector, the research community and others.

Workers packing harvested fish from a pond in ice, ready for transport to wholesale market by boat.
Photo Credit: Ben Belton

> **"Working in partnership with universities like MSU was and continues to be a top priority of Feed the Future."**
>
> — Rob Bertram

Through Feed the Future and other efforts, the U.S. government has partnered with other donors and other countries to continue to elevate food security and nutrition to the top of the global development agenda. The efforts are aimed at addressing the root causes of food insecurity, increasing economic stability and helping avoid recurrent food crises.

Feed the Future includes efforts by the USAID; the U.S. Departments of State: Agriculture, Commerce, Treasury and Geological Survey; the African Development Foundation; the Office of the U.S. Trade Representative; the Millennium Challenge Corporation; the Overseas Private Investment Corporation and the Peace Corps. ❖

MOVING TO A GLOBAL STAGE

Light shines bright on nutrient-rich crop during 2016 Year of the Pulses

• BY JAMES DAU, STAFF WRITER •

"PULSES HAVE BEEN AN ESSENTIAL PART OF THE HUMAN DIET FOR CENTURIES, YET THEIR NUTRITIONAL VALUE IS NOT GENERALLY RECOGNIZED AND IS FREQUENTLY UNDERAPPRECIATED."

With these words, director-general of the United Nations (UN) Food and Agriculture Organization (FAO) José Graziano da Silva officially ushered in the 2016 International Year of Pulses (IYP). As part of the UN's effort to promote sustainable food production and increased food security and nutrition around the planet, IYP is meant to highlight the importance of pulse crops.

Pulses are a subgroup of legumes that produce edible seeds that are harvested for dry grain. These include such regular denizens of the Western diet as kidney beans, navy beans, chickpeas and many lentils. All told, hundreds of varieties of pulses are grown worldwide.

Traces of pulse production dating back to 3300 B.C. have been discovered around the Ravi River in the Punjab region of modern-day India and Pakistan, the seat of the Indus Valley civilization, one of the earliest human societies. Evidence of pulse consumption has also been found in Egyptian pyramids and in Swiss villages dating back to the Stone Age. Despite their historic ubiquity, pulses are often described by the research community as one of the most – if not the most – undervalued family of crops.

The extensive history of pulses within cultures can be attributed to their numerous nutritional and agricultural benefits. High in protein, fiber, iron, zinc, phosphorus and other nutrients, pulses are a complement to cereal crops such as rice, wheat and corn. They are particularly critical for populations that cannot afford to rely heavily on animal food sources for protein.

Legumes also fix nitrogen in the soil, which reduces the farmer's reliance on fertilizer inputs when they are used in crop rotation. Their added biomass as a cover crop improves soil organic matter, which helps retain water and nutrients under drought conditions. They also require less water than many other crops, so they are more drought-resistant.

Researchers at Michigan State University (MSU) are praising the UN's declaration of 2016 as the International Year of Pulses for shedding light on the often overlooked and underloved crops.

James Kells, chairperson of the MSU Department of Plant, Soil and Microbial Sciences, said the UN declaration is certainly warranted because of the crops' nutritional value, especially in developing countries.

"They are agronomically and nutritionally important in the United States and globally, and bringing the attention of the world community to them can only help increase awareness of that fact," he said.

This sentiment is the driving force behind the IYP. Despite healthful benefits, pulse production has experienced a decline in recent years as agricultural economies have turned more and more toward cereal grains.

Sieglinde Snapp, professor in the MSU Department of Plant, Soil and Microbial Sciences, said it's important to draw attention to pulses, especially now.

"There's been a slight decline in pulse consumption almost everywhere in the world except South Asia because of the promotion of cereals, which receive the bulk of government attention and research funding," she said. "We need investment in pulses — they haven't received the attention they deserve in years."

The IYP declaration has reaffirmed MSU's commitment to continue pulse

Michigan State University's Sieglinde Snapp (second from right) in Malawi with farmers.

research aimed at delivering better, healthier cultivars to areas of the world needing them the most.

William "Vance" Baird, professor and chairperson of the MSU Department of Horticulture, said the IYP helps to justify the efforts behind legume research.

"To see the crop group recognized on this stage validates the continuation of those efforts beyond the local, regional or even national level to a worldwide focus," he said.

"To see the positive impacts that pulses have for the human population recognized and featured so prominently provides the opportunity to continue the growth and development of still better crops and practices."

Pulses have been an important segment of agriculture in Michigan since they were introduced in the 1880s. The state, which is home to a quarter of a million acres of edible dry beans, ranks second only to North Dakota in production. The 12 classes of edible dry beans grown by Michigan farmers annually contribute $150 million to the state's economy, according to the Michigan Bean Commission.

Recognizing the economic and nutritional significance of beans, MSU has taken a leading role in pulse research that has implications worldwide.

"Since pulses are important to the world and to Michigan, they are important to MSU," Kells says. "We have leading genetics and breeding programs in our department that are important to growers and to the industry at large."

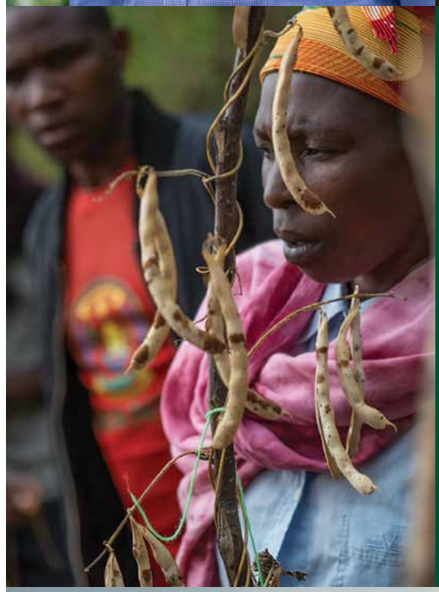
"Some of the bean research we do at MSU is second to none," Snapp adds. "In my own work, I see pulses as an essential part of a greener revolution in Africa."

In the east African nations of Malawi and Tanzania, where much of Snapp's work is concentrated, chemical fertilizer is two and 10 times as expensive as in Michigan, respectively, and supplies are extremely limited. Consequently, the ability of pulses to fix soil nitrogen in these regions is critical. Because of poor soil health and drought, these countries stand to reap many benefits from the production of pulses. Bringing improved pulse cultivars to the region is an important step to increase food security and improve health and nutrition.

"If we can get more legumes in the region, that will mean more fodder for livestock, more biomass to protect the soil and more high-quality grain for family nutrition," Snapp said. "We need all of these things to get better returns on the cash crops such as corn or sorghum. They really benefit from the diversity that pulses provide."

Baird said MSU is well-poised to develop sustainable ways to increase yields, improve stress tolerance, boost nutritional value and advance postharvest processing.

"I think MSU's strength in plant sciences – its combination of expertise in cutting-edge plant science and breeding – is crucial as we move forward with crop improvements that allow producers to grow pulses more efficiently," Baird said. ❖



COMBATTING HUNGER & POVERTY

Upper left:
James Kells

Upper right:
Bowls of different pulses

Middle right:
Pulses ready to be cooked

Lower right:
A bean farmer at work

Lower left:
Village with nearby bean fields

Middle left:
Bean varieties being viewed by Rwandan villagers

BY HOLLY M. WHETSTONE, EDITOR

#Legumes4Africa

WORLD LEADERS CONVENE IN ZAMBIA TO TALK PULSE IMPROVEMENTS

"We must put the hand hoe where it belongs – in the museum – because it does not have a place in agriculture today. The African woman, the African youth cannot continue to till the land with such back-breaking, inefficient and archaic tools."

These words were delivered by Zambian Minister of Agriculture Given Lubinda as part of his opening remarks for the 2016 Joint Pan-African Grain Legume and Cowpea Conference in Livingstone, Zambia. More than 520 registered participants from 46 countries throughout sub-Saharan Africa, Latin America, the United States and India gathered to discuss ways to boost productivity, intensify cropping systems, improve human nutrition and develop value chains of grain legumes.

Sub-Saharan Africa was chosen as the site of the conference because of its traditionally poor bean production. Pests and diseases, low soil fertility, poor agronomic practices and climate change, along with increased populations, have prevented beans from reaching their full potential in this region of the world where hunger, poverty and malnutrition are daily challenges.

In his speech, Lubinda talked about the growing world population and the subsequent need to increase the global food supply by 70 percent by 2050. He said he is particularly concerned over the lack of agricultural technology in his homeland and the deterrence it poses to future generations of farmers.

"The youths are leading smart lives," he said. "The youths will only be involved in smart agriculture, and unless we take the hand hoe away, I'm afraid the population of farmers will perish."

In addition to the lack of modern agricultural tools, African agriculture is stymied by poor access to high-yielding, drought-resistant legume seed and market chain supply, and opposition to crop diversity. Most farming is done on a small-scale basis, primarily by women, some whom bear children who suffer stunted growth due to poor diets and lack of proper nutrition.

In an effort to help find solutions to these challenges, the Feed the Future Legume Innovation Lab (LIL) – housed at and administered through Michigan State University (MSU) – took a leadership role in organizing the conference. Other partners included the International Institute for Tropical Agriculture (IITA), the Centro Internacional de Agricultura Tropical (CIAT) and the Zambia Ministry of Agriculture.

It was the sole signature international event in Africa to celebrate the United Nations Food and Agriculture Organization proclamation of the 2016 International Year of Pulses (IYP). The designation highlights the importance of edible grain legumes to improving the livelihoods of rural farmers, especially women; human health and nutrition; and the sustainability of agricultural systems worldwide.

The MSU delegation of 22 faculty and staff members was led by Douglas Buhler, MSU assistant vice president of research and graduate studies, and Irvin Widders and Cynthia Donovan, director and deputy director of LIL, respectively.

In his remarks, Buhler – the lone academic institution representative on the conference panel of honored dignitaries – said he is sometimes questioned in the United States about the importance of conducting international research.

"I will often be asked and challenged

Zambian Minister of Agriculture Given Lubinda (red tie) chats with dignitaries and guest speakers, including MSU Assistant Vice President of Research and Graduate Studies Douglas Buhler (far right) at the 2016 Joint Pan-African Grain Legume and Cowpea Conference held in Livingstone, Zambia earlier this year.

by some of our investment partners as to why we have people in our departments and investments in faculty in other parts of the world when we have plenty of problems and things to do at home," he said.

"The simple answer to that is we gain more from our partnerships than our partners do. I would also add that, with agriculture and food being such a global industry, it's actually an important element for our faculty and our students to be internationally engaged, and this is one way to do that."

Jeff Ehlers, program officer with the Bill and Melinda Gates Foundation – another conference co-sponsor – said the importance of research on such topics as crop breeding and integrated pest management through institutions such as MSU is critical because of the low costs and low risks involved.

"Most of us realize that the small farmers in Africa are getting two to three times lower production rates than what can be done on research station sites," Ehlers said. "That is generally due to what I would call under-management – lack of use of improved seeds, poor varieties and suboptimal use of agronomic practices."

Robynne Anderson, founder of Emerging Ag Inc., said she is working with the Global Pulse Confederation (GPC) to help lead the pulse industry to major crop status by facilitating free and fair trade and increasing production and consumption of pulses worldwide. She said that as of the end of February, GPC had hosted pulse events in 36 countries and engaged 200 million people on Twitter (#ilovepulses, #IYP2016).

In addition to raising awareness, GPC is working to improve food security and nutrition by encouraging students to pursue technology and new uses of pulses while advocating for additional research. Compared with other crops such as maize, legumes lag far behind in external funding support, Anderson said.

"There is currently a $177 million investment in research for the 13 crops considered pulses," Anderson said. "This means we would need a tenfold increase to reach the $1 billion investment in research for corn alone."

Conference keynote speaker Yemi Akinbamijo, executive director of the Forum for Agriculture Research in Africa, said there may never be a greater time to speak about grain legumes because of their significant impacts on food security, income security, nutritional security and feed security. He said that climate change and the need for sustainable farming practices are adding more pressure to find solutions to feed the growing world population.

"Grain legumes are often referred to as the 'poor people's meat,'" Akinbamijo said. "They're extremely important to those who cannot afford meat, milk or fish to meet their protein needs."

The conference presentations focused on all facets of grain legume production, from genetics to seed selection and from nutritional benefits to workforce gender issues. In addition, some 60 scholarships were awarded to African scientists and graduate students to attend and present papers.

In finishing his opening remarks, Lubinda urged conference attendees to support efforts to advance "smart agriculture in Africa" through commercialization and modern-day mechanization.

"In this paradigm [in Africa], agriculture continues to support the much needed jobs for our youths and the much needed incomes for our women," Lubinda said.

David Bergvinson, director general of the International Crop Research Institute for Tropical Agriculture, emphasized the need not to lose sight of the smallholder farmer. He added that continued partnerships are necessary to transform food systems and address poverty and hunger.

"More and more governments, whether in India or Zambia, are recognizing the role of pulses," Bergvinson said. "If we stay focused on the farm, we will have a much better story to tell in 2020." ❖

GRAIN LEGUMES ARE OFTEN REFERRED TO AS THE 'POOR PEOPLE'S MEAT.' THEY'RE EXTREMELY IMPORTANT TO THOSE WHO CANNOT AFFORD MEAT, MILK OR FISH TO MEET THEIR PROTEIN NEEDS. - *Yemi Akinbamijo*

75% of the world's poorest countries are located in Africa.

In 2013, the 10 countries with the highest proportion of residents living in extreme poverty (less than $1.25 per day) were all in sub-Saharan Africa.

1 in 4 undernourished people in the world live in Africa.

There are **33 million family farms** of less than 2 hectares in Africa; that's 80 percent of farms. **Only 3 percent** of farms in Africa **have more than 10 hectares.**

64%+ of African women work in agriculture, producing an estimated 80 percent of food resources.

Less than 20 percent of African women have access to education.

Women in sub-Saharan Africa are more than **230 times more likely to die during childbirth** or pregnancy than women in North America.

Preschool children in Africa suffer the highest rate of stunting because of malnutrition – an estimated **37%**

Some **589 million people live without electricity** in sub-Saharan Africa.

SPREADING THE MESSAGE FOR BETTER HEALTH IN THE HIGHLANDS OF GUATEMALA

MASFRIJOL = ‘MORE BEANS’

• BY MARGUERITE HALVERSEN, CONTRIBUTING WRITER •

THE MAYAN POPULATION IN GUATEMALA'S WESTERN HIGHLANDS IS ONE OF THE MOST UNDERNOURISHED IN THE WORLD, WITH CHILDREN THERE SUFFERING HIGH RATES OF STUNTING. A WELL-ESTABLISHED INDICATOR OF EARLY CHILDHOOD MALNUTRITION, STUNTING CAN AFFECT COGNITIVE DEVELOPMENT AND PRODUCTIVITY AS WELL AS INCREASE THE LIKELIHOOD FOR HEART DISEASE, DIABETES, KIDNEY DAMAGE AND ANEMIA INTO ADULTHOOD.

Beans, a nutrient-dense food with a high percentage of protein, may seem a likely answer to remedy Guatemala's malnutrition problem, but the solution isn't quite that straightforward.

Local farmers don't grow enough beans to meet the nutritional needs of the people. Limited access to farmland and elevations greater than 2,500 meters above sea level make bean production difficult.

Maize, beans and squash – also known as the "three sisters of agriculture" – are grown in the highlands, and they're eaten in disproportionate amounts for proper nutrition. The ratio of maize to bean consumption is 97:3 for most households. A diet this high in corn does not provide the necessary protein and other nutrients to promote healthy growth and development.

"To achieve a high-quality protein — equivalent to that of meat — the recommended corn-to-bean consumption ratio should be 70:30," said Sharon Hoerr, a nutritionist with MASFRIJOL and professor emerita from the Michigan State University (MSU) Department of Food Science and Human Nutrition. "A high-quality protein contains the nine essential amino acids that humans must get from food for proper nutrition, health and growth. Beans and maize both contain incomplete proteins; if combined during the same day, however, they form an excellent high-quality protein."

Critical problems also lie in the population's limited understanding of the nutritional value of beans, which are often dismissed in favor of processed foods. Consequently, beans are not always consumed when they're available. Instead, farm families frequently sell their beans to purchase less nutritional foods.

Furthermore, poor farmers possess limited means to safely store beans for more than a month or two. Open plastic containers attract weevils and other insect pests that can quickly devastate a harvest, making beans, at best, a seasonal food source.

Michigan State University's MASFRIJOL in the highlands of Guatemala educating locals about the benefits of proper nutrition.

A mobile educational unit travels to different remote communities in the highlands of Guatemala, educating locals.

ENTER MASFRIJOL

In 2013, Irvin Widders, professor in the MSU Department of Horticulture and director of the Feed the Future Legume Innovation Lab (LIL), and Luis Flores, assistant professor in the MSU Department of Community Sustainability and MASFRIJOL project principal investigator, proposed a project to address the problems facing Guatemala. They realized that improving nutrition in the western highlands required the following goals:

- Increasing bean yields.
- Increasing bean consumption.
- Improving nutrition education, especially about the long-term health benefits of proper nutrition.

A year later, in 2014, the U.S. Agency for International Development (USAID) and USAID's Guatemala Mission awarded funds to the LIL to initiate MASFRIJOL, Spanish for "more beans." The project is a four-year Associate Award to the Leader Award for the LIL to increase bean consumption in the Western Highlands through agricultural interventions and nutrition education.

MASFRIJOL began its work by providing 15,000 smallholder farmers each with 5 pounds of high-quality seed of improved, disease-resistant bean varieties adapted to the unique agroecology of the region. These altitude-appropriate varieties – ICTA Hunapú, ICTA Superchiva and ICTA Altense – were developed by the Institute of Agricultural Science and Technology (Instituto de Ciencia y Tecnología Agrícola [ICTA]) to improve bean yields in the inhospitable, high-altitude elevations of the region.

Through its collaboration with the Guatemalan Ministry of Agriculture (Ministerio de Agricultura, Ganadería y Alimentación), the project also provides farmers training on soil preparation, seed germination and safe bean storage postharvest. The training helps farmers improve their integrated crop management, enabling them to grow more beans on their land and safely store the increased yields long-term. As a result, beans can last up to six months after harvest.

"By relying on the expertise of established public and private sector agencies and organizations in the region, MASFRIJOL has been able to extend its impact to reach greater numbers of farmers in even the most remote areas of the highlands," said Salvador Castellanos, national director of the Guatemala MASFRIJOL office. "The partnerships have effectively linked the agriculture and nutrition education activities to ensure that farming families are not only growing more beans but eating more of the beans they've grown."

To support these lessons and facilitate technology adoption, MASFRIJOL's training team has developed technical guides and videos that focus on key training messages.

"Key messages are limited to three to five per topic, so farmers and families can remember to put them into practice at home," said Celina Wille, MASFRIJOL agricultural extension specialist and MSU assistant professor of community sustainability. "We don't want to overwhelm them with too much information but build on the knowledge they have — and then lead them to new skills for growing and consuming more beans.

"For example, in our training on seed storage — one of 15 training modules offered through MASFRIJOL — we make sure participants understand exactly how to use special plastic bags to store and preserve their grain for six to 12 months, and that optimal seed humidity for bean storage is less than 14 percent. The science behind these principles is interesting, but the farmers don't need to understand such details to use the bags, so training doesn't emphasize them. We focus on practical skills that can be easily applied."

And applied they are. Many farmers who had become used to inferior seed quality and assumed that beans were difficult and risky to produce have reported twofold bean yield increases. And most are saving beans for family consumption and the next planting season instead of selling them.

Safe storage is critical to ensuring increased bean consumption beyond the month or two after harvest. Weevils, which are attracted to open containers of beans, are the main threat to bean quality and can destroy a stored harvest in a month. GrainPro storage bags, which are made of three extruded layers of a special plastic material and distributed through MASFRIJOL, have helped prevent the infiltration of weevils and other pests into stored beans.

Locally operated community seed depots are also being developed to ensure that quality planting seeds will continue to be available to farmers who are unable to save seed from harvest because of unexpected agricultural challenges or other problems.

NUTRITION EDUCATION

Within months of the improved seed distribution and crop management education, MASFRIJOL, working with the Guatemalan Ministry of Health (Ministerio de Salud Pública de Guatemala), began establishing nutrition education programs to increase the understanding of the link between regular consumption of beans with maize and improved health.

With its partners, MASFRIJOL has developed culture-sensitive educational materials that accommodate the literacy and language barriers of the target populations, including a coloring book for children focused on making healthy food choices. Lessons include dietary information designed for both the general adult population and the more vulnerable populations of women of childbearing age and young children.

Bean and nutrition fairs are held to unite communities and raise awareness of the importance of bean consumption. Held in open fields or community markets, educational activities include informational and instructional videos, taste testing, recipe contests and projects that engage community members directly. A video on protein complementarity, for example, is followed by a discussion on how to proportionally integrate maize and beans into favorite recipes.

Other teaching programs focus on the dietary health of children, including how to make a bean-based formula for young children to replace atole, a maize-sugar beverage given to infants that provides calories but little nutrition. They also include instruction and practice on how to prepare an appetizing bean-based porridge often enjoyed by young children.

TWO YEARS AFTER ITS FORMATION, MASFRIJOL REPORTS THAT:

- Families consume more beans at family meals (at least three times a week).
- Infants and children younger than 5 years are being fed more beans on a daily basis instead of a predominantly maize-based diet.
- Families are learning to measure how many pounds of beans they need per week to meet their food requirements.

Although there is more work to do and more people to reach, MASFRIJOL is succeeding in its project goals. Families are growing and eating more beans and sharing them with neighbors. MASFRIJOL teams have empowered communities to manage improved varieties on a sustainable basis and implement technologies and practices to grow and consume more beans in the future. ❖

Growing black beans in coffee fields

Like most of his neighbors, Carlos Dominguez, a smallholder farmer in Tierra Blanca La Vega — a community in Guatemala's western highlands — depends on subsistence agriculture for survival. And Dominquez says his life has steadily grown more difficult each year with decreased crop production and, consequently, reduced family income.

Agricultural challenges include low soil fertility and crop yield, poor seed quality and varieties, and lack of crop diversity. During particularly trying times, Dominguez and families like his have trouble growing enough food and are forced to buy food despite dwindling incomes. In fact, 65 percent of the population in Tierra Blanca La Vega is poor, with 20 percent extremely poor. And hunger and undernutrition are common.

Last year, however, Dominguez harvested 200 pounds of black beans, which provided 100 pounds of food for his family along with seed for the upcoming planting season. This windfall grew out of the USAID-supported MASFRIJOL project. The collaboration with ANACAFE (the Guatemalan National Coffee Association) and rural value chains distributed 5 pounds of the improved variety of bean seed called Altense to each smallholder farmer, including those who hadn't traditionally grown beans. Farmers in Dominguez's village along with 16 other communities within the municipality received the seed in 2014.

Dominguez intercropped Altense instead of maize with coffee plants, breaking with the traditional cropping system. This allowed him to maintain his cash crop while growing food for his family. With the improved bean variety Altense in his fields, Dominguez was committed to participating in the technical training on the agronomic management of bean crops provided by MASFRIJOL Extension agronomists and adding the recommended organic fertilizer to his field to produce the best yield possible.

Mario Tello, a MASFRIJOL extension specialist, visited the Dominguez family after their first bean harvest and found that Dominguez had already planted a second improved bean seed crop, this time with tomatoes.

NO MOUNTAIN TOO HIGH: BRINGING BEAN EDUCATION TO FARMERS

Nutrition educators understand that meeting people in their villages at times convenient to them is critical to the success of MASFRIJOL.

The indigenous people of Guatemala's Western Highlands lack the means and the time to travel to educational gatherings away from home. So MASFRIJOL comes to them — a plan that sounds easier than it is. Roads are often unpaved and consist of a series of narrow hairpin turns that rise and fall throughout the mountains. An 80-mile trip can easily require three to four hours of driving, sometimes followed by hikes ranging from five to 35 minutes.

To reach these remote villages, MASFRIJOL purchased and equipped four mobile multifunctional training units that serve as classrooms. These four-wheel-drive trucks, staffed by trained technicians and equipped with audiovisual projectors, educational materials, and up-to-date bean and nutrition education technologies, stop in gathering places that villagers can easily reach on foot, such as schools and churches.

"Typically, prearranged village meetings begin around 10 a.m., after older children have headed to school but before lunch preparation begins, to allow the greatest number of people to attend," said Carolina Molina, monitoring and evaluation specialist from the Guatemala MASFRIJOL office. "Many of these women farm their family's land and make decisions about family meals, so the meeting time needs to work with their schedules.

"The educational events serve as social gatherings for the villagers where MASFRIJOL educators can provide hands-on information on healthy dietary choices that are easy to incorporate into daily meals, especially since recipes are provided and practiced at the gatherings. The videos shown from the mobile units also make learning about nutrition interesting for the attendees, who don't generally have access to television and enjoy the opportunity to see shows."

Children, typically under the age of 4, usually accompany their mothers. In addition to lessons on combining maize and beans for healthier all-family meals, teachings emphasize meeting the special nutritional needs of young children, for whom complete proteins ensure proper growth and development.

"We often measure the young children and then discuss their measurements against a normal growth chart," Molina said. "Since children are often small for their age, explanations and demonstrations on how to make a bean-based formula for infants are central to the lessons."

This bean-based formula, which ensures that children regularly receive a quality protein in their diet, replaces the ever-present corn sugar-based atole, which provides calories but no nutrition. Disseminating information on this nutrient-dense and delicious formula is critical to achieving MASFRIJOL's goals.

While mothers learn how to prepare bean-based meals for family members of various ages, children color in books that feature nutritious food combinations. Practicing recipes allows everyone to learn and to taste some of the recommended dishes, which are based on traditional Mayan foods.

After class, attendees leave, not only having enjoyed the gathering but also equipped with new information, meal plans and strategies for implementing beans into their daily diet. The hope is that the new understanding of nutritional needs for proper growth and development motivate them to put what they've learned into practice.

A monitoring process is underway to determine families' bean consumption after the intervention.

A masterful bean breeder & mentor

BY HOLLY M. WHETSTONE, EDITOR

James Kelly visiting bean fields in Africa

Halfway around the world at a gala reception in Africa, Michigan State University (MSU) Distinguished Professor James Kelly mingles as if right at home. He works his way from one candlelit table to the next, taking only a few steps between conversations. Most centered on beans and bean research. In addition to knowing many of the guests, Kelly has close personal ties to several of the evening's distinguished awardees, including a few former students.

Having developed 47 bean varieties in the past 35 years, Kelly was frequently recognized and fondly greeted, not only at the evening's festivities, but throughout the weeklong 2016 Joint Pan-African Grain Legume and World Cowpea Conference in Livingstone, Zambia held in early March. He could easily chalk up the notoriety and camaraderie to an illustrious career, but chooses not to.

"Maybe it's just a case of longevity and having been at this long enough," he said. "Having worked with the crop for that many years, both as a student and then as a researcher in a couple of different places and so forth – you build up these friendships and relationships with people. Yeah, I think just because of that and my work being published over the years. People see the publications and they talk to you and so forth."

Kelly, who speaks with a charming Irish accent, was born and raised in County Antrim in the northeastern part of Northern Ireland. Growing up, he spent time on his grandfather's livestock farm, but it was his father's interest in horticulture that had the most influence on Kelly's career. His dad, a primary school teacher by trade, grew vegetables in greenhouses at their home. Frequent visits from the local Extension specialist who offered valuable plant advice made a lasting impression on the young lad, who eventually realized that science was what intrigued him most.

While working on a bachelor's degree in agriculture in his homeland, Kelly began to take note of Norman Borlaug who at the time was making headlines plant breeding, mainly wheat, and who later became known as the "Father of the Green Revolution." Inspired by Borlaug's achievements, Kelly came to the United States in 1969 to pursue his doctoral degree in plant breeding from the University of Wisconsin (UW). As part of his doctoral studies, Kelly spent about two years conducting research overseas for the International Center for Tropical Agriculture (CIAT). It was then that his bean breeding connections began to firmly take root.

"Yeah, there are a lot of tentacles, I suppose," he said, describing his relationships within the bean community both at home and across the globe.

Upon receiving his Ph.D., Kelly became employed by UW and has been working with beans ever since. He joined the MSU faculty in 1980 as an assistant professor in the Department of Crop and Soil Sciences, now Plant, Soil and Microbial Sciences.

While developing one bean variety can take more than 10 years, Kelly said he stays interested in the process by setting a series of short-term goals. Along the way, he works closely with farmers and the processing industry to ensure that they are pleased with the final product. When asked which of the bean varieties he considers to be his crowning achievement, Kelly said it was probably his first – a navy bean called C-20. Although not on the market for long, C-20 became "grandpappy" to many black bean and navy bean descendants, he said.

"C-20 had its faults, but we were able to learn from those and improve future cultivars — which is what you do in plant breeding," he said. "You develop something and then you build to improve it further. Even when you have new varieties coming out, we still have a couple years of work on them to improve them further."

Samurai, released in 2015, is Kelly's most recent creation, made specifically for the Japanese market. Although it resembles a white bean used in baked beans, Samurai is processed into a bean paste used in many Japanese baked goods and sweets. Kelly said that because the country is heavily populated and has little available land mass, it must depend on other countries for many of its agricultural products.

The majority of Kelly's beans are grown in North America, primarily Michigan, Minnesota and North Dakota. Kelly said there are huge challenges to bean production, from high plant costs to production on primarily marginal lands. Because of limited investment in research, bean yield improvements have failed to match those of several major cereal crops. The fact that pulses are much more complex nutritionally makes improvements more difficult to achieve.

Beans are key contributors to the food security of many countries in Latin America and sub-Saharan Africa, where they have become integral components of smallholder farming systems. Kelly has forged research and outreach partnerships in countries such as Mexico, Ecuador and Rwanda in efforts to increase both the quantity of beans produced per unit of cropland and their nutritional quality.

When people hear the word "breeding," Kelly said they often erroneously assume it involves GMOs. In fact, dry beans are not a GMO crop. Part of the reason, he said, is that scientists have not been able to genetically engineer beans.

"Dr. Kelly was an exceptional mentor. His knowledge of plant breeding and genetics, particularly of common bean, is exceptional. Through his mentorship, I now have the necessary skillset to manage a bean breeding program."

– Kelvin Kamfwa, bean breeder at the University of Zambia

"Would there be GMO traits out there that would help beans? I'm certain there would be," he said. "Are they going to come? I don't know. There is nervousness about trying to bring them forth and trying to sell them. One feels sometimes like you're running a race against other commodities with your hands tied behind your back because those tools are not available to you."

Kelly admits that the fact that beans do not contain GMOs makes marketing beans easier. However, with mandatory food labeling expected in the near future, baked beans could be labeled GMO because they contain sugar, a GMO crop. Either way, Kelly said he is irritated by the GMO backlash because engineered traits such as disease resistance, insect resistance and herbicide resistance can help decrease dependency on chemical use and save resources – both economically for farmers and ecologically, especially in developing countries.

"Third-world farmers are being prevented from access to these food crops by essentially people who are well-fed and well-healed. That's what bothers me the most," he said. "Why should they have a right to dictate what others, who have much less in the way of resources, do?"

As bean breeding begins to incorporate more and more plant genomics – an area Kelly is not trained in – he is carefully thinking about his future.

"Somebody just asked me if there was anything I wanted to finish before retiring," he said. "The thing with plant breeding, there is always something you want to move forward on. You'd like to see some things click and work, but there isn't anything specifically. I'm not hanging on here to get one thing finished. I'll find an appropriate time to retire."

In the meantime, Kelly remains deeply committed to both his research and his teaching. Mentoring and training of students has been an integral component of his research strategy across his entire career.

More than 30 graduate students, many from developing countries and many who did their research in the developing world, have obtained M.S. and Ph.D. degrees under his guiding influence. More than 100 other students have sought and benefitted from his advice as a member of their graduate committees. Kelly continues to teach in the classroom, too, helping to equip new generations of agricultural talent. And just last summer he graduated six graduate students under his advisement.

"I try to instill in my students that one has a job to do, and that's it," he said. "You need to put in the effort, get the work done and do it right – taking it through to the final dissertation and getting the information published. Some of the work is a lot easier than others." ❖

BY CAMERON RUDOLPH, STAFF WRITER

CREATING NEW INTERNATIONAL SUPPLY CHAIN OUTLETS PROVES CHALLENGING

EACH SEMESTER SINCE HIS RETIREMENT IN 2011, RICHARD BERNSTEN HAS SAT IN ON A CLASS AT MICHIGAN STATE UNIVERSITY (MSU). THE FORMER DEPARTMENT OF AGRICULTURAL, FOOD AND RESOURCE ECONOMICS PROFESSOR OF 26 YEARS DOESN'T TEACH OR INTERJECT ANYMORE — HE LISTENS. HE ATTENDS COURSES ON VEGETABLE CROP PRODUCTION, PLANT PATHOLOGY AND ENTOMOLOGY, WANTING TO LEARN ABOUT THE SCIENCE BEHIND THE CROPPING SYSTEMS THAT HE SPENT DECADES TEACHING ABOUT FROM FINANCE AND POLICY PERSPECTIVES. WHY NOW? BERNSTEN SAYS HE CONTINUES TO WANT TO IMPROVE THE LIVES OF PEOPLE ACROSS THE WORLD — A CAUSE TO WHICH HE'S DEDICATED HIS ENTIRE CAREER. PLUS, THERE'S ONE CAUSE STILL ON THE ECONOMIST'S MIND — OPENING NEW SUPPLY CHAIN OUTLETS FOR SMALL-SCALE BEAN GROWERS GLOBALLY.

Bernsten's passion for international development originated during his time as a Peace Corps volunteer in Sierra Leone. From there, Bernsten was hooked. After completing master's and doctoral degrees in agricultural economics at the University of Illinois, he made his way to the Philippines to join the International Rice Research Institute. Wanting to return stateside after four years in Southeast Asia, he obtained a position at Winrock International in Arkansas, a nonprofit that works with disadvantaged populations in the United States and abroad. In 1985, he jumped at the chance to join MSU and focus on international projects.

With funding from the Legume Innovation Lab (LIL) at MSU, among other entities, Bernsten has investigated ways to bring economic opportunity to developing countries. He has a particular affinity for Honduras, where several of his former graduate students and collaborators are from.

With Juan Carlos Rosas, a Honduran dry bean breeder and professor at Escuela Agrícola Panamericana, and a team of graduate students, Bernsten embarked on a project in 2009 that explored the bean export supply chain from Honduras to the United States.

In need of cash, most Honduran farmers sell their beans just after harvest. The downside is that prices are low because the market is flooded. Bernsten wanted to devise ways to give farmers more selling options.

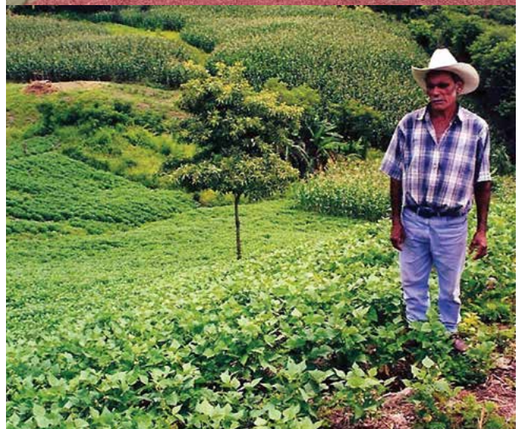
"We were looking to assist small-scale farmers in making larger profits from the beans they grow," he said. "There is a market class in Honduras called small red beans. This market class isn't grown in the U.S., but it accounts for more than 90 percent of all beans grown in Honduras. With the growing interest in fair trade in the U.S., we thought fair trade beans might be a good idea."

Around for many years, fair trade practices have begun to flourish only in the past two decades. Coffee is the most popular fair trade product, but others are gaining steam. Proponents tout the standards set by third-party certifying organizations that respect growers and the environment. Bernsten believed he could help farmers tap into an emerging upscale U.S. consumer base that was increasingly concerned with worker conditions and food origins. Plus, farmers growing fair trade beans would receive a 10 percent price premium.

Rosas initiated conversations with local growers to gauge their participation interest, while Bernsten attempted to address the main concern: who will buy these beans? Jack Allen, a retired professor in the MSU Eli Broad College of Business, recommended speaking to one of his former students, a regional manager for Whole Foods Market. The manager connected Bernsten with the bulk commodity buyer for Whole Foods in Austin, Texas, and negotiations began.

"We had to establish a price that was fair to the farmers and take into account the cost of all steps of the supply chain," Bernsten said. "As we delved further into the process, the complexity of fair trade certification became very apparent."

Whole Foods agreed to purchase 20 metric tons of beans if the farmers formed an association for fair trade purposes, met standards set forth by the International Marketing Organization (IMO) and agreed to the price. This required the farmer association to complete a 50-plus page application that vetted the group's membership and governance. To gain and maintain fair trade status, the association needed to pay an annual fee of $2,700 to cover associated costs.



Top: Richard Bernsten speaks to a group about his international research.
Second: Juan Carols Rosas (second from left) views a bean field with fellow researchers and farmers.
Bottom: Farmers in the field with their crops.

Bernsten determined that certification costs, shipping, fumigation, customs brokerage fees and more would require a higher price than the $1 per pound initially settled on. In addition, a purchase price must be arranged six to nine months prior to delivery. Initially, the farmers accepted the offer. But as the local price of beans increased because of supply shortages, the farmers asked for a higher price. Whole Foods agreed to the new price again. But as local prices continued to climb and farmers asked for yet another increase, Bersten said negotiations came to a stalemate and eventually fizzled.

"These are farmers who are used to selling on the spot market," Bernsten said. "They don't know if the price will rise or fall in six to nine months, so it's a scary proposition to forward contract. If it was only a portion of their crop, they could dip their toes in the water without jumping all the way in."

In the end, an agreement between the farmers and the retail chain could not be reached. Bernsten said the group gleaned information, including the possibilities of expanding target customers.

"I was extremely impressed with Whole Foods and the excitement they had to partner with us," Bernsten said. "It's unfortunate that we couldn't come to a price agreement, but it just shows the unpredictable nature of the marketplace. The price of beans isn't the only volatile thing here. The price of shipping can go up, as well as any number of other complications. There's a tremendous amount of uncertainty and risk for small-scale farmers who want to sell their produce in the international market."

Cynthia Donovan, the deputy director of the LIL, praised Bernsten's innovative work with fair trade beans. This project, along with others led by Bernsten, provides hands-on experience for students.

"The research was extremely valuable, as it involved farmer organizations and the U.S. private sector opening up a new trading channel that is growing today," Donovan said. "Dr. Bernsten has done amazing international development work, and his graduate students have gone on to flourish in their careers."

Bernsten said he has advised more than 40 international graduate students. He tries to stay in touch as frequently as possible and has derived significant pride from monitoring their success.

"I've always said the best thing about being a faculty member is following the careers of your students," Bernsten said. "It's not your publications. It's not the classes you teach. It's seeing your students go on to do amazing things that impact a lot of people. We don't always get the perfect result with our research, but we take what we've learned and apply it to the next project. It's a valuable teaching tool, and it helps us get better as researchers." ❖

Paying it FORWARD

Upper left:
Matt Berry stands among young plants

Upper right:
Osei-Bonsu tends young bean plants

Middle right:
Graduate student Princess Adjei-Frimpong

Lower right:
David DeYoung

Lower left:
Gerardine Mukeshimana in Rwanda

Middle left:
Rosemary Bulyaba in the field

BY JAMES DAU, STAFF WRITER

Paying it FORWARD:

Taking legume learnings from MSU to other countries

WHEN HE ARRIVED AT MICHIGAN STATE UNIVERSITY (MSU) FROM HIS HOME IN KUMASI, GHANA, ISAAC OSEI-BONSU ALREADY HAD TWO DEGREES IN PLANT SCIENCE AND A DECADE OF WORK EXPERIENCE IN A LAND WHERE 80 PERCENT OF THE POPULATION DEPENDS ON SOME FORM OF SUBSISTENCE FARMING FOR FOOD.

His training provided insight into the need for improved soil health and diversity of crops in a country where most agricultural production is not sufficient to meet local demand. Poor yields are brought on by low soil organic matter, low soil nitrogen and other nutrients, and limited access to chemical fertilizers and crop varieties resistant to drought, pests and disease.

"One of the main problems throughout Africa is poor soil health," Osei-Bonsu said. "Before coming to MSU, I was introduced to legumes as a research scientist because they fix nitrogen, putting it into the soil instead of taking it out, and I saw potential for them to help fix my country's soil nutrition problems."

Last year Osei-Bonsu was selected – one of five from a pool of 200 candidates – to join the Legume Scholars program, a partnership between the Consultative Group for International Agricultural Research's Research Program on Grain Legumes, the Peanut Productivity and Mycotoxin Control Innovation Lab at the University of Georgia, and the Legume Innovation Lab (LIL) at MSU. The program provides graduate fellowships for students from developing countries to study legumes at leading universities in the United States.

"The program is a great opportunity to further my knowledge and expertise in the area of legumes," Osei-Bonsu said. "I want to find effective solutions to the problems our farmers face, and this is how I can accomplish that."

Osei-Bonsu joined the lab of David Kramer, Hannah distinguished professor in photosynthesis and bioenergetics in the MSU-Department of Energy Plant Research Laboratories, to study photosynthesis in legumes. Kramer's lab is a leading voice in photosynthesis research through its pioneering PhotosynQ project, a worldwide network of researchers and citizen scientists collecting a wide range of plant health data. For Osei-Bonsu, this opportunity provides access to one of the world's best databases on photosynthesis under various climatic and soil conditions.

Photosynthesis forms the basis of numerous essential plant processes, so ensuring its functioning at optimal levels is a critical component to producing a resilient, high-yielding legume crop. Osei-Bonsu is searching for the mechanisms that regulate the process within the plant and how environmental variables such as drought and/or high temperatures affect it. He said he hopes the results will help usher in a new era of legume agriculture.

"Understanding how photosynthesis works and how to improve it in legumes means better production, better food security, better nutrition and healthier soil for everyone," he said.

LEGUME SCHOLARS AND GLOBAL BENEFITS

Each applicant to the Legume Scholars program brings his or her variant of Osei-Bonsu's story. Connecting bright young scientists with the cutting-edge resources and training available from American universities to help developing nations solve these issues is at the heart of the program.

"By 2050, the world will need to feed an additional 2 billion people," said Cynthia Donovan, deputy director of the LIL and professor in the MSU Department of Agricultural, Food and Resource Economics (AFRE). "That sort of challenge requires the best and brightest ideas in agricultural science and getting them into the hands of the people who can use them best."

Each student selected for the program receives full tuition for a master's or Ph.D. program, as well as opportunities for lab and field experience and professional development workshops.

Rosemary Bulyaba was born in Kampala, the largest city in Uganda, but became familiar with the challenges that her country's farmers face during an internship in the Kamuli district, an agriculture-heavy rural region in the eastern part of the country. At the time, she was studying agribusiness for her undergraduate degree at Makerere University. Her internship involved working with schools and farmers to provide healthy meals for students, and it was there she learned of the health and economic benefits of legumes for communities.

"We were working with primary schools to make sure they had lunches so that students had something to eat before they went home in the evening," Bulyaba said. "Legumes, high in protein, offer great nutrition and a more diverse diet for children, who are often malnourished."

Wanting to make this important crop group more widely available at home, Bulyaba joined the Legume Scholars program and is now pursuing a Ph.D. at Iowa State University and working to find better ways to grow cowpeas and common beans in Uganda. "There's so much research being done here in the United States — I want to bring that back home where we can apply this knowledge and expertise in the field, where it can help people who are struggling."

SENDING SPARTANS AROUND THE WORLD

Many students from the developing world come to MSU to study legumes; many others take the expertise they acquire at MSU abroad.

Matt Berry, a Ph.D. student and Indiana native working in the lab of Karen Cichy, adjunct assistant professor in the MSU Department of Plant, Soil and Microbial Sciences, is spending the summer in Tanzania through a graduate research grant from the U.S. Borlaug Fellows in Global Food Security Program. He is applying his knowledge of plant genetics toward discovering what areas of the genome are responsible for the fast-cooking trait observed in beans. He presented a poster on his work during the Joint Pan-African Grain Legume and World Cowpea Research Conference in Zambia in March.

"I've wanted to work with beans since I was an undergrad student," Berry said. "Beans are very nutritious, but even after soaking in water for up to 12 hours, they can still take another hour or more to cook. I'm trying to decrease the cooking time through plant breeding."

In a region of the world where most in-home cooking is done atop wood-burning fires, which take time and energy to start, shorter cook time is a much-desired trait. By reducing cooking time, Berry hopes to make beans an easier, more time- and cost-effective dietary choice.

MANY STUDENTS FROM THE DEVELOPING WORLD COME TO MSU TO STUDY LEGUMES...

Though he grew up in Michigan, David DeYoung has been working in the developing world since 2007, when he was part of a non-governmental organization in Honduras during the world food price crisis. The turmoil saw food prices skyrocket and threaten food security in many countries. That experience motivated DeYoung to declare AFRE as his major. He participated in a project to bring improved bean cultivars to Haiti, Honduras, Guatemala and Nicaragua through the LIL.

"The project provided the opportunity to work with established community seed banks in Nicaragua," DeYoung said. "We studied what factors led to sustainability in seed banks and passed that information back to them."

DeYoung graduated from MSU in December but has continued studying farmers' access to improved seed varieties in Haiti and parts of Asia as an MSU Extension specialist.

"On a personal level, my time in the field in Latin America reinforced to me the value of working directly with farmers," DeYoung said. "Talking with local seed experts and farmers was the best way to learn about the specific challenges they face on both the production and marketing sides, as well as how we could best help meet them."

THE FUTURE OF LEGUME SCIENCE IN DEVELOPED & DEVELOPING COUNTRIES

Through MSU's many research endeavors, facilitated by labs and programs across the university, the next generation of legume scientists is training to tackle agricultural, environmental and economic challenges around the world. The knowledge that they generate will have many applications, from increased yield to better nutrition, healthier soil and greater food security, and the beneficiaries of their work will be growers and consumers throughout developed and developing countries alike.

"The implications of our work are numerous — improving air quality in homes, reducing fuel consumption, saving time and improving nutrition," Berry said. "These are important advances in the developing world, but anyone who cooks beans will benefit, no matter where they are."

The training and research opportunities available through MSU play an important role in helping young scientists acquire the knowledge and expertise they need to make these breakthroughs.

"As we make legume varieties better and more available to farmers, they'll benefit from higher yields, more income, more food and healthier soils — all things we need back home," Osei-Bonsu said. "The benefits to farmers could be great, and I want to help them find that." ❖

BATTLING INSECTS

KEEPING PESKY POD BORER, BEAN WEEVIL AT BAY

• BY CAMERON RUDOLPH, STAFF WRITER •

INSECT INFESTATION, BOTH IN THE FIELD AND AFTER HARVEST, IS A MAJOR THREAT TO LEGUME CROPS. STORAGE TO THWART POSTHARVEST LOSSES HAS BEEN THE FOCUS OF MUCH RESEARCH, RANGING FROM TESTING VARIOUS TYPES OF CONTAINERS TO USING MOTION AS A PEST DETERRENT.

A 1991 paper published in Nature by MSU entomology professor James Miller and two graduate students, Martha Quentin and Joseph Spencer, recommended that farmers in sub-Saharan Africa use 50 to 75 percent-filled cylindrical containers to store beans and rotate them one full rotation twice a day. The tumbling prevented bean weevils from boring into the beans, an activity that typically takes 24 hours. Unable to establish a position to bore, the weevils become exhausted and eventually die. The research resulted in lowering bean weevil populations by 97 percent compared to non-movement controls.

It was the first study to examine motion as a pest control. The downside: it wasn't a feasible option for large-scale farms due to the time and labor. To have a profound impact on large operations, the containers in which crops are stored needed to be evaluated.

Larry Murdock, a distinguished professor of entomology at Purdue University, has been studying pest management in Africa since 1987. He and his team developed a triple-layer plastic bag that protects cowpeas from weevils and other insects with funding from the Legume Innovation Laboratory (LIL), known as the Purdue Improved Crop Storage (PICS) project. The layers are individually sealed to form an airtight container.

Researchers also analyzed the bag's efficacy with other crops, including common bean, maize, pigeon pea and many others. The project, now headed by Dieudonné Baributsa, a research associate professor of entomology at Purdue, also examined the bags ability to prevent mold and preserve seed viability for planting. Results were promising and economic research showed that the bags could be a cost-effective practice for African farmers, moving the project into a third stage. PICS3, as the program is known today, functions with funding from the Bill and Melinda Gates Foundation. Its mission is to expand food security, market access and cash incomes for farmers through increasing the bag's implementation in the targeted countries of Burkina Faso, Ethiopia, Ghana, Malawi, Nigeria, Tanzania and Uganda. The goal is to promote a local supply chain by pinpointing manufacturers and distributors. Additionally, with the assistance of international research and extension entities, as well as nongovernmental organizations (NGOs), demonstrations of the bag's effectiveness are delivered to growers throughout the region.

"Postharvest storage loss of legume crops is a major challenge among smallholder farmers," Baributsa said. "PICS bags improve income, food security and nutrition by reducing storage loss. By 2015, PICS demonstration activities reached more than 3 million farmers in at least 46,000 villages. About 7 million bags have been sold by more than 15 licensed manufacturers and distributors in Africa and Asia."

Barry Pittendrigh (left) inspecting cowpea plants for infestation. Without appropriate treatment, larvae can ravish an entire crop in short order.

Initially funded by the Bean/Cowpea Collaborative Research Support Program at Michigan State University, the PICS project has distributed thousands of bags to farmers across Africa to protect their crops in storage. The initiative is led by Dieudonné Baributsa, a research associate professor at Purdue University. *Photo courtesy of Antoine Waongo, INERA Burkina Faso.*

BRINGING IT ALL TOGETHER

Millions of people around the world rely on cowpeas as a fundamental component of the daily diet. Grown in warm climates such as Africa, South Asia, Central America and South America, they are tolerant to drought and can thrive in poor soil conditions. The rich nutrient profile consists of vitamins, minerals and protein, making cowpeas an important food source for many who can't afford meat.

The significance of this crop is intensified considering the lack of access to food in many developing countries, so protecting what is produced is crucial. Despite the cowpea's hardiness, it faces its share of biotic dangers. Pests and diseases can drastically reduce yields when not properly managed. Scientists from U.S. universities and international institutions have been working for decades to mitigate these risks and bring food security to countries in desperate need of a stable food supply.

The legume pod borer is the primary pest of cowpeas in the field, decimating up to 90 percent of some farmers' yields. Also referred to as *Maruca vitrata*, the legume pod borer lays eggs on the flowers of legume plants. Larvae feed on the flowers before moving to pods. Without appropriate treatment, larvae can ravish an entire crop in short order. The pod borer can be controlled with insecticides, but they are expensive, not easily accessible to resource-poor farmers, and continuous use results in the advancement of resistance in target pests.

Whether it's deploying groundbreaking storage bags or biotechnology, equipping developing nations with new infrastructure to fight pests requires capacity building. MSU is committed to offering educational services, consultation and expertise through the World Technology Access Program (WorldTAP).

Trainings on integrated pest management, biotechnology, food safety, intellectual property rights and more are available. Partnering with local institutions in Africa, WorldTAP seeks to connect growers with solutions. For cowpea farmers, the introduction of a disease- and pest-resistant variety could transform their operations.

An international team of scientists from the African Agricultural Technology Foundation (AATF), in collaboration with local researchers in Africa and advanced laboratories, is working to cultivate cowpea varieties that have built-in insect protection through the use of a gene from bacteria (Bt gene). The Bt gene produces a protein that interferes with the digestive system of legume pod borers, but it is specific to pod borers and safe for all other organisms, including beneficial insects, humans and animals.

"We help to introduce practical, sustainable technologies to farmers in Africa who may not otherwise have access to them," said Denis Kyetere, the executive director of AATF. "Through our partnerships, we can develop and deliver technology such as Bt

cowpea that improves crop yields. This is one component of a larger integrated pest management (IPM) plan. MSU and other institutions assist in educating the public about IPM and what it can do to boost productivity."

Bt cowpea lines have been tested in confined field trials in Burkina Faso, Ghana, Malawi and Nigeria, showing promising results. These varieties are expected to reach smallholder farmers in the next five years. Kyetere was among several who visited MSU in May to attend a conference for the university's new Alliance for African Partnerships initiative. The Alliance encourages research innovation and collaboration, while expanding MSU's portfolio of work in Africa.

"Capacity building is extremely important because we want to create sustainable systems in these countries, for pest management and much more," said Karim Maredia, an MSU entomology professor and program director of WorldTAP. "Training and education are a necessity, and we need to develop and present a range of options to farmers. Biotechnology is just one tool in the toolbox. We are looking to develop a package of strategies that will work long into the future. That means we need experts from all disciplines to weigh in."

The LIL backs numerous capacity building projects, including a cowpea pest initiative run by Barry Pittendrigh, an endowed chair in Insect Toxicology at the University of Illinois (UI), who will join the MSU faculty in August as an MSU Foundation Professor in the Department of Entomology.

His research aims to provide growers in Benin, Burkina Faso, Ghana and Niger with tactics that consider cost, human health and environmental impact. Many local producers live on less than $2 per day, so management improvements need to make sense economically. Pittendrigh along with Julia Bello-Bravo — assistant director of the Center for African Studies at UI — and international scientists have generated "IPM-omics." The project incorporates genomics and geographic information systems technology into integrated pest management.

Pittendrigh's group has conducted field studies that define pest populations in the region for legume pod borer and other insects. Traditional methods such as spraying neem oil, which has been used as a natural pesticide for hundreds of years, have been explored. Biocontrol tests with a wasp that preys on the legume pod borer are also underway.

"Cowpea is a staple for millions of people and an important source of protein," Pittendrigh said. "It needs to be protected in ways that are feasible to local farmers. We have worked with Manuele Tamò (insect ecologist at the International Institute of Tropical Agriculture in Benin) on the development and release of biocontrol agents and with our host country scientists on local solutions that can be taught to farmers. But it all comes down to sustainability and making sure that we give a full range of IPM strategies for farmers to choose from."

Once management plans are created, dissemination can be a substantial challenge that requires a network of organizations. The research team is working with NGOs and Scientific Animations Without Borders (SAWBO), a program cofounded by Bello-Bravo and Pittendrigh. SAWBO conveys scientific and extension information through two- and three-dimensional animations that are accessible in several languages and free of charge. For cell phones and tablets, a free SAWBO app is available. A Nigerian television station has aired some of the animations, prompting Pittendrigh to scout elsewhere for similar opportunities.

"The research is needed to provide scientifically-sound solutions, but it doesn't mean much if we can't get it into the hands of the farmers," Pittendrigh said. "SAWBO helps us connect with both local educators and end users through mobile devices, such as cell phones and in some cases through computers and television. The availability of these devices is increasing significantly in developing countries. The more platforms where SAWBO animations are used, the better chances that it can positively influence a greater number of people." ❖

Getting to Know Barry Pittendrigh, PhD

MSU Foundation Professor; Department of Entomology

Most recent position:
C.W. Kearns, C.L. Metcalf and W.P. Flint Endowed Chair in Insect Toxicology; University of Illinois

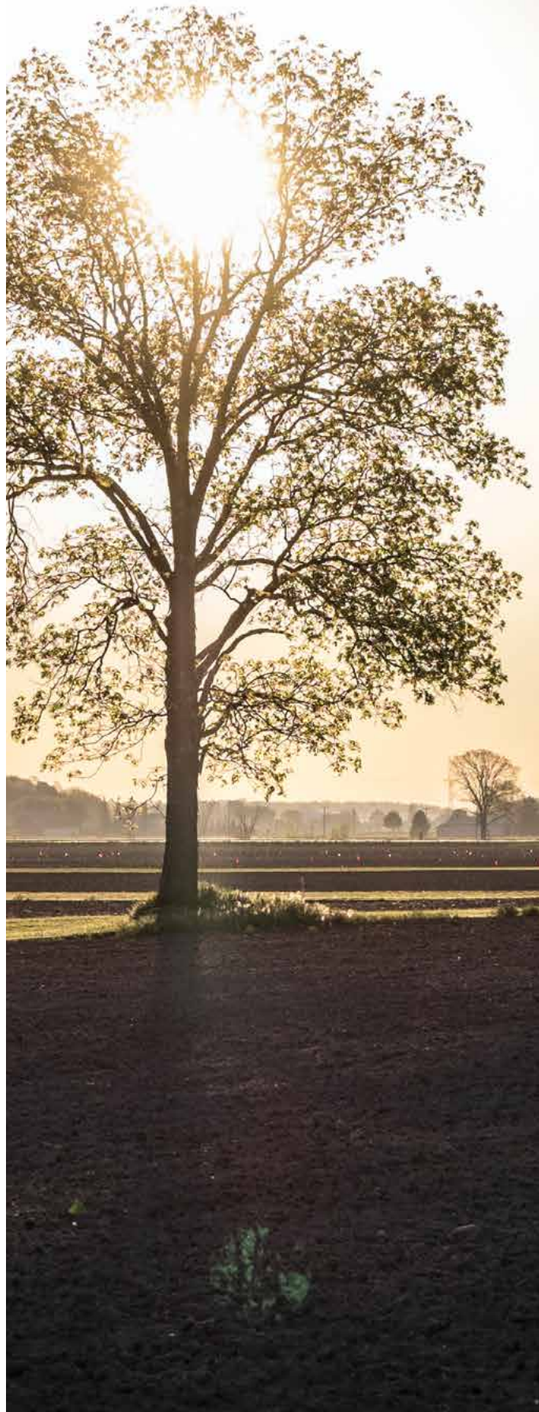
Education:
Max Planck Post-Doctoral Fellow; Max Planck Institute for Chemical Ecology, Germany

Ph.D.
Entomology; University of Wisconsin-Madison

M.S.
Entomology; Purdue University

B.Sc.
Biology; University of Regina, Canada

Why MSU?:
"The Legume Innovation Lab has been a wonderful mechanism to showcase MSU's expertise in international research and development, a strength that attracted me to continue my career there."



MSU HISTORY CONTINUES STRONG

IN SAGINAW VALLEY AND THUMB REGIONS

In 1901, Ab Stoutenburg started his family farm growing dry beans, sugar beets and other crops on 80 acres of land near the outskirts of Sandusky in Michigan's Thumb region. Today, 115 years and three generations later, the farm has grown to more than 1,000 acres. The road leading to the farm now bears the family name, and Clint Stoutenburg — Ab's great-grandson — carries on the family business.

BY JAMES DAU, STAFF WRITER

A new Agricultural Education Center at the Saginaw Valley Research and Extension Center in Frankenmuth opened this summer with more than $1 million of funds raised by the industry.

The Stoutenburgs have been heavily involved with the industry over the years. Clint's father, Al, sat on the board of the Croswell Beet Growers Association. And Clint himself, once chair of the Michigan Bean Commission, continues to sit on the commission's research and promotion board. He also is on the U.S. Dry Bean Council's executive committee.

Clint believes that research is the major reason for the Michigan dry bean industry's prosperity and competitiveness nationally and internationally. Much of this work is conducted at the Michigan State University (MSU) Saginaw Valley Research and Extension Center (SVREC), situated northeast of Frankenmuth in the heart of the state's dry bean and sugar beet region.

"The technology that has been tested by the scientists at the research center – we use it every day in the field," Stoutenburg said. "Whether they're different bean varieties, seed treatments, chemicals or harvest equipment, they're all things that we need. That we rely on."

Michigan ranks as the largest producer of black beans in the nation and second largest for all dry beans behind only North Dakota. In 2014, Michigan farms produced nearly 327 million pounds of dry beans, valued at over $139 million.

A LEGACY OF IMPACT THROUGH RESEARCH

Dry beans are known as a difficult-to-grow, high-risk crop. They require very specific growing conditions: temperatures between 64 and 75 degrees Fahrenheit and 20 to 25 inches of rainfall during the growing season. Consequently, most of Michigan bean production occurs in the Thumb and Saginaw Valley regions of the state.

SVREC was founded in 1971 on a 120-acre farm near Saginaw. The land was a joint purchase between the Michigan Sugar Company, the Michigan Bean Commission and the Michigan Bean Shippers Association. In 2008, it moved to its present location near Frankenmuth after the MSU Land Management Office purchased a 250-acre farm to increase research capacity. In addition to sugar beets and dry beans, SVREC scientists assist Michigan corn, wheat and soybean growers.

"Specialty crop industries such as dry beans don't have the resources that larger crops, like corn, have in the private sector," said Joe Cramer, executive director of the Michigan Bean Commission. "We rely on the university to provide the research that keeps cutting-edge technology in the hands of our farmers."

Much of that technology takes the form of improved crop varieties. MSU is home to one of the world's leading dry bean breeding programs under the stewardship of James Kelly, University Distinguished Professor in the Department of Plant, Soil and Microbial Sciences. Since 1982, Kelly's lab has produced 47 dry bean cultivars, many of which are grown widely throughout the state, the nation and the world. SVREC has served as the test site for the vast majority of them.

Paul Horny, SVREC coordinator for the past 32 years, has seen firsthand the positive impact that dry bean research has had on Michigan farmers.

"Without the research support we provide, farmers would have to test these new varieties themselves, risking large acreages and potential losses," Horny said. "Here at the center, we can screw up so they don't have to. About 95 percent of the varieties fail, and most farmers couldn't afford that."

In a given year, the SVREC researchers test approximately 2,000 potential varieties, paring that down over the course of two to three years and numerous trials until a new cultivar emerges superior in some way — whether in yield, canning quality or disease resistance — to those that came before.

"Farmers don't see some diseases, like dry edible bean rust, in the field much anymore because of the improved varieties we've developed," Horny said. "We're now working on doing that for other major diseases, such as white mold and common blight."

Greg Varner, research director for the Michigan Bean Commission and Michigan Bean Shippers, is responsible for coordinating the Michigan dry bean industry's research efforts and communicating goals with scientists. Working closely with Kelly and Horny, Varner plants the potential varieties that show the most promise in test plots to observe performance under practical conditions.

"You can't duplicate everything that you'll run into on a farm," Varner said. "We get better statistical data at the research center because of the greater control we have there, but taking the varieties to test on farms allows us to extrapolate that, as well as get them into the hands of growers so they can see whether the new varieties are relevant to their needs."

Steady, consistent development of technologies at SVREC has yielded real, practical advances for people like Greg Ackerman, a fourth-generation dry bean farmer and member of the Michigan Bean Commission from Vassar, Michigan. Ackerman recalls the state of the industry a decade ago, when nearly all dry beans were harvested by windrowing – a time-consuming practice of pulling crops and allowing them to dry in the field before gathering and bundling. Today, the dry bean harvest looks much different, thanks to SVREC advancements.

IT'S THE PERFECT PLACE — IN THE PERFECT LOCATION

"We can directly harvest beans in the field now, and that's all thanks to new technology from the research center," Ackerman said. "A few people tried it earlier, but none of them did it right. It doesn't work unless you have the right equipment and varieties, and the scientists at the center found the right combination to make it work."

A CONTINUING PARTNERSHIP

The close relationship between the Michigan dry bean industry and SVREC researchers has yielded a rich body of practical knowledge and a partnership that will continue to serve the needs of Michigan agriculture into the future.

Last year, Michigan's dry bean and sugar beet industries collected $1 million in donations to build a new 11,000-square-foot Agricultural Education Center at SVREC. The new facility, home to a 250-person meeting room, a 50-person classroom, on-site offices and multipurpose reception space will be a key hub for industry, research and outreach.

For Stoutenburg, that means a better equipped, more informed future generation of Michigan dry bean growers. He envisions a day when MSU instructors will be able to hold classes for students from the area, whether in person or through digital communication.

"One of the main functions of the research center is to keep education easily accessible for everyone," Stoutenburg said. "Not every kid on a farm in Michigan is going to be able to go to MSU to take college courses. But if we make courses available close enough to home, we could reach more people than ever before. To me, that's really important, and that's why our farm contributed to funding the new facility."

The new facility is central to Horny's vision for SVREC. He said opportunities to host training workshops, industry gatherings and conventions, 4-H events and Master Gardener courses are just some of the possibilities.

"The industry came together and raised the money for the facility, and they've given us this great opportunity to improve our ability to work with and educate farmers at all levels," Horny said.

"My goal is to provide people with as many ways to reach people as possible, whether that means providing space for in-person meetings and courses or the technology for distance learning and digital communication."

The new facility is another step in a long history of cooperation.

"An industry that doesn't invest in research will stagnate and ultimately disappear," Horny said. "Our partnership with the dry bean industry in Michigan has helped the crop group remain not only competitive but a leader in the nation. And we're going to continue that work."

Like so many other things, that is a sentiment echoed by the farmers.

"The Saginaw Valley research center isn't just a facility for MSU faculty and students," Stoutenburg said. "It's an agricultural research facility that we're lucky to have right here in our own backyard. It's the perfect place, it's in the perfect location, and it has everything we need to keep going and keep farming." ❖

By Marguerite Halversen,
Contributing Writer

Improving grain legume production with new ag technology

BEANS ARE AN IMPORTANT LEGUME CROP IN ZAMBIA, WHERE 60 PERCENT OF THE POPULATION LIVES IN POVERTY AND MORE THAN 350,000 SUFFER FROM FOOD INSECURITY. UNFORTUNATELY, BEAN PRODUCTION IN THIS AFRICAN COUNTRY IS SEVERELY LIMITED BY DISEASES, INSECTS, LOW SOIL FERTILITY AND DROUGHT. AND NATIONAL BEAN HARVESTS OF 300 TO 500 KILOGRAMS PER HECTARE EACH YEAR FALL SHORT BY MORE THAN 2 MILLION POUNDS.

David Kramer, Michigan State University (MSU) Hannah Distinguished Professor in Photosynthesis and Bioenergetics, and the 2016 Charles F. Kettering Award recipient for excellence in the field of photosynthesis, said countries like Zambia (ranked 164 out of 184 countries on the Human Poverty Index), cannot wait years for traditional plant breeding.

"There is an urgent need to develop highly productive, robust and sustainable bean crops — and the urgency is only increasing as climate change continues to impact farming systems and plant production negatively each successive season," he said. "In short, we need to think about improving beans in new ways, and we need the tools to dramatically accelerate the processes."

Kramer and colleague Kelvin Kamfwa at the University of Zambia have teamed up in a three-year project funded by the MSU-managed Feed the Future Legume Innovation Lab to accelerate improvements in the robustness and efficiency of photosynthesis. They started by identifying hurdles that limit plant improvement in Africa and working with the MSU Center for Advanced Algal and Plant Phenotyping (CAAPP, which is run by Kramer) to develop new technologies to overcome them.

One factor limiting crop productivity is photosynthesis—the process by which plants capture solar energy to generate food and energy for growth and development. Ultimately, any increases in yield depend—directly or indirectly—on photosynthesis. Low photosynthetic efficiency in Zambia, which is highly sensitive to biotic and abiotic stresses, severely constrains grain legume production.

"Plant breeders have been really effective at targeting certain kinds of traits, like disease resistance or plant architecture, but we really haven't touched the core processes of photosynthesis," said Kamfwa.

This means that the solar energy input into the plant has remained constant or, in some cases, even decreased, over the past century. But there are additional reasons for improving photosynthesis.

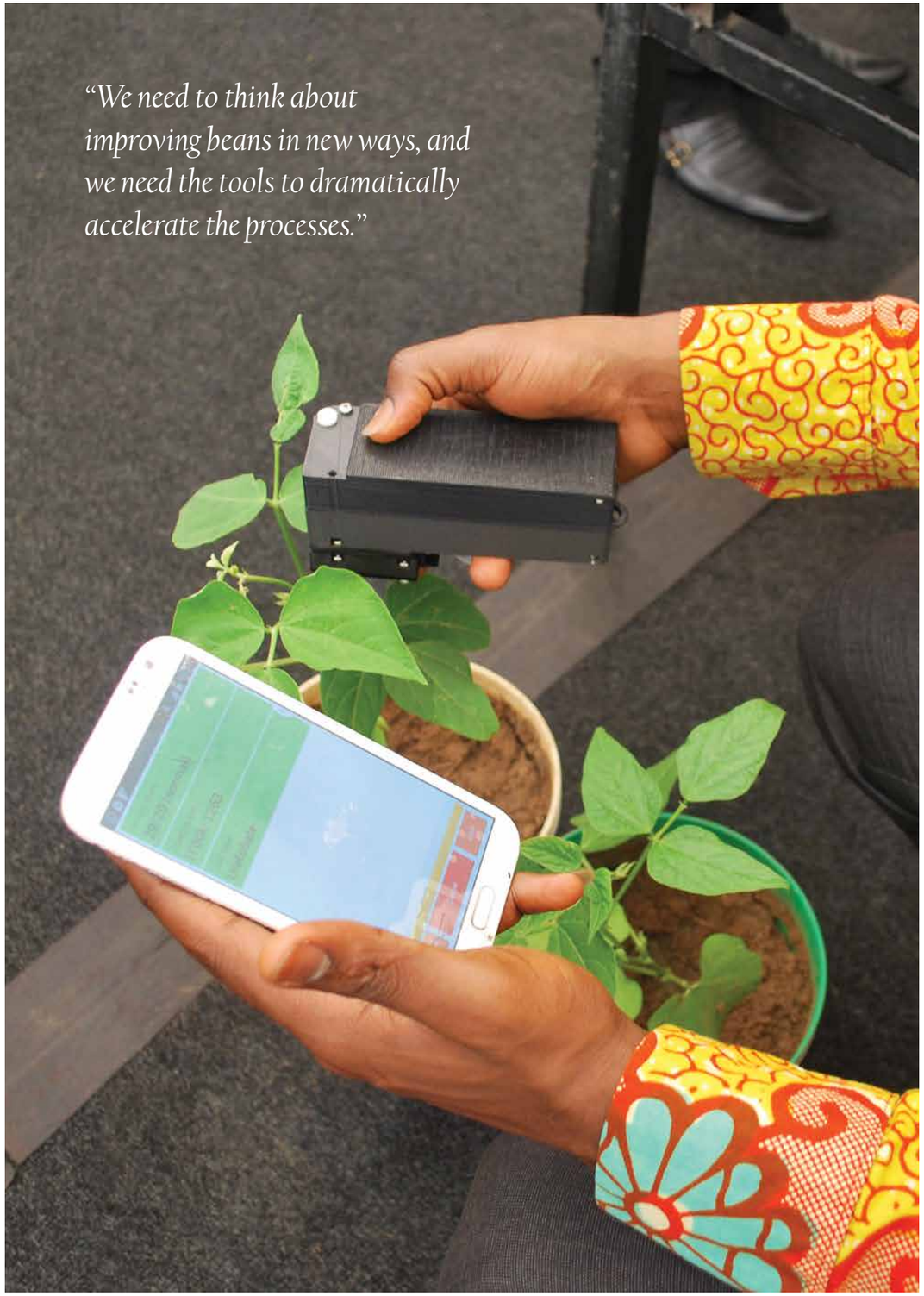
"In addition to its importance for plant energy, photosynthesis is an excellent way to probe plant health," said Kramer. "Photosynthesis must be extremely well controlled to avoid toxic byproducts, especially when the plant is under environmental stresses. Consequently, a lot of information about the health of a plant can be learned measuring photosynthetic reactions. It's like a window into the workings of plant."

Kramer's lab has developed a series of new tools that gauge living plants in the field and measure photosynthesis in real time. Using these tools, they found signals that could be used to indicate how efficient photosynthesis is, whether the plant is productive or if it's under stress, losing energy or being damaged.

But Kramer believes this emerging technology could be made even better.

"To really map genes so we can breed better plants," said Kramer. "We need to observe photosynthesis on many plants, under varying conditions—and then analyze the data. Plants, which are particularly sensitive to their environments, must be measured under the conditions in which they are actually grown. It's a massive undertaking."

The photosynthesis project is harnessing two new phenotyping technologies developed at MSU. One of these, the PhotosynQ platform (www.photosynq.org), allows researchers, farmers and extension agents throughout the world access to sophisticated yet very inexpensive and easy-to-use instruments to measure reactions related to photosynthesis. This field-deployable network of handheld sensors and associated online communication and analysis tools enable researchers and farmers to conduct plant phenotyping experiments, analyze data and share results, and allow improvements in breeding and management on local and global scales.



David Kramer's lab has developed new tools that gauge living plants in the field and measure photosynthesis in real time.

"With these tools, we are now able to monitor many photosynthesis reactions in crops in multiple environments under natural conditions," said Dan TerAvest, a post-doc in Kramer's plant research lab. "Among the measurements we need to obtain in developing a stronger germplasm is photosynthesis regulation."

The second platform called Dynamic Environmental Phenotyping Imager (DEPI) simulates field conditions in special chambers so that sophisticated imaging sensors from Kramer's lab can probe a myriad of plant processes and properties. For example, DEPI can measure how sensitive photosynthesis, growth, etc. are to specific weather conditions.

Developing DEPI and the PhotosynQ platform has been a major part of this project. With these technologies now available, distribution along with training and use of them has now shifted to the forefront. The goal of improving the robustness and efficiency of photosynthesis to accelerate the breeding efforts to improve grain legumes and germplasm can soon be explored.

Kramer's team has provided six handheld PhotosynQ MultispeQ units to Kamfwa's team to initiate the project's first field trials. They will study a gene platform in common bean plants that confer better performance under Zambian environmental stresses, looking for more resilient and productive traits.

"The key limiting factor of plant breeding is determining phenotypes, that is, the performance levels of particular traits in the field," said Kramer. "The technology we've developed determines which phenotypes are contributing to good or bad yield outcomes. We can map genes, but we don't know what the genes do. The MultiSpeQ and PhotosynQ can tell us that—and Kelvin is using the technology to that end in Zambia as part of his work to improve bean germplasm for better yields."

Using the MultispeQ and PhotosynQ, Kamfwa and his team in Zambia are beginning to develop rapid bean phenotyping protocols. Kamfwa's undergraduate and graduate students are using the PhotosynQ platform to find genes that let photosynthesis work more efficiently under combinations of agricultural limitations experienced in the region, including drought (and lack of irrigation), low soil nutrients (and the high cost of fertilizers in Africa) and various diseases.

Meanwhile in East Lansing, MSU graduate students Isaac Osei-Bonsu and DongHee Hoh are using both the DEPI and PhotosynQ platforms to identify factors that allow beans and cowpeas to perform better under extreme temperature changes, a major hindrance worldwide of these crops.

Ultimately, the technological results will determine which cowpea and bean lines are most promising for breeding germplasm to achieve optimal grain legume yields in Zambia.

Kramer has just recently expanded this technology network into Malawi at three different research stations, where six researchers from Malawi's Department of Agricultural Research Services are collecting data for 15 different projects on various plants and cropping systems studies. ❖

BY CAMERON RUDOLPH,
STAFF WRITER

PREVENTING MALNUTRITION

MSU scientist looking at fatty acids to stop stunting, poor cognitive development

An expert on human nutrition at Michigan State University (MSU), Jenifer Fenton knows the harsh consequences of malnutrition. Some of her ongoing work is in Africa, a continent where 40 percent of children are stunted and nearly 20 percent are underweight, and more than half of the deaths are from nutrition-related illnesses. The effects of poor access to food, especially nutrient-rich foods, are devastatingly apparent throughout this expansive continent.

Fenton, an associate professor in the Department of Food Science and Human Nutrition, said that there is an abundance of research in developing countries examining the impacts of iron deficiency and carbohydrates, but not much has been done on essential fatty acids. These are necessary fats that are not naturally produced in the body.

"We did some background work and found that very few people are studying whether children in developing countries are deficient in essential fatty acids," she said. "Those are fatty acids that are not synthesized by the body. We can't make linoleic acid, an omega-6 fatty acid, and alpha-linolenic acid an omega-3 fatty acid. Those have to be consumed."

When an opportunity arose to participate in a collaborative human nutrition research project on fatty acids in Tanzania, an African coastal country of more than 50 million, Fenton quickly threw in her cap.

A WORLDWIDE REACH

With a passion for health and problem solving and a plan to go on to veterinary school, Fenton acquired her bachelor's degree in animal science. But a study examining how calorie-restricted diets influence reproduction in livestock prompted her to change from medicine to nutrition.

She received both her master's degree and doctorate in animal science with an emphasis on nutrition. Eighteen months of postdoctoral research work later, she was accepted into the prestigious Cancer Prevention Fellowship Program at the National Cancer Institute, where she also obtained a master's degree in public health.

Shortly after joining MSU as a faculty member, Fenton built connections with colleagues at the Innovative Agricultural Research Initiative (iAGRI), a U.S. Agency for International Development-funded program exclusively operating in Tanzania. Managed by the Ohio State University, iAGRI is a partnership among Tanzanian institutions, food security cooperatives and six U.S. land-grant universities, including MSU. Through the program Fenton met Theresia Jumbe, an iAGRI student from Tanzania interested in nutrition.

Not long after, Jumbe began to pursue her doctorate at MSU under Fenton's guidance. Together, they embarked on a project to explore the role of essential fatty acids in growth and cognitive development of 2- to 6-year-old children in the village of Rudewa Mbuyuni in Kilosa, Tanzania. To get a baseline of essential fatty acid

Theresia Jumbe takes baseline measurements of children involved in the Tanzanian studies

ONE OF THE REASONS THIS RESEARCH IS UNIQUE IS THAT IT'S MORE CHALLENGING FROM A TECHNICAL STANDPOINT THAN WORK ON OTHER HEALTH PROBLEMS — THE WORK IS TIME CONSUMING & EXPENSIVE

levels, blood samples had to be gathered from the 334 children in the study.

Using a finger prick, the researchers collected a drop of blood from each child on an antioxidant-treated card. The cards were sent back to the United States and examined by William Harris, a professor of medicine at the University of South Dakota.

"One of the reasons this research is unique is that it's more challenging from a technical standpoint than work on other health problems," Fenton said. "The equipment used in gas chromatography analysis is expensive, and the work is time-consuming relative to some of the other routine blood measurements, so we're especially thankful to Dr. Harris."

Results showed that more than 23 percent of the children were experiencing preclinical essential fatty acid deficiency, more than 30 percent were stunted and 13 percent were underweight – all according to World Health Organization standards.

Matthew Pontifex, an assistant professor in the MSU Department of Kinesiology, was then tapped to assess the cognitive skills of each child in the study. An expert in neurocognitive kinesiology, Pontifex helped the team employ a method called the dimensional change card sort test, a tool that measures brain functioning.

Children were asked to sort a set of cards according to specific criteria. As the test advances, the difficulty increases. Researchers determined that children who had higher whole blood levels of essential fatty acids were three to seven times more likely to successfully complete all tasks than those with lower whole blood essential fatty acid levels.

"Tanzanian diets are mainly starchy and cereal-based, with the intake of fats below recommended levels," Jumbe said. "Tanzania is home to several seeds, nuts and oils, but the fatty acid profiles and mineral levels of these foods are poorly described."

Much of the fats and oils in American diets come from animal foods and refined oils, which are expensive compared with plant-based ones. Though Fenton and Jumbe did not perform a thorough diet analysis of individuals in the village, they conducted surveys to determine the most common foods. The research group found that pumpkin seeds, soybeans and various oils – common to the region — could provide the needed essential fatty acids. They intend to eventually provide residents with ways in which they can incorporate these types of foods into their diets.

Jenifer Fenton

After the completion of the initial stages of the project, Jumbe graduated with a doctorate in human nutrition from MSU. She is the first woman from the iAGRI program to earn a Ph.D. She now works on the faculty at Sokoine University of Agriculture in Tanzania.

A similar initiative is set to begin in Ghana this year led by Mary Adjepong, a student of the Borlaug Higher Education for Agricultural Research and Development program at MSU.

"Essential fatty acid deficiency is an obvious issue to most of us who do nutrition research," Fenton said. "Our hope is that, through the Tanzania findings and our next work in Ghana, we can show that this is a significant challenge that requires our attention."

Sarah Comstock, assistant professor in the MSU Department of Food Science and Human Nutrition; Eric Crawford, professor in the MSU Department of Agricultural, Food and Resource Economics; and Joyce Kinabo, associate professor at Sokoine University of Agriculture, also contributed to the Tanzania project. ❖

THREE recipes

RECIPES COURTESY OF MASFRIJOL

CEVICHE BEAN SALAD

INGREDIENTS

2 cups whole black beans
1 cucumber
2 tomatoes
1 onion
Juice of 4 limes
4 Tb. Worcestershire sauce
5 Tb. ketchup
Shrimp bouillon (available on Amazon)
1 cup Protemas (an unflavored textured soy protein; a substitute is available on Amazon)

DIRECTIONS

1. Cut the cucumber, tomatoes, and onion into small pieces.
2. Drain the beans.
3. Add shrimp bouillon to two cups boiling water and remove from heat. Add one cup of Protemas to the shrimp bouillon and let stand for 15 minutes; if the Protemas seem too dry, add a bit more water.
4. Transfer the Protemas to a medium-sized bowl; add the cucumbers, onions, and tomatoes and stir.
5. Add the ketchup, lemon juice, and Worcestershire sauce.

FRESH CORN TORTILLAS

INGREDIENTS

2 cups masa de maiz (corn meal)
1-1/4 cups of water
1 heaping teaspoon salt
From https://blog.unbou nd.org/2013/03/how-to-make-guatemalan-tortillas-recipe/

DIRECTIONS

1. Mix the masa de maiz (corn meal) with water and salt until they reach a play-dough-like consistency.
2. Shape a tablespoon-plus-sized portion of dough into a ball.
3. Flatten the dough by hand, forming it into a small circular shape (about 3.5 to 4 inches across). You can also use a rolling pin or a tortilla press.
4. Cook both sides of the tortilla in a pre-heated skillet over medium-high heat until golden brown.
5. Remove cooked tortilla from the skillet and place it in a basket or a covered dish to keep warm.
6. Prepare and cook the remaining tortillas.
7. Serve warm or use in another recipe.

STUFFED TORTILLAS

INGREDIENTS

2 cups black beans, mashed
1 bunch baby spinach
1.5 pounds masa de maiz (corn meal) dough (for making fresh tortillas; see recipe above)
Salt

DIRECTIONS

1. Clean and chop the spinach, then fold it into the tortilla dough; salt the mixture to taste.
2. To stuff a tortilla, form a golf-ball-sized portion of corn meal dough into a ball. Create a well in this ball and add 2 T. of beans; bring the sides of the tortilla up and around and slightly over the beans, then flatten into a small pancake, keeping the pocket in the center of the tortilla filled with beans. (Note: the outside [non bean-filled part of the tortilla] should be no more than 3/8-inch in diameter; most of the tortilla should be filled, giving it a small rise in the center.)
3. Lightly oil a griddle and cook the stuffed tortilla on each side, flipping it once to cook the dough and heat the beans inside it.
4. Serve warm.

Legume leader

...driven by passion to improve lives worldwide

It's difficult to believe that Irvin Widders, given his standing within the international legume community, hasn't always been professionally dedicated to this particular group of crops. The long-time director of the Legume Innovation Lab (LIL), Widders came to Michigan State University (MSU) in 1982 as an environmental plant physiologist in the Department of Horticulture. His research focused on the physiology of vegetable crops, primarily warm-season produce and pickling cucumber.

It wasn't until 1998 that he became the deputy director of the Bean/Cowpea Collaborative Research Support Program, now LIL. And in 2000, he was named director. The program has grown into one of the most influential of its kind in the world, thanks in large part to Widders' passion for improving livelihoods in developing countries.

"Access to food is probably the most fundamental need for every country," Widders said. "What we try to do is give farmers in these areas an affordable, sustainable way to both feed their own families and provide their markets with access to quality food."

LIL was one of many organizations that urged the United Nations to name 2016 the International Year of Pulses (IYP). One of 10 IYP signature events throughout the year took place from Feb. 28 to March 5 in Livingstone, Zambia: the Joint Pan-African Grain Legume and World Cowpea Conference. More than 520 participants from 46 countries attended the gathering, which focused on the sustainability of legume systems for food, income and nutritional security.

Widders was honored at the conference with two awards — recognition from the International Institute for Tropical Agriculture for his leadership to the global cowpea research community, and an award from the Technical Management Advisory Committee for leading the LIL and assisting with the organization of the conference.

"I couldn't imagine a better outcome for the event," he said. "I was very surprised and moved by the recognition I received. It was wonderful to see so many people from different countries attend a very important conference because an event of this magnitude doesn't happen without a lot of coordination among many organizations. We're thrilled that we could be a part of it." ❖

Name: Irvin Widders

Title: Director of the Legume Innovation Lab

Joined MSU: 1982

Education:
Bachelor's degree, horticulture, Penn State University

Master's degree, vegetable crop physiology, University of California, Davis

Ph.D., environmental physiology, University of California, Davis

Hometown:
Strasburg, Pennsylvania

Favorite food:
I love rice and beans, of course. I also love "pig stomach." It's a Pennsylvania Dutch dish, which consists of a pig's stomach stuffed with stuffing, sausage, potatoes and saffron.

Favorite song/group:
"Edelweiss" – The Sound of Music

Book I'd recommend:
Anything on history

Coolest gadget:
I'm not enamored with modern technology, but I love mechanical puzzles. I share these with students because it forces them to think outside the box for problem solving.

On my bucket list:
Visit the Great Wall of China

Person throughout history I'd most like to meet:
Nelson Mandela

Best trip/vacation:
Morocco and Vietnam

On a Saturday afternoon, you'll most likely find me:
Gardening

Research discovery I'd like to see: Expanding research on the use of crop diversity as a strategy to deal with climate change.

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CHANGE SERVICE REQUESTED

Facility Focus: Saginaw Valley Research & Extension Center

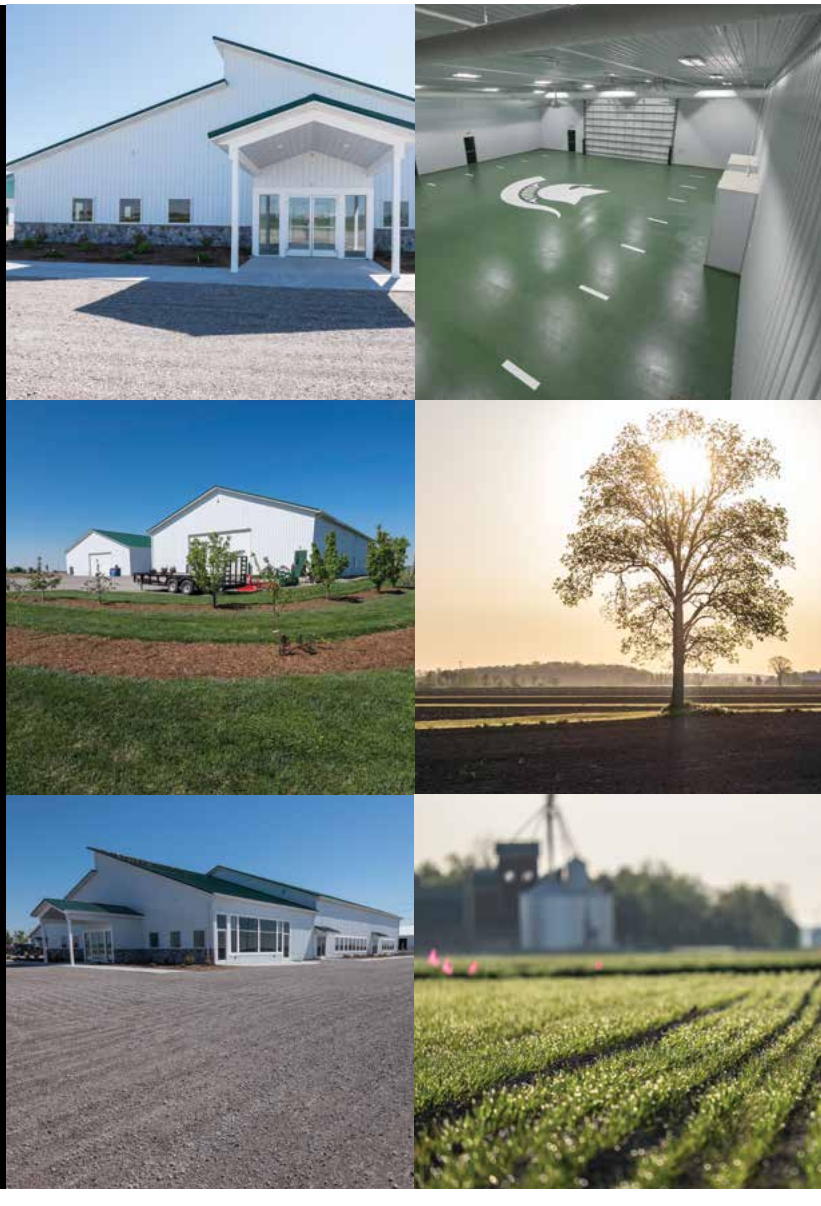
Nestled on 310 acres in the heart of Michigan's dry bean and sugar beet region, the Saginaw Valley Research and Extension Center (SVREC) provides research and outreach for growers of these and other economically important crops in the state.

Nationally, Michigan continues to be the No. 1 producer of black beans, the No. 2 producer of all dry beans and the No. 3 producer of sugar beets. SVREC scientists have helped advance crop varieties, tillage techniques, harvest technologies, and pest and disease management practices. Research also focuses on corn, wheat, soybeans and other important rotational crops.

"We take on the risk of developing new technologies so that farmers don't have to," said Paul Horny, SVREC coordinator.

A new 11,000-square-foot educational facility provides hands-on and distance learning training for farmers in the Saginaw Valley and Thumb regions of the state, and serves as a venue for a variety of demonstrations, industry meetings and events.

agbioresearch.msu.edu/centers/saginawvalley



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