

International Programs in Agriculture



IPIA

Annual Highlights
2014-2015

Message from the Director

University-based international programs are in transition, and Purdue International Programs in Agriculture (IPIA) is no exception. IPIA goals remain the same: help students understand the world they live in, support international efforts of faculty, and bring university research and outreach to those who can benefit from the innovations. But opportunities and constraints are changing. For example:

- Security is an overriding concern for travel to any part of the world, and even within the United States.
- More students want to combine education with service when they travel abroad. Purdue College of Agriculture responded in the 2014-2015 year with service learning courses in Romania, Haiti and Zambia.
- Public sector donor funding is increasingly competitive, and partnerships are ever more essential. IPIA helps faculty identify reliable international partners that share their interests and motivation.

- As economies grow in the developing world and budgets of donor countries tighten, public-private partnerships are becoming a more important channel for Purdue innovations to reach farmers, businesses and consumers in Africa, South Asia and Latin America.
- International donors are demanding professional project management. IPIA has a strong track record and a team of project managers that can help faculty, staff and students realize their international education, research and engagement goals.

The 2014-2015 Highlights is a record of Purdue international programs in agriculture activity over the past year. The print version is a brief summary. More detail is available online at our website (https://ag.purdue.edu/ipia/Pages/annual_highlights.aspx). We look forward to hearing from you.

Jess Lowenberg-DeBoer
Associate Dean and Director of
International Programs in Agriculture

International Programs in Agriculture Study Abroad

In 2014-15, 322 agriculture students participated in a study abroad experience. Forty-seven of those students studied abroad for one semester at partner institutions. More than 31% of our graduating undergraduates studied abroad prior to graduation. We welcomed 32 international exchange students for a semester or a year. Students studying at Purdue were from Brazil, Norway, Taiwan, Ireland, Costa Rica, Austria, Sweden, England, France, Australia, Denmark, and Wales.

We are grateful for the faculty members who led short-term summer study abroad courses: Dr. Steven Hallett and Dr. David Umulis to China, Dr. Scott Downey to Italy, Dr. Paul Ebner and Dr. Mark Russell to Romania, Dr. Tomas Hook and Dr. Douglass Jacobs and Dr. John Dunning to Sweden and Norway, and Dr. Kolapo Ajuwon to Zambia. Two new courses were offered: Dr. John Patterson and Sherry Fulk-Bringman



International Agriculture Ambassadors: Top row, from left: Tess Chamberlain, Abbey Amos, and Kelly Beeker. Bottom row: Baily Altman, Jim Vinyard, Jared Burke, Jacquelyn Brown, Whitney Blankenberger, Matthew Rodgers, and Melisa Galizio.

Telephone: 765-494-6876

FAX: 765-494-9613

International Programs in Agriculture

615 W. State Street

West Lafayette, IN 47907-2053

www.agriculture.purdue.edu/ipia

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to The Netherlands and Belgium, and Dr. Andrea Liceaga and Dr. Fernanda San Martin-Gonzalez to Spain.

Four departmental spring break courses were offered: Dr. Pamala Morris and Myron McClure to Colombia, Dr. Mark Tucker and Anneliese Kay to Ireland, Dr. Reuben Goforth to Costa Rica, and Dr. Marcos Fernandez, Dr. John Graveel and Amy Jones to Costa Rica. Dr. Mark Russell and Dr. Tamilee Nennich's course to Haiti happened during winter break.

A student exchange agreement was completed with Massey University in New Zealand. Students will be able to study abroad at Massey University for a semester or a year.

Thanks to the generosity of our supporters, scholarships totaling \$59,300 were awarded through IPIA to agriculture students who participated in study abroad programs.

The 10 International Agriculture Ambassadors assisted at 70 events, including tours of campus, talking with students at fairs, speaking in classrooms, and promoting study abroad during Ag Week, hosting an international food festival, and taking trips with international exchange students. The ambassadors for 2014-15 were:

Baily Altman – Sustainable Agronomic Systems,
Abbey Amos – Agribusiness Management,
Kelly Beeker – Agriculture Communications & Agricultural Economics,
Whitney Blankenberger – Animal Science,
Jacquelyn Brown – Ag Sales and Marketing,
Jared Burke – Agribusiness Management and Spanish minor,
Tess Chamberlain – Food Science,
Melissa Galizio – Food Science,
Matthew Rodgers – Landscape Architecture, and
Jim Vinyard – Animal Science.

INTERNATIONAL EXTENSION

Mark Kepler and Andrea Burniske worked to shape FarmStays. Five Chinese students were placed with families in Fulton County. The Colombia Farmer to Farmer project with a Colombian university partner institution – Unillanos — provided technical assistance and established a local food system and food hub to small farmers in the department of Meta. Michael Morrow of Hoosier Harvest Market is instrumental in this initiative. Carmen and her son Cris worked with farmer and youth organizations to increase their level of organizational development. Andrew Martin worked with producers in a former conflict area to learn to make and market mature cheeses. Steve Engelking helped plan a small farms conference.

International Extension is active on the Purdue DATA committee, the Association for International Agricultural Extension Educators, and also represents Purdue in the Extension Disaster Education Network (EDEN).

Regional International Partnership Efforts

Asia

Drs. Karen Plaut, Hazel Wetzstein and Ragu Raghothama traveled to Shanghai to enhance research interactions and develop a plan to establish a joint research center at the Plant Science Institute headed by Dr. Jian Kang Zhu. Dr. Raghothama presented research talks at Jaipur and Dayalbagh University, Agra, India, and interacted with researchers at National Center for Biotechnology Research, Delhi. This was followed by a capacity building activity for hosting Afghan students at UAS and UHS Bangalore. Dr. Marisol Sepulveda and Raghothama were invited by Utsunomiya University, Japan, to explore joint research and educational opportunities. Dr. Jess Lowenberg-DeBoer and Raghothama explored emerging engagement opportunities in Myanmar. This included a visit to Yezin Agricultural University and discussion with ministry officials at Naypyidaw. Working sessions to prepare a proposal to USAID were also held with professors and administrators of Royal Agriculture University, Phnom Penh, and ministry officials in Cambodia, a feed the future country in Asia.

Dr. Shawn Donkin and Raghothama visited Federal University of Vicosa and Federal University of Lavras to promote the exchange of students and researchers under the Science Without Borders initiative by the Brazilian government.

Latin America

Intercollege activities, fostered by the Colombia-Purdue Initiative (<https://engineering.purdue.edu/CPIASR>), included a visit by the Purdue Provost (Dr. Debasish Dutta) who was accompanied by the Dean of Agriculture (Dr. Jay Akridge), the Dean of Engineering (Dr. Leah Jamieson) and the Dean of Science (Dr. Jeff Roberts). This delegation visited key Colombian partners in Bogotá, Cali, and Medellín. At Purdue, the second annual Undergraduate Research Experience Purdue-Colombia Program (UREP-C) was organized by Drs. Tamara Benjamin (Botany Plant Pathology) and Juan Diego Velasquez (Engineering). This program brought 49 students from four Universidad Nacional campuses to work on research projects in Purdue laboratories. Non-interest loans acquired by each student was the main source of funding for UREP-C. In addition to providing a rich research experience for the students, the program encourages collaborative activities between professors at Universidad Nacional and Purdue. Twenty professors from Universidad Nacional visited Purdue during the month of July. Colciencias, Colombia's National Science Program, noted the success of last year's UREP-C program, which prompted Colciencias to develop a pilot student internship program that will support 20 additional Colombian students for a six-month research experience at Purdue in 2016.

A Farmer-to-Farmer project developed by Jess Lowenberg-DeBoer and Andrea Burniske was developed to respond to the needs of smallholder farmers by bringing technical assistance and support to local farmers in the Department of Meta <https://ag.purdue.edu/ipia/Pages/Colombia.aspx>. Volunteers for Economic Growth Alliance (VEGA) and USAID fund this project. The early success of this activity, together with discussions

with Liliana Gomez, who directs Purdue's office in Medellín, Colombia, prompted the US embassy in Colombia to ask Purdue to organize a group of land grant universities to help Colombia develop its agricultural sector. Dr. Lowenberg-DeBoer leads this effort.

Interdisciplinary International Efforts

Afghanistan Overview

The IPIA Afghanistan program has been in operation since 2007. These years of continued growth and success could not have been possible without the cross-campus collaboration of many Purdue faculty and staff. Faculty and staff participate by developing training materials, traveling to Afghanistan to deliver training and gain understanding of the realities in-country, advising Afghan MS and PHD students at Purdue, and hosting Afghan visitors and trainees at their homes for meals and fellowship. During the period of this highlights publication we have engaged 19 staff members and 43 faculty members across campus. A number of additional Purdue University faculty, staff, and students were engaged in programming related to Afghanistan projects in a variety of ways supporting academic development, understanding US higher education, understanding US agriculture, understanding US culture, and other areas.

Afghanistan Agricultural Extension Projects (AAEP and AAEP II)

The three-year Afghanistan Agricultural Extension Project ended in September 2014. Purdue's expatriate staff, Joe Stangl and Sevanne Calsoyas, continued their work with local staff to provide tailored training to Directorate of Agriculture, Irrigation and Livestock (DAIL) employees, farmers, and Extension workers throughout July and August.

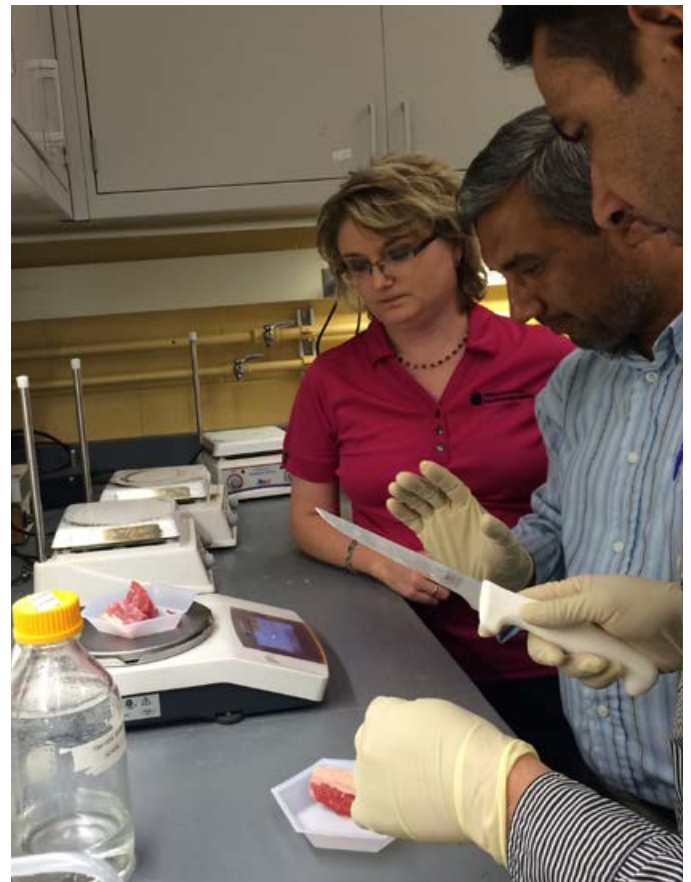
The AAEP project was awarded the U.S. Department of Agriculture Secretary's Honor Award in the global food security category – the highest award given by USDA. This award recognizes exceptional leadership contributions or public service in support of USDA's mission and goals. Dr. Kevin McNamara attended the award ceremony along with other university partners on November 5.

USAID awarded a three-year follow-on project, AAEP II, due to the many successes of the original AAEP project funded under USDA. This follow-on project continues to focus on building Extension capacity in Afghanistan. As with the original AAEP project, Purdue's base of operation is in Herat. Joseph Stangl returned to continue as our Extension Specialist. Efen Altoveros, who previously worked for us in Kabul on the A4 and SAAF projects, rejoined us as the Regional Site Manager.

Efen and Joe work closely with the local DAIL director to identify current training needs in the region. Based on these needs, Joe has been working with our national staff to develop and deliver practical trainings to Extension workers, Herat University faculty and staff, farmers, and local industry partners. Trainings have included: hoop houses and high tunnels; chickpea cultivation; composting; transplanting saplings; cutting flower varieties; cultivating pine, cedar, and pistachios; cultivating green beans; hermetic

storage and personal hygiene in seed storage; willow trees as windbreaks; how to conduct a household survey; drip irrigation, aerobic composting, and cotton cultivation; melon cultivation; sunflower and mungbean cultivation; and apricot and almond budding. Amanda Deering has joined the AAEP II team and traveled to Herat to provide training. She supports this project with expertise on post-harvest storage and hygiene.

The DAIL continues to support our work in Herat, and is pleased that we choose to share office space with them and seek their advice on areas of needed training and support. Both our staff and the DAIL staff believe that it is this close relationship that allows our work to be so successful throughout the province.



Multiple visits: Amanda Deering, a Clinical Associate Professor in the Department of Food Sciences, provided training for three projects in Afghanistan. Here, she works with faculty members in a food processing laboratory.

Afghanistan Sanitary and Phytosanitary Project (SPS)

Purdue faculty developed and delivered several trainings in Afghanistan in the last three months of the project. Amanda Deering, Haley Oliver, and Paul Ebner delivered trainings in Kabul on the topics of microbiology, border inspection, and good agricultural practices.

We also partnered with the Dutch Committee of Afghanistan (DCA) to provide basic sanitation training to community members in three provinces in Afghanistan. Amanda Deering and Haley Oliver trained the DCA trainers who traveled to the provinces and trained local community members.

The SPS project ended in September 2014. Over the 3-year life of the project, Purdue faculty trained over 1,500 Afghans in the topics of Food Safety, Animal Health, and Plant Protection. Afghans who received training from our faculty members continue to contact them for advice.

The Ministry of Public Health was so pleased with the success of the SPS project that they requested we continue to work with them on issues of sanitation beyond the ending of the project. Our faculty continue to discuss potential ways to work together given funding limitations.

University Support and Workforce Development Project (USWDP)

Purdue was awarded a subcontract for the USAID-sponsored University Support and Workforce Development Project. Over the next five years, Purdue faculty will work with five Afghan universities to develop bachelor's degrees in agribusiness and one Afghan university to establish a bachelor's degree in food technology. The team has been very busy, and the project is off to a great start. Partnership agreements have been established between the six Afghan universities – Herat, Balkh, Khost, Kunduz, Kandahar, and Nangarhar.

Kevin McNamara and Herat Dean Yousef Tami worked with Purdue and Herat faculty to create a steering committee to guide and measure development of the Food Technology Department. Purdue is partnering with the Universities of Horticultural Science (UHS) and Agricultural Sciences (UAS) in India to provide 14 Afghans with master's degrees. Four faculty members have been selected from Herat University to study Food Technology at UHS. Two faculty members from each Khost, Kunduz, Balkh, Kandahar, and Nangarhar will be selected to study Agribusiness at UAS.

During the summer of 2015, Purdue faculty held short-term intensive training for an additional 18 Afghan faculty members who will jumpstart the bachelor programs while the others are in India working toward master's degrees. Three faculty members from Herat University (HU) traveled to Purdue and worked with Amanda Deering, Haley Oliver, and Paul Ebner for three weeks to learn basic food microbiology, food chemistry, and sanitation. In August 2015, these Herat faculty will use their new skills to co-teach the first group of students at HU.

Don Breazeale and Hamid Faisal held a two-week intensive agribusiness training in Kabul for faculty members from these institutions — Balkh, Khost, Kunduz, Kandahar, and Nangarhar universities — to develop places for an initial agribusiness program. This training dived into the topics of agribusiness management and spreadsheets.

Mirwais Rahimi, Purdue's staff member in Herat, is working with Amanda, Haley, Paul, and HU faculty and administration to repurpose three adjoining rooms at HU into three teaching lab spaces. When completed, these labs will allow space for the faculty to teach food processing, food microbiology, and food chemistry.

Departmental Travelers

Amanda Deering (Food Science) – Amanda traveled to Afghanistan multiple times to provide training this year, supporting three projects – AAEP II, SPS, and USWDP. She traveled to Kabul to provide training on microbiology to Ministry of Public Health (MoPH) and Central Veterinary Diagnostic and Research Laboratory (CVDRL) employees and good agricultural practices to a group of local food processors. In January, she was part of a team that traveled to Herat to work with Herat University to develop a workplan for the food technology program Purdue is helping to establish as well as assess the university facilities. The following month, she provided a training hermetic storage and personal hygiene for seed storage to a group of farmers and Extension agents.

Paul Ebner (Animal Science) – Paul traveled to Afghanistan twice this year. He provided training on border inspection to a group of Ministry of Agriculture, Irrigation and Livestock (MAIL) employees, Ministry of Public Health (MoPH) employees, and industry members. In early 2015, he was part of a team who traveled to Herat to work with Herat University to develop a workplan for the food technology program Purdue is helping to establish and to assess the university facilities.

Dan Egel (Plant Pathology) – Dan Egel provided a five-day hands-on training in Herat, Afghanistan, for DAIL employees, university professors, and university students. The training focused on pest management and provided experience with laboratory instruments, comparisons between nutrient deficiencies and disease symptoms, and weed management.



DAIL in Afghanistan: Dan Egel, a Clinical Engagement Associate Professor – SWPAC, in Plant Pathology, works in Herat, Afghanistan, helping employees of Directorate of Agriculture, Irrigation and Livestock (DAIL), university professors, and university students identify crop diseases.

Haley Oliver (Food Science) – Haley traveled to Afghanistan twice this year under two separate projects – SPS and USWDP. She provided training to Ministry of Public Health (MoPH) and Central Veterinary Diagnostic and Research Laboratory (CVDRL) employees on the topics of microbiology while in Kabul. She traveled to Herat to work with Herat University to develop a workplan for the food technology program Purdue is helping to establish and assess the university facilities. As part of the USWDP project, she also traveled to Bangalore, India, to meet with administrators at the University for Horticultural Sciences (UHS) about partnering to admit Afghan faculty members into a master's degree program for food technology.

Kevin McNamara (IPIA) – Kevin McNamara continues to lead IPIA's Afghanistan program, which currently consists of four projects. Kevin extensively traveled to Afghanistan this year. During his numerous 3-week trips, he visited Kabul, Mazar-e-Sharif, and Herat to oversee project progress and meet with officials and faculty at Herat, Balkh, and Kabul universities; officials at the Ministry of Higher Education and Ministry of Agriculture, Irrigation and Livestock; and representatives for President Ghani.

Note of appreciation for George Van Scoyoc (Agronomy), who retired in December 2015, for his long-standing help with National Guard Training, the Afghan Junior Faculty Development Program and Afghan student mentoring.

Support Afghan Agriculture University (SAAF)

Eight Afghan university faculty members completed their MS degree under the Purdue SAAF Project in 2015. They were: Khalili Rahman Jahed (Peter Hirst, Horticulture), Safiullah Khurram (Doug Jacobs, Forestry), Shams Rahman Rahmani (Phillip Owens, Agronomy), Mohammad Nasir Shalizi (Barry Goldfarb, Forestry, NCSU), Noor Jon Zazai (Tamilee Nennich, Animal Science), Mohammad Wali Sahar (Todd Applegate, Animal Science), and Mujtaba Bashari (Fred Cabbage, Forestry, NCSU).

Herat Partnership

Professors Ghafori and Amini from Herat University in Afghanistan spent a semester at Purdue as visiting professors working with Rick Foster and Peter Hirst on applied research activities. Ghafori focused on weed management and Amini on apple production, and they are continuing their collaboration with Purdue faculty through the Purdue AAEP project.

Four junior Herat faculty were at Purdue during the winter semester 2015 working with Purdue professors Tom Creswell, Dan Egel, Peter Hirst and Rick Foster on an intensive training program focused on applied research skills, lab skills, plant diagnostics, and professional teaching. The Afghans also learned about integration of teaching, research and Extension at Purdue.

Junior Afghan Faculty Development Program (JAFDP)

IPIA hosted 22 young Afghan University faculty members from diverse academic backgrounds on campus for a 10-week State Department-funded training program. The program had campus-wide support with direct involvement from the Center for Instructional Excellence, Purdue Libraries, the Honors College, the College of Agriculture, Liberal Arts, Engineering, Health, Polytechnic, Science and Education. The program was designed to

strengthen the Afghans' academic skills. Many of the Afghan participants will continue their studies at US universities as Fulbright Fellows.

Purdue hosted a group of eight undergraduate students for a two-week training program in June-July 2015 for a program to help the students improve their understanding of US agriculture and higher education, and to help them build learning skills. The program involved over 25 faculty/staff and included trips to SWPAC, IPUFW, and farm and agriculture market visits. A three-day homestay with American families was also built into the program.

Purdue Improved Cowpea Storage (PICS1), Purdue Improved Crop Storage (PICS2) and PICS3

Purdue Improved Cowpea Storage (PICS) IPIA Highlight

The PICS team is continuing to explore opportunities to commercialize the PICS technology throughout the world, with the PICS3 project in several African countries, a partnership with CRS in Sierra Leone, growing commercial interest in Nepal and Bangladesh, and discussions in other regions of the world, including Southern Africa, South Asia, South and Central America, and the Caribbean. More than 1.3 million bags were produced and sold during the 2014 season. To date, more than 5 million bags have been produced and sold by the private sector in Africa. The commercialization of PICS bags is empowering farmers to reduce post-harvest losses and providing the opportunity for the private sector to invest in manufacturing, distribution and sales of PICS bags.



It works: Farmer storing grain in PICS bags in Tougan, Burkina Faso. Photo by Tom Campbell

Purdue Improved Crop Storage (PICS3)

The Purdue Improved Crop Storage (PICS3) project has completed its first year of activities. PICS activities were implemented in Nigeria, Ethiopia, Tanzania, Uganda, Burkina Faso, and Malawi and Ghana. The PICS3 project is partnering with government and international research organizations, and local and international NGOs, including IITA in Nigeria and Ghana, INERA in Burkina Faso, NCBA CLUSA in Uganda, Sasakawa Global 2000 in Ethiopia and, CRS in Ethiopia, Tanzania, and Malawi. About 800 Extension agents were trained to implement PICS village activities in all these countries. Demonstration activities reached 3,868 villages in the seven PICS3 countries. PICS bags are being manufactured and supplied to PICS3 countries by local or regional plastic manufacturers.

PICS CRS/Purdue Seed Storage project in Sierra Leone

A special PICS effort was launched in Sierra Leone during the Ebola crisis to help farmers store their seeds and grain when markets were disrupted due to Ebola quarantine. Purdue partnered with Catholic Relief Services (CRS) to promote PICS bags in Sierra Leone during the Ebola crisis. Community awareness was created through short message services (SMS) and radio programs and advertisements. Given the quarantine, PICS trainings were conducted in small groups and using mobile phone videos. Ten thousand (10,000) PICS bags were imported from Mali into Sierra Leone. About 3,700 farmers received bags and were trained as a result of a grant from Catholic Relief Services. The PICS bags put farmers in charge in responding to disaster, making them more resilient to the Ebola crisis. For more information visit <https://extension.purdue.edu/Pages/article.aspx?intItemID=13024>.

PICS Leverages

PICS awareness building and supply chain development activities have generated a lot of interest among donors, projects and government agencies concerned with mitigating post-harvest losses. There have been leverage activities in the form of grants to Purdue or the private sector, and training farmers in additional village activities, etc. About \$1.5 million USD have been granted to Purdue and partners to create awareness and develop the supply chain of the technology in Kenya, Tanzania and Sierra Leone. The PICS team is continuing to explore opportunities to commercialize the PICS Technology in other regions of the world, including Southern Africa, South Asia, South and Central America, and the Caribbean.

USDA/FAS Scientific Exchange Scholars and Borlaug Fellowships

IPIA assisted in matching international fellowship opportunities to Purdue faculty expertise in Agriculture and Veterinary Medicine. Purdue Agriculture faculty were selected to train one Borlaug Fellow and one Scientific Exchange Scholar. Ms. Leticia Amoakoah Twum, Borlaug Fellow from Ghana, trained in the Food Science Department with Dr. Srinivas Janaswamy on food safety/residue analysis. Ms. Amoakoah Twum also attended the World Food Prize Symposium in Des Moines, Iowa, as a part of her Fellowship. Mr. Gilles Koné,

Scientific Exchange Scholar from Mali, trained with Dr. Jerry Peters, Department of Youth Development and Agricultural Education, on agriculture curriculum development and design.

A Purdue Veterinary Medicine faculty member, Dr. Mohamed Seleem, was chosen to train two Egyptian Scientific Exchange Scholars, Dr. Maha Ibrahim and Ms. Marwa El-Zeftawy. They visited Purdue from April 20 to July 11, 2015. IPIA staff member Lonni Kucik served as Training Coordinator for all of the aforementioned visiting scholars.

Innovation Laboratories

The Feed the Future Innovation Lab for Aquaculture & Fisheries (AquaFish Innovation Lab)

Kwamena Quagrainie (Agricultural Economics) continues to lead this project in Africa. The focus of Kwamena's project was the development of a cellphone-based Seafood Market Information System (SMIS) for tilapia in Ghana. The SMIS is web-based and provides tilapia market information online and via voice and SMS/text messaging to users. The system will help inform production and harvesting decisions and minimize the information gaps along the tilapia value chain in Ghana. The project involves collaboration with FarmerLine, an IT company in Ghana, as well as Kwame Nkrumah University of Science and Technology in Ghana.

Horticultural Innovation Lab

The first phase of the Horticulture Innovation laboratory project on African Indigenous Vegetables (AIVs) ended in September, and a new Phase two project was funded in December for five years. Stephen Weller is the PI for this project. Both phases one and two involved activities in Kenya, Tanzania and Zambia with collaborators from Purdue University and Rutgers University in the US. Activities included an end-of-project symposium in Kisumu, Kenya, that was attended by collaborators from all the African host countries and US collaborators and included accomplishments with presentations from representatives of the Kenyan USAID Mission, Kenyan Agriculture and Livestock Research Organization (KALRO) and Jomo Kenyatta University of Agriculture and Technology. The project involved investigations on improved AIV germplasm, agriculture production systems and pest management, methods for improved storage and drying and nutritional composition of the AIVs, and connections of farmers to markets. Emphasis was placed on connecting smallholder farmers with markets in all countries. The second phase of the project emphasizes the contributions of AIVs to a nutritious diversified diet and how increased consumption can contribute to improved health of consumers. Additionally, research and outreach on improved production practices and connections to markets are being conducted. Activities to date have included surveys of farmer households, market stakeholders and assessments of the health status of populations and their consumption patterns.

Global Nutrition Innovation Lab

Jerry Shively (Agricultural Economics) completed his fourth year as a PI for the Feed the Future Nutrition Innovation Lab. The goal is to understand and measure the connections between agricultural capacity, technology adoption, nutrition outcomes, and conditioning factors at levels of aggregation ranging from household to district levels. Research activities focus on using several nationally representative datasets on child health outcomes to better understand patterns and drivers of nutrition outcomes in Nepal and Uganda. Several graduate students in agricultural economics conduct research in Nepal and Uganda and are supported by the project.

USAID Innovation Lab for Nutrition

Gerald Shively (Agricultural Economics) completed another year as a primary investigator on the Feed the Future Nutrition Innovation Lab project. The project's goal is to understand and measure the connections between agricultural capacity and performance and nutrition outcomes, using data from various levels of aggregation ranging from households to districts. Research focuses on linking data on child health outcomes to remotely sensed satellite data, as well as data on markets and market infrastructure. Several graduate students in Agricultural Economics are supported by the project and conducting research in Nepal and Uganda. His research was highlighted in a widely broadcasted USAID webinar conducted in Washington, D.C., in September.

USAID Feed the Future Innovation Lab for Food Processing and Post-harvest Handling

Food Processing and Post-harvest Handling, (FPL) was officially launched in August in Dakar, Senegal. In addition to investigators, represented were: USAID Senegal Mission; USAID-YAAJEENDE project; USAID Education and Research in Agriculture project; Catholic Relief Services; CORAF program and the FTF Innovation Lab for Reduction of Postharvest Losses at Kansas State University. Details about the project can be found at:

<https://ag.purdue.edu/ipia/fpl>. The project goal is to increase access to safe and nutritious foods by improving the drying and storage capacity of smallholder farmers and expanding market opportunities through diversified processed products that address quality in the market and nutritional needs. Project partners include: North Carolina A&T State University; University of Pretoria, South Africa; Institut de Technologie Alimentaire, Senegal; L'Institut Sénégalais de Recherches Agricoles, Senegal; the Cooperative College of Kenya; University of Eldoret, Kenya; CIMMYT-Kenya; and A to Z Textiles, Tanzania.

News of Departments

Agricultural and Biological Engineering

Abigail Engelberth gave an oral presentation at the 8th International Conference on Countercurrent Chromatography at Brunel University in Uxbridge, United Kingdom. This was an excellent opportunity. She met the key players in the CPC/CCC field and shared research efforts.

Oswaldo Campanella traveled to Brazil and taught a course regarding extrusion for industry and research centers. He also taught and gave seminars at Universidad del Litoral in Santa Fe. He traveled to the University of Sao

Paulo and Pirassununga campuses and taught a course on Food Rheology. He gave several talks as well as a seminar at the International Conference Rheology in Campinas.

Bernard Engel attended the CIGR meeting in Beijing, China, along with ABE colleagues Jiqin Ni, John Lumkes, and David Wilson. Following the CIGR meeting, 11 US ABE department heads met with eight Chinese department heads at the Chinese Academy of Agricultural Mechanization Sciences in Beijing. This meeting allowed the US department heads to learn more about opportunities for working jointly with related programs in China. Bernie spent two days at China Agricultural University (CAU) to continue development of an undergraduate 2+2 program, interact with students in the 2+2 program, and explore other opportunities at CAU. Bernie also traveled to Ireland to review the University College of Dublin programs in Biosystems Engineering.

William Field traveled to Thiruvananthapuram, India, to attend an international symposium titled *Assistive Technology for Rehabilitation and Disability Management*. At the conference he had the opportunity to speak alongside the Chief Minister (Governor) of Kerala, a province with 35 million people, and the Minister of Education. William spent a day at Kerala Agricultural University, where approximately 700 students are enrolled in various agricultural majors. He also traveled to Finland to attend the Nordic meeting on agricultural occupational health and safety. William traveled to a conference in Porvoo, Finland, and then traveled to Dublin, Ireland, to attend PhD thesis defense.

Albert Heber traveled to Uludag University in Bursa, Turkey, to collaborate with Dr. Kilic on his research project and to work on papers that will be co-authored on National Air Emission Monitoring Study data.

Klein Ileleji traveled to Morocco, Zambia, and the United Kingdom. In Morocco, Ileleji attended the Global Entrepreneurship Summit and participated in the Global Innovation in Science and Technology, (GIST) Tech-I training and finals training for the American Association for the Advancement of Science. Dr. Ileleji served as a mentor and judge for finalist teams participating in the GIST Tech-I competition organized by the US State Department.

In Zambia, Dr. Ileleji participated in the "Cracking the Nut 2015" in Lusaka, Zambia, where global partners working in agricultural enterprise development met to present their projects, forge partnerships and discuss pathways to pressing solutions needed to grow Africa's agriculture. Catholic Relief Service, a partner of Purdue, was one of the sponsors of the program.

Dr. Ileleji attended a three-day workshop and presented his work on biomass granulation for feed production at the 7th International Granulation Workshop in Sheffield, UK. He also visited the Center for Post-Harvest Loss Reduction at the Natural Resource Institute (NRI) at the University of Greenwich, Chatham, UK, to discuss his work on post-harvest reduction in Africa and be informed about their work, in particular APHLIS.

Joseph Irudayaraj visited universities and gave a seminar in India. In China, he visited Beijing University and gave presentations and met with collaborators.

Monika Ivantysynova attended the 8th Fluid Power Net International (FPNI) PhD Symposium in Lappeenranta, Finland. A graduate student in Ivantysynova's Maha Group successfully tested the blended hydraulic hybrid transmission concept on Maha's dynamometer test rig. The blended hybrid uses a combination of hybrid and hydrostatic operation in a new circuit solution. This student received the prestigious Backe Medal 2014 for his paper on *Hardware-in-the-Loop, Testing of a Novel Blended Hydraulic Hybrid Transmission* published in the Proceedings of the 8th FPNI PhD Symposium, Lappeenranta, Finland.

Ivantysynova attended three other international conferences. In England she attended the American Society of Mechanical Engineers, (ASME)/BATH Symposium on Fluid Power and Motion Control. In Japan, Ivantysynova received Best Paper Award at the International Symposium on Fluid Power. She also attended the Scandinavian International Conference on Fluid Power in Tampere.

Michael Ladisch traveled to Rostock, Germany, to participate in the 16th meeting of the Recovery of Biological Products Conference Series. The Recovery Conference Series (<https://recoveryconferences.org>) is the premier international forum for the presentation and discussion of the status, direction and trends in the recovery of biological products of therapeutic, diagnostic and industrial value. Sponsored by the American Chemical Society, Division of Biochemical Technology (BIOT), this international biennial conference provides exposure to the latest developments in bioprocessing with a focus on downstream processing. The invitation-only conference provides multiple opportunities for discussion and development of new areas relating to the separation, purification and efficient processing of biological products. Dr. Ladisch participated in the conference and also presented a report of the strategy committee to the Biorecovery Governing Board, of which he is an emeritus member. He served on the board from 1998 to 2012 and co-organized two of the 16 conferences, in 1988 and 1996.

John Lumkes attended the 2014 American Society of Agricultural and Biological Engineers (SABE) Annual International Meeting in Montreal, Canada, with three graduate students, to present three papers on international development projects.

He also attended the 2014 ASME/BATH Fluid Power Conference in Bath, UK, from September 8-12, 2014. He and a graduate student presented a paper on digital pump/motors.

Professor Lumkes attended the CIGR meeting September 13-18, 2014, in Beijing, China, along with ABE colleagues Bernie Engel, Jiqin Ni, and a graduate student. They presented papers on the Purdue Utility Platform (PUP) project.

Lumkes gave invited lectures at South China University of Technology (SCUT) in Guangzhou, China, March 6-13, 2015.

Lumkes traveled to Bangang, Cameroon, with Purdue students to construct a PUP utility vehicle at the African Centre for Renewable Energy and Sustainable Technologies (ACREST) from May 18 to June 2, 2015. Visitors from Makerere University in Uganda also traveled to Cameroon to learn about the PUP project and have subsequently begun constructing their own vehicles.

Professor Lumkes participated in the Land O'Lakes Global Food Challenge as a faculty mentor and traveled June 28-July 15 with faculty and students from Purdue, George Washington, Iowa State, Minnesota, and Northwestern universities to Malawi, Zambia, Botswana, and South Africa to visit Land O'Lakes international development sites.

Jiqin Ni is collaborating on research and graduate education with several universities in China. In September 2014, he was invited and visited Zhejiang University (ZJU), China Agricultural University (CAU), Changzhou College of Information Technology (CCIT), and Northwest A&F University (NAFU). During this travel he gave two seminars, contributed to graduate research project reviews, and provided technical advisory for anaerobic digestion and air quality monitoring system designs. He was also invited to the Hangzhou Energy and Environmental Engineering Co. Ltd. in Hangzhou, China to provide technical advisory for biogas technology implementation.

Ni visited three other universities, Northeast Agricultural University (NEAU), Heilongjiang Bayi Agricultural University, and Harbin Institute of Technology in northeastern China. He was invited to give a seminar at each university. At NEAU, he also attended the defense of a Ph.D. student that he co-advised.

Shweta Singh attended the International Congress on Sustainability Science Engineering Conference in Balatonfured, Hungary.

Richard Stroschine met with China Agricultural University students who will be matriculating at Purdue in August 2015.

David Umulis co-led a study abroad trip with Steve Hallett for Purdue undergraduate students with a focus on agriculture, the economy, and the environment. During the trip, the Purdue students visited farms to develop their own views on food production for one of the world's largest populations. Stops included Beijing, Hong Kong, Chengdu, and Kunming.

Professor Umulis also participated in a partial differential equation workshop at the Isaac Newton Center in Cambridge England. During the workshop, he shared his group's research work and spurred on conversations on the topic of data integration in mathematical modeling in biology.

Andrea Vacca went to Russia, Japan, Finland, Germany, China and Italy. In Russia, he attended the Second International Conference on Dynamics and Vibroacoustics of Machines, Samara. In Matsue, Japan he attended 9th Japan Fluid Power System Society International Symposium on Fluid Power.

He attended the 8th Fluid Power Net International PhD Symposium on Fluid Power in Lappeenranta, Finland. In Germany he attended the IFK International Fluid Power Conference in Aachen. A dissertation by a PhD student who worked on Vacca's team, "Advanced Control Strategies for Mobile Hydraulic Applications," received the Aachen HP Award during the International Fluid Power Conference IFK2014. The Aachen HP Award is awarded to persons who have distinguished themselves by outstanding studies in the field of Fluid Power.

Vacca attended the Scandinavian International Conference on Fluid Power in Tampere, Finland. He visited industries and gave seminars in Huhan and Guangzhou, China, and visited manufacturers Casappa, CNH and Turolla in Italy along with a seminar and being an invited speaker at Naples.

Agricultural Economics

Corinne Alexander participated in the 11th International Working Conference on Stored Product Protection in Chiang Mai, Thailand. She presented a paper titled *Evaluating the profitability of on-farm storage pest management in developing countries*.

Alexander traveled to Kenya as part of the USAID Farmer to Farmer Food Processing Lab to work with local partners to identify the major challenges for drying and storage for smallholder farmers. Alexander also traveled to Malawi, Tanzania and Thailand as part of the PICS 3 project. In Lilongwe, Malawi, she and Dieudonne Baributsa conducted a PICS training of trainers (ToT) for field agents who are training farmers in 400 villages. In Tanzania, she worked with local partners to conduct three ToTs in the Lake Zone, including Musoma, Mwanza and Biharamulo; these field agents will train farmers in 1,200 villages. In Thailand, she and Dieudonne Baributsa participated in a Bill and Melinda Gates Foundation meeting about how to better understand farmer adoption decisions. They presented a case study on how PICS has successfully promoted farmer adoption. *Dr. Corinne Alexander passed away unexpectedly in January 2016 after leading many illustrious international research and outreach programs filled with great accomplishment. Purdue colleagues and international community will dearly miss her!*

Freddie Barnard worked with the Association of African Business Schools on a project funded by that organization to modify the Purdue Agribusiness Management Simulation. The modification incorporated business management practices used in several African countries (i.e., limited use of accounts receivable, limited use of overtime, etc.) and a currency converter. The simulation is used to teach agribusiness management principles at adult education programs and as part of business management courses at educational institutions that are members of the association. Dr. Barnard presented a seminar and training session using the modified simulation in Cape Town, South Africa.

Ken Foster (agricultural economics professor and department head) is co-teaching a multidisciplinary international service-learning course with Dr. Ernest Blatchley in Civil Engineering and Dr. Vicki Simpson in Nursing. The course involves students from all three disciplines as well as Food Science. They work with communities in the Dominican Republic to design, build, and transfer management of community-scale water purification systems. They have built and transferred management of one system so far in the village of Las Canas. This year they traveled to the Dominican Republic to identify communities for future systems, have been raising funds for at least three more, and hope to begin design and construction on their second system in spring of 2016.

Michael Gunderson presented a paper at the International Food and Agribusiness Management symposium with C.O. Trejo-Pech and A.W. Gray on June 15, 2015, in Minneapolis, Minnesota. He participated in an invited session at the International Food and Agribusiness Management Forum

with A.W. Gray in Minneapolis. Gunderson coached a graduate student team to a 2nd place finish at the International Food and Agribusiness Management Case Study Competition.

Gunderson mentored undergraduates in the Land O'Lakes Global Food Challenge internship program and traveled with the program to Malawi, Botswana, and Zambia in late June/early July to visit International Development Division projects.

Dominique van der Mensbrugge participated in the annual meeting of the Integrated Assessment Modeling Consortium—it plays a major role in the global economic analysis of climate change—held at the University of Maryland. Dominique attended the annual meeting of the Agricultural Model Intercomparison and Improvement Project (AgMIP), at the University of Florida. One of the key objectives of AgMIP is to better understand future food security across the globe, particularly as it will be affected by climate change. He is also part of an expert group for a French government agency looking at future food security. In Melbourne, he presented a paper on “Shared Socio-Economic Pathways (SSPs) and global income distribution” at the 18th Annual Conference on Global Economic Analysis. The Center for Global Trade Analysis, of which he is the Director, offered the 22nd Annual Short Course in Global Trade Analysis, a 10-week program that combines online and on-site instruction on computable general equilibrium analysis. The on-site portion of the course was held on Purdue's campus. This course introduced the Global Trade Analysis Project (GTAP) Model to 36 individuals—from all parts of the world—working in international and national government agencies, academia and the private sector. The Center also offered GTAP 101, a fully online course, which provides an introduction to general equilibrium modeling, twice during the past 12 months with a similar mix of students across nationalities and places of work.

Paul Preckel traveled to Inner Mongolia Agricultural University to present a two-week short course in the Department of Agricultural Economics. He also is executing a project for the International Center for Agricultural Research in Dry Areas that focuses on evaluating farming system technologies in Jordan.

Kwamena Quagrainie (Agricultural Economics) continues to lead a project in Africa, the Feed the Future Innovation Lab for Aquaculture & Fisheries (AquaFish Innovation Lab). The focus of Kwamena's project is the development of a cellphone-based Seafood Market Information System (SMIS) for tilapia in Ghana. The SMIS is web-based and provides tilapia market information online and via voice and SMS/text messaging to users. The system will help inform production and harvesting decisions and minimize the information gaps along the tilapia value chain in Ghana. The project involves collaboration with FarmerLine, an IT company in Ghana, as well as Kwame Nkrumah University of Science and Technology in Ghana.

Jacob Ricker-Gilbert continued building his international research program. He traveled to Malawi to work on a survey of fertilizer and seed suppliers to estimate how they have been affected by the country's input subsidy program. In Ethiopia he set up a baseline survey for the PICS3 project. Ricker-Gilbert also traveled to Senegal to launch the first phase of the

baseline survey for the Feed the Future Innovation Lab for Food Processing and Post-harvest Handling, funded by USAID. In Milan, Italy, he presented several papers at the International Conference of Agricultural Economists.

Gerald Shively (Agricultural Economics) completed another year as a primary investigator on the USAID Feed the Future Nutrition Innovation Lab project. The project's goal is to understand and measure the connections between agricultural capacity and performance and nutrition outcomes, using data from various levels of aggregation ranging from households to districts. Research focuses on linking data on child health outcomes to remotely sensed satellite data, as well as data on markets and market infrastructure. Several graduate students in Agricultural Economics are supported by the project and conducting research in Nepal and Uganda. His research was highlighted in a widely broadcasted USAID webinar conducted in Washington, D.C.

Shively continued to maintain a very active schedule of international activities. He completed his 9th and final year as Editor-in-Chief of *Agricultural Economics*, the flagship journal of the International Association of Agricultural Economists (IAAE). At the triennial meeting of the IAAE in Milan, he was recognized for his service to the profession with an award. His research projects on food security in Uganda and Nepal, funded by the USAID Nutrition Innovation Lab, are discussed elsewhere in the newsletter. He continued to partner with a number of colleagues on agricultural development research in China, Ethiopia, the Philippines, Malawi, and elsewhere, and continued to serve on a C-FARE Blue Ribbon Panel formed to study frontier issues in international development. He participated in a number of international research meetings, including the European Association of Environmental and Resource Economists' annual meeting in Helsinki, Finland. He was also part of a three-faculty team (with Steve Yaninek and Steve Hallett) that visited Cuba on behalf of the College of Agriculture.

Farzad Taheripour served as the PI for a World Bank research project aimed to examine the consequences of future water scarcity on the economies of South Asia. We developed several reports for this project and sent them all to the World Bank.

Wally Tyner has been working with the International Civil Aviation Organization to help develop a market-based system to be used to reduce aviation greenhouse gas emissions. In connection with that activity, he traveled to Brazilia, Brazil and Montreal, Canada. Wally presented a paper on the prospective impact of losing GMO technology at a biotechnology conference in Ravello, Italy. He received the honorary life member award from the International Association of Agricultural Economists. This award is their version of fellow. The award was presented at the association's triennial meeting in Milan, Italy.

Holly Wang's research on Chinese food market and demand has generated great impact. She conducted field surveys in three Chinese cities in June, and gave multiple research talks about Chinese food demand and food safety in China, US, Italy and UAE. She participated in the Indiana Agricultural Trade Mission Delegation led by the Indiana Lt. Governor on an official visit to China, and assisted Indiana agribusiness to explore and expand the Chinese market. She also delivered two talks at the US Senate

and the US House of Representatives in October about agricultural export issues with China.

Brigitte Waldorf participated in the 14th International Workshop on Spatial Econometrics and Statistics Research at the University Panthéon-Assas in Paris, France.

Agronomy

Sylvie Brouder was an invited participant in a working group on "Feeding the World, Ethically" sponsored by the Global Food Ethics Project of the Johns Hopkins University. Berman Institute of Bioethics, Bloomberg School of Public Health and the School of Advanced International Studies (funded by the Stavros Niarchos Foundation). The initial weeklong meeting occurred in Ranco, Italy, and convened 17 international experts in science, policy and society research domains relevant to food security/ethics to build shared conceptual framework for identifying distinctly moral disagreements/challenges impeding global food availability. Brouder represented the crop production science domain. The workshop output was "The 7 by 5 Research and Policy Agenda: 7 Projects to Make Progress on Ethics and Global Food Security in 5 years." Funding is currently being pursued for these projects by the working group. With two workshop collaborators, Brouder presented the proposal at the joint meeting of the Association for the Study of Food in Society and Agriculture, Food and Human Values Society held at Chatham University in Pittsburgh, Pennsylvania.

Brouder also served as an independent expert and evaluator for the Independent Evaluation Arrangement of UN FAO to review two CGIAR Research Programs (CRP): CRP Wheat, and CRP Water Land and Ecosystems (WLE). The reviews combined desk reviews of documents with travel to an array of countries to visit project sites and interview researchers, partners and stakeholders. Brouder traveled to India to visit CRP Wheat sustainable intensification projects in the Ganges and Punjab. She traveled to Sri Lanka and East Africa (Kenya and Ethiopia) to evaluate CRP WLE sustainable intensification projects. For both CRP reviews, Brouder has served as the team member responsible for assessment of sustainable intensification research as well as for the overall evaluation of program-wide quality of science. The CRP Wheat review concluded in March, and the CRP WLE review will conclude in early 2016. <http://iea.cgiar.org/evaluation/crp-evaluation-wheat> and <http://iea.cgiar.org/evaluation/crp-evaluation-water-land-and-ecosystems-wle>

James J. Camberato visited Dr. Jiwang Zhang at Shandong Agricultural University and Dr. Renhe Zhang at Northwest Agriculture and Forestry University for about eight days this summer. He made two presentations at each university – *Principles of Nitrogen Management for Corn* and *The Role of the Land Grant University in Supporting U.S. Crop Production*. Dr. Camberato also visited with administrators, faculty, graduate students and stakeholders at both these universities on these topics and other issues related to research, teaching and Extension.

Jim Camberato, Bob Nielsen, and Corey Gerber spent seven days working with agronomists from Condifesa Lombardia Nord-Est to improve corn production in the Po River Valley of Italy and to initiate the development of an Italian version of the Purdue Corn and Soybean Pocket Guide.

Rich Grant taught a short climate change seminar in Mauritania to seven students from University of Nouakchott, Mauritania. In this seminar, he had two Skype conference calls between these students and students in his and Dr. Cliff Johnston's "Climate change in Africa" course (AGRY 399). Dr. Grant also assisted in the development and operation agro-meteorological station at the Advanced Institute for Agronomy and Veterinary Science in Faranah, Guinea, while teaching 22 teachers on statistics, climate change and agrometeorological measurements. He is a member of Board of Directors, Global Education Morocco that operates a 700-student school in Casablanca, Morocco, with two site visits to the school during the year. Dr. Grant continues to collaborate in developing a method for measuring methane using unmanned aerial vehicles with colleagues in the Institute for Meteorology and Climate Research, Atmospheric Environmental Research Division, Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany (IMK-FSU). In addition, he evaluated Borlaug Fellows for the Purdue Center for Global Food Security.

John Graveel co-lead a study abroad course for one-hour credit to Costa Rica with Dr. Marcos Fernandez (Professor of Animal Science, Associate Dean of Academic Programs). There were 20 students who participated in this study abroad experience. In Costa Rica, they focused on issues and practices related to sustainability around tropical agricultural, environmental and community environments. In addition to Dr. Graveel and Dr. Fernandez, this rewarding educational experience was co-lead by colleagues from EARTH University and Tropical Agricultural Research and Higher Education, (CATIE).

Yiwei Jiang gave a lecture, "Physiological and Genetic Mechanisms of Salinity Tolerance in Perennial Ryegrass," to College of Agronomy at Shandong Agricultural University and Northwest Agriculture & Forestry University of China. He continued collaborations with colleagues in Institute of Botany, Jiangsu Province and Chinese Academy of Sciences for a project funded by China NSF under Overseas Collaborative Program to provide understanding in drought tolerance of perennial grass species using physiological and genomic approaches.

Cliff Johnston and Rich Grant returned to Guinea, West Africa, as part of a USAID project, "Agriculture Education and Market Improvement Program (AEMIP)," as a follow-up to a trip in February 2014. They taught a group of 24 faculty members and graduate students principles of climate science, land and water resources. They are helping to coordinate the construction of a weather station located at the Institut Supérieur Agronomique et Vétérinaire de Faranah (ISAVF). The only functional weather station in Guinea is located at the airport in Conakry, 450 kilometers from ISAVF. In addition, instruction was provided regarding soil sampling and soil analysis.

Dr. Johnston participated in a ring-trial experiment along with about 20 other research scientists from around the world to characterize a comprehensive suite of biochar samples. He traveled to Sydney, Australia, where the results from the different laboratories were presented. The results are currently being summarized in a book that will be published by Commonwealth Scientific and Industrial Research Organization, (CSIRO).

The University of Alberta recognized Johnston as the D.B. Robinson Distinguished Speaker for 2015 at the University of Alberta, Department of Chemical and Materials Engineering, for his work in the Alberta oil sands.

In Scotland, Johnston presented an invited lecture on the surface properties of clay minerals at the Euroclay Conference held in Edinburgh.

Linda S. Lee was invited to present and serve on a panel at the Network for Industrially Contaminated Land in Europe (NICOLE) 2015 Spring Meeting & Workshop in Manchester, UK. She presented her work on fate and remediation of perfluoroalkyl substances and participated on a four-member panel designed to address industry, regulatory, and public concerns toward identifying appropriate regulations protective of human, wildlife, and ecosystem health.

In China, Lee was invited to present both her work on the fate and ecotoxicity potential of hormones, as well as the fate and remediation of perfluoroalkyl substances. She made several presentations at Beijing Normal University, Dalian University of Science and Technology, and at the Second Ecological Toxicology Symposium of China in Xiamen. She also interacted with colleagues at Peking (Beijing) University, which resulted in some collaborative work and a recent manuscript submission and some new proposal development opportunities.

Jianxin Ma gave a plenary talk as an invited speaker at the 2nd International Agricultural Genomics, one of the nature conferences that was co-organized by the local sponsors of the Chinese Academy of Agricultural Sciences and Chinese Academy of Sciences.

Mohsen Mohammadi traveled to Afghanistan to take part of a field tour of their facilities. He is also hosting Yousof Jami, the Dean of Agriculture of Herat University, in conjunction with **Shaun Casteel**.

Dev Niyogi continued his various international collaborations and projects with academic institutions and research labs as well as governmental organizations in India, China, El Salvador, France, Luxembourg, Zimbabwe, the Netherlands, Spain, Ireland and the United Nations Educational, Scientific and Cultural Organization, (UNESCO).

Projects with India involve using computational tools and information technology to improve hazard mitigation and management and is part of an ongoing, multiyear activity supported through the Indian Department of Telecommunication and Information Technology (DIET). This involves advising established and newly emerging Technology Universities alike on hydroclimatic curricula, urban climate research, and hazard mitigation and response approaches. Dev Niyogi also advises and evaluates the programmatic progress each year through site visits, and webinars for the different projects supported under this initiative.

The highlights were working with a research and state hazard response team on Urban Flood prediction and management, and helping coordinate a monsoon school on urban floods with nearly 50 participants from India and surrounding countries.

Another project funded through India's National Monsoon Mission is supporting the improvements to the operational weather models for seasonal climate outlook, including development of enhanced monsoon outlooks using coupled models.

A third set of activities under the auspices of the IndoUS Forum for Science and Technology continues hosting scientific visitors from India for research toward improving the land-falling tropical cyclones forecasts and response. These activities are closely coordinated with the NOAA Hurricane Research Division, and the US National Centers for Environmental Prediction.

India has started plans for 100 future smart cities. Part of the ongoing activities included working with policy makers and infrastructure management groups in discussions related to future cities. A series of high-level meetings on the IT to urban planning and governance issues on this topic were conducted, and a plan to work with MBA schools is evolving to use urban resiliency and smart cities as a knowledge base.

Work with China continues as a research collaborator and advisor to the Institute of Urban Meteorology in Beijing for design of a field experiment on Urban Haze and Thunderstorms. A large urban field experiment is being planned (summer of 2016) as part of these meetings to understand the nature of haze and poor air quality in Beijing during winter months, and the flood hazards due to summer thunderstorms.

Collaborated with French scientists over the past year on a convening team for the International Conference on Urban Climate in Toulouse, France. Dev Niyogi was one of the speakers for this inaugural event.

A series of ongoing collaborative activities have been underway with research groups from France, Luxembourg, Spain, and Ireland through visits and online collaborations as part of a world urban dataset and development of a portal tool. This data tool and portal called WUDAPT is being used as an international research and educational collaboration for work related to urban climate.

Activities with Zimbabwe involve collaboration with the Africa University and were initiated as part of a yearlong visit by its former Vice Chancellor, hosted by Dev Niyogi. Current activities included a survey on climate change understanding among school children, and development of a curricula for climate assessment. Project activities are underway to scale up the efforts at the regional level.

Darrell Schulze and **Phillip Owens** (Agronomy Department), along with Nicole Kong (Purdue Libraries), Wilson Ng'etich (Soil Science Department, University of Eldoret, Kenya), Naman Nyabinda (AMPATH, Eldoret, Kenya) and graduate students, are working on a project titled *Delivering Spatially Explicit Soil and Crop Management Information to Agricultural Extension Educators in Rural Western Kenya*. The goal of the project is to create a high-resolution digital soil map of a portion of western Kenya and then to use the map to deliver spatially explicit soil management information to AMPATH agricultural Extension educators in the field by utilizing mobile tablet computers and the cellphone network. The project is funded by the Purdue Center for Global Food Security Faculty Seed Grant Program.

Tony J. Vyn gave invited presentations on his maize systems research and Extension programs to Jilin Academy of Agricultural Sciences, Shandong Agricultural University, and China Agricultural University with the assistance of his current Ph.D. student from China. Dr. Vyn and his Ph.D. student continued research collaborations with CIMMYT personnel on maize nitrogen use efficiency in Kenya and Zimbabwe. The latter project is part

of a broader effort under the Improved Maize for African Soils program. He served as a graduate faculty mentor and research advisor for a "sandwich Ph.D." student from the University of Sao Paulo, Brazil, and he hosted three visiting scholars from Brazil and Argentina for six-month periods. He also gave presentations at Purdue to international groups from Argentina, Brazil and Japan.

Cliff Weil and The Weil Lab hosted two visiting international scientists this past year, Elaine Azu for three months from the West Africa Center for Crop Improvement in Ghana, and Khalil Kane for two weeks from CERRAS in Senegal. Both scientists were working on genetic improvement of protein digestibility in sorghum.

Cankui Zhang was invited by CYMMIT to attend a meeting in Germany to present his work in heat and drought stress physiology in wheat. He was also invited by NSF and Gates Foundation to attend a PI meeting in Washington, D.C., for all BREAD programs, where he had valuable discussions on international agriculture with many international attendees. In addition, Dr. Zhang was invited by two Chinese institutes in May to give seminars on mechanisms of carbohydrate phloem loading and transport in plants.

Animal Sciences

Paul Ebner, Patricia "Scotti" Hester, Brad Kim, Shihuan Kuang, Jon Schoonmaker and **Heng-wei Cheng** hosted undergraduate students from Zhejiang University and Taiwan University for the 10th Summer Research for Chinese Students.

Heng-wei Cheng also hosted two visiting graduate students from China in his lab in April and August 2015.

Alan Mathew, Department Head of Animal Sciences, hosted a Chinese delegation and Elanco affiliates for a tour of Animal Sciences and Animal Sciences Research and Education Center. The guests represented the top 20 Chinese feed mills, including technical directors, managers, owners and nutritionists.

The Animal Sciences Department has had an outstanding year hosting visiting scholars from Brazil, China, Egypt, Korea, and United Kingdom.

Alan Mathew, Shihuan Kuang, and Heng-wei Cheng visited the College of Animal Science of Zhejiang University to discuss joint education and research efforts.

Alan Mathew and Heng-wei Cheng visited Sichuan Agricultural University to discuss joint education and research efforts.

John Patterson led a study abroad spring break trip with 10 students to the Netherlands and Belgium.

Michael Schutz continued in his second year as an external reviewer for curriculum in Animal Breeding and Management for the Animal Sciences Department at University College in Dublin, Ireland. Schutz traveled to Ireland to review instruction, exams, and student performance and consulted with faculty on dairy breeding projects. Schutz traveled to the University of Caldas in Manizales, Colombia, as an invited speaker on genetic approaches to reducing somatic cell counts in milk at a national workshop on mastitis

in dairy cattle. While in Colombia, he also met with several groups about US models for university involvement in Extension.

Biochemistry

Clint Chapple traveled to Vancouver, Canada, in July to present a seminar, *Transcriptional feedback mechanisms that impact lignin biosynthesis in Arabidopsis*, at the 25th International Conference on Arabidopsis Research (ICAR 2014) at the University of British Columbia. In August, he presented the same talk in Umea, Sweden, at the Lignin 2014 Biosynthesis and Utilization conference. Dr. Chapple also traveled to Copenhagen, Denmark, to serve on a PhD defense committee and present a talk, *Interplay between the regulation of lignin biosynthesis, glucosinolate, and anthocyanins*, at the University of Copenhagen.

Natalia Dudareva traveled to Xiamen, China, in July and presented a talk, *Plant aromatic amino acid network: what's left to know?* at the 3rd International Conference on Plant Metabolism. That same month, her postdoc traveled to Alberta, Canada, and presented a talk, titled *Export of phenylalanine from plastids is mediated by a cationic amino acid transporter*, at the 4th Banff Conference on Plant Metabolism. Dudareva traveled to Europe and served on several review boards. She was a member of the Scientific Advisory Board for a Center of Excellence on Plant Sciences (CEPLAS), Heinrich-Heine University, Dusseldorf, Germany; Peer Review Committee for the Graduate School "Experimental Plant Sciences," Wageningen, The Netherlands; and a member of the review board for the Leibniz Institute for Vegetable and Ornamental Crops in Großbeeren and Erfurt, Großbeeren, Germany.

Humaira Gowher traveled to India to give a talk, *Modulators of DNA methylation and their role in gene expression*, at the International Conference on Cellular and Molecular Mechanisms of Disease Processes meeting at the University of Kashmir as well as in the Department of Clinical Biochemistry at Kashmir University. She also presented this talk for the Department of Biochemistry at the Indian Institute of Sciences in Bangalore. During her visit to India, specifically, Kashmir, which is also her hometown, Gowher was invited to speak to life sciences undergraduate students, especially women, to tell them about her experiences as a woman scientist in work-life balance and ways to meet the challenges of pursuing an academic career. Her interview was also published in few local journals and in a newspaper. <http://www.kashmirlife.net/into-genes-vol06-issue10-59390/>

Additionally, Dr. Gowher traveled to Nassau, Bahamas, and presented a talk titled *Modulators of DNA methylation* at the FASEB meeting on Biological Methylation. A graduate student from Saudi Arabia, joined the Gowher lab. A postdoc from China also joined in the Gowher lab for 9 months, as well as a postdoc from New Delhi.

Andy Tao and his postdoc traveled to Geneva, Switzerland, to attend the International Mass Spectrometry Society meeting. Andy gave a keynote talk titled *Proteomic mapping high resolution kinase network*. From there, Andy traveled to Zurich, Switzerland, to meet with Professor Bernard Bodenmiller at the University of Zurich. During the same trip, he and Anton also visited Paris, France, where he met Biochemistry alumnus Juan Martinez.

Tao traveled to Shanghai, China. He was invited to present two seminars in the Key Laboratory of Glycoconjugates Research, Ministry of Public Health, Institutes of Biomedical Sciences at Fudan University. His first seminar was *Mapping high resolution kinase-substrate network*, and the second seminar was *Soluble nanoparticles to study cellular entry and drug targets*. Tao also traveled to Beijing and gave a talk entitled *Mass spectrometry-based targeted proteomics* at the Beijing Institute of Technology (BIT).

Feng Wang joined the Tao lab as a visiting scholar in February. Feng received her MS and PhD from the College of Forestry Resources & Environment at Nanjing Forestry University.

A graduate student in the Tao lab attended the 65th Lindau Nobel Laureate Meeting held in Lindau, Germany. Only the 650 most qualified young scientists can be given the opportunity to enrich and share the unique atmosphere of the Lindau Nobel Laureate Meetings. A graduate student from northern India in the Department of Chemistry joined the Tao lab.

Beth Tran traveled in August to Stockholm, Sweden, where she presented a talk titled *Unexpected mechanisms for long non-coding RNAs in transcriptional poising* at the Regulatory RNAs in Microbes Symposium.

Tran was elected to the Board of Directors for The RNA Society. The RNA Society is an international scientific organization of over 1,000 members worldwide. Tran will serve on the Board for the 2016-17 calendar years.

Mark Hall traveled to Ottawa, Canada, where he presented a seminar, titled *Substrate recognition by the anaphase-promoting complex: new insights and therapeutic implications*, at the University of Ottawa Medical School.

Botany and Plant Pathology

Tom Creswell traveled to Bangladesh in November 2013, March 2014 and August 27- September 5, 2014, to join a team from the USDA-Foreign Agricultural Service to visit that country's major agricultural universities and agricultural research institutes to evaluate strengths and seek opportunities for collaboration across traditional boundaries of research, plant problem diagnostics and Extension. A consensus report from the team found significant opportunity for collaboration between the US plant health program and Bangladesh Phytosanitary Laboratories. The US team supported and organized the first of a series of conferences intended to facilitate collaboration and synergies between disparate research centers, regulatory agencies and universities; with the ultimate goal of benefiting Bangladesh agriculture and trade. The conference was held in August 2014 with representatives from major agriculture research institutions and universities in attendance. Tom presented talks on the National Plant Diagnostic Network (NPDN) model of collaboration among diagnostic labs in the US. The conference culminated in a unanimous vote by attendees to pursue development of a national network of research laboratories modeled after the NPDN.

Creswell was invited to St. John's University, Grenada, to conduct a plant problem diagnostics workshop Sept. 22-26, 2014. Participants included plant protection authorities and diagnosticians from Dominica, Cayman Islands, Jamaica, Grenada, British Virgin Islands, St. Lucia, Trinidad and Tobago and other Caribbean nations. Field sampling was conducted to teach the participants the importance of good sample collection practices for quality diagnosis. Tom delivered daily classroom training on plant disease diagnosis, fungal morphology and classification. Each participant also engaged in extensive hands-on laboratory work with diseased samples to apply concepts learned in the classroom.

In February 2015, Tom Creswell, Gail Ruhl, and Dan Egel provided approximately 10 hours of in-laboratory experience in diagnosing plant disease to five visitors from the Faculty of Agriculture of Herat University, Afghanistan. The visitors also received classroom training and lab experience in entomology, IPM training and horticulture as part of an 11-day immersive program arranged by Kevin McNamara.

Entomology

Rick Foster continued to serve as graduate advisor for an Afghanistan student from Herat, who has now completed three of his four years of dissertation research. Foster also served as graduate advisor of a student from Kabul who successfully completed all the requirements for an MS degree in fall 2014.

He hosted and mentored a visiting faculty fellow from Herat University in Afghanistan for one semester. In addition to taking two classes and participating in research and Extension activities, the faculty fellow completed a manuscript for publication based on a research project that he completed prior to coming to Purdue. The research project was designed in collaboration with Steve Weller.

In addition, Foster hosted and mentored four young faculty from Herat University in an intensive training fellowship. He taught an IPM class and co-taught, with Peter Hirst, a class on research methods and involving fellows in various Extension activities. Foster hosted an undergraduate student from Colombia. Foster and a postdoctoral scientist at Purdue supervised the student's research project on biological control of pests of tomatoes and cucumbers grown in high tunnels.

Cliff Sadof completed his sabbatical leave and Fulbright Fellowship in Madrid in July 2014. He continued to work with the National Socio-Environmental Synthesis Center in Maryland on issues of international trade in live plant material. This group published the first of several articles in May 2015 on international phytosanitary policy. Cliff also took on a Colombian Student Intern with experience in the Colombian rose export industry. In addition, he co-published an international article, *International differences in national phytosanitary legislations and regulations, despite common basis*, in *Environmental Science and Policy*.

Steve Yaninek collaborated with Steve Weller, Maria Marshal, Jim Simon (Rutgers) and African collaborators in three countries on an African Indigenous Vegetable project called the *USAID Horticulture CRSP Indigenous African Leafy Vegetables for Enhancing Livelihood Security of Smallholder*

Farmers in Kenya, Tanzania and Zambia. It is funded by the USAID Horticulture Innovation Lab. The research focused on the occurrence and abundance of pests on African indigenous vegetable varieties under different fertilizer treatments and seasons.

Food Science

Amanda Deering trained Afghans on the use and basic principles of hermetic storage, in Herat, Afghanistan.

Andrea Liceaga attended the 5th Trans-Atlantic Fisheries Technology Conference in Nantes, France. The conference focused on mechanisms for better utilization of aquatic resources. Dr. Liceaga and her graduate student presented their research results on the effect of microwave-assisted hydrolysis on functional properties and antioxidant activity of proteins derived from fish by-products.

Food, Agriculture and Culture of Spain is a study abroad course — Study Abroad and International Learning (SAIL) from the Office of International Programs (IP). Dr. Liceaga and Dr. San Martin took a group of Purdue undergraduate students to visit different regions of Spain. The group visited the country's capital (Madrid), Toledo and the northern region of Spain, including cities such as Llanes, Pamplona, San Sebastian, and Barcelona. Within the 14-day visit, they learned about the production process for different food and beverages, such as *Manchego* cheese, apple cider, *Pamplona chorizo*, and anchovies. The group also visited a winery in the Rioja-Alavesa region and several cultural, historical and UNESCO world-heritage sites.

Suzanne Nielsen participated in the "Academic Week" of the Fuli Institute of Food Science at Zhejiang University in Hangzhou, China, May 27-30, 2014. She is a member of the Academic Committee for the Institute, which has a special program for select Food Science undergraduate students that includes covering the expenses for the students to study abroad one semester. In the fall, five of the students in this program spent the semester studying at Purdue University.

Forestry and Natural Resources

Tomas Hook served on the board of the International Association of Great Lakes Research, which involved collaboration with researchers from around the world, with particular strong Canadian involvement. Dr. Hook spent March-July 2015 in Sweden working in collaboration with researchers at Uppsala University. Drs. Hook, Dunning and Jacobs continued to co-lead an International Natural Resources course in collaboration with North Carolina State University and SLU (Swedish University of Agriculture). In 2014, this course was based in the Maritimes of Canada, and in 2015 the course was based in Sweden and Norway.

Rick Meilan met with a contingent from Utsunomiya University in Japan to discuss the potential for collaboration. In 2015, a proposal was submitted to the NATO Science for Peace and Security program with colleagues from Ukraine (Dr. Nataliya Kutsokon, Institute of Cell Biology and Genetic Engineering) and Germany (Dr. Konstantin Krutovsky, Department of Forest Genetics and Forest Tree Breeding, Büsgen-Institute, Göttingen University).

Liz Flaherty attended the 7th International Colloquium on Arboreal Squirrels in Helsinki Finland, June 1-5, 2015.

Carl Eckelman engages in ongoing cooperative communications with Mohammad Derikvand of the University of Tehran. He gave advice to Andy Graham concerning drying of wood in Togo, Africa, along with information concerning manufacture and export of wood constructed of teak. He communicated with Okolo Emmanuel concerning his sawmill and furniture manufacturing program in Nigeria since his graduation from the University of Ibadan. He also helped Ziga Amelia Lang with his master's program at Eduardo Mond Lane University in Mozambique—and is member of his graduate committee. In addition, he continued to cooperate with Ali Kasal and Yusuf Erdil at Mugla University in Turkey concerning allowable design values for furniture joints.

Marisol Sepulveda visited Utsunomiya University in Japan in March 2015. She was invited by the International Office at Utsunomiya. She then hosted a visit to Purdue by faculty from the same university in September 2015. Three of her PhD students are international, from China and Egypt.

Paul Brown hosted two visiting scholars from China; Dr. Liu Bo, Associate Professor, Chinese Academy of Fisheries Science, Freshwater Fisheries Research Center, Wuxi, and Dr. Amin Wang, Associate Professor, Department of Ocean Technology, Yancheng Institute of Technology, Yancheng.

Guofan Shao participated in collaborative research activities at the Chinese Academy of Sciences and China Jilin Forest Industry Group. He jointly published research articles with scientists from these two organizations. He supervised three visiting scientists from China. He gave presentations at Xiamen University and the Institute of Urban Environment, Chinese Academy of Sciences. He organized a meeting between forestry professionals from the China Jilin Forest Industry Group and the Indiana Economic Development Corp. in Indianapolis.

Songlin Fei is actively involved in international research collaborations. He presented his research at several international conferences and was invited as a keynote speaker for the Eighth International Symposium of Modern Ecology in Tianjin, China. He currently serves as the Secretary for the Asian Ecology Section of the Ecological Society of America and a board member for the IUFRO Biological Invasions Task Force.

Douglas Jacobs served as Editor-in-Chief of *New Forests* (Springer Publishers), an international journal on the biology, biotechnology, and management of afforestation and reforestation. Jacobs organized and hosted the 2nd International Union of Forest Research Organizations (IUFRO) Restoring Forests Symposium in Lafayette, Indiana, (Oct 2014). He also co-instructed FNR460 (International Natural Resources Program), an international exchange course in collaboration with the Swedish Agricultural University (SLU), which was held in northern Sweden and Norway. Jacobs hosted visiting international scientists from Beijing Forestry University, China; Austral University, Chile; University of Alcalá, Spain; and Zhejiang University, China.

Horticulture and Landscape Architecture

Steve Hallett and **David Umulis** led a study abroad trip to China in May/June 2015 entitled *China: Globalization, Agriculture and Environment*. Fifteen students traveled by train from Beijing to Xi'an, Lehan, Kunming, Guilin and Hon Kong investigating environmental and agricultural issues. Steve Hallett visited western Kenya to assist a graduate student who is investigating the role of African Indigenous leafy greens in nutritional security in sub-Saharan Africa.

HLA Professor **Mike Dana** and **Rosie Lerner**, Extension Consumer Horticulture Specialist, led a 12-day Master Gardener study tour of the Gardens of Northern England and Wales. Twenty-five Master Gardeners from Indiana and six other states received advanced training by studying and experiencing 15 historic and contemporary landscapes in the regions of Yorkshire, Lake District, West Midlands, and Wales.

Hazel Wetzstein gave an invited lecture at the International Horticulture Research Conference in Nanjing, China, on the "Reproductive Biology and Selection of Superior Genotypes of the Medicinal Plant, *Artemisia* annual." She made a second presentation to a meeting in Nanjing of professional administrators of Chinese Graduate Schools on *The U.S. Graduate Student: Training the Next Generation of Scholars*. During a visit to the Chenshan Botanical Garden in Shanghai, she presented an overview of the Purdue Department of Horticulture and Landscape Architecture.

Jules Janick consulted and presented a lecture in Guangdong Higher Education Institute, South China Agricultural University. Janick also attended an International Symposium on Loquat in Palermo. He presented papers and was editor of the Proceedings.

Stephen Weller is the PI for the Horticulture Innovation Laboratory project on African Indigenous Vegetables (AIVs) the first phase of this project ended in September 2014 and a new phase two project was funded in December 2014 for five years. Both phases one and two involved activities in Kenya, Tanzania, and Zambia and collaborators from Purdue University and Rutgers University in the US. Activities included an end of project symposium in Kisumu, Kenya that was attended by collaborators from all the African host countries and US collaborators and involved summary talks and posters on project activities and accomplishments. Presentations were given from representatives of the Kenyan USAID Mission, Kenyan Agriculture and Livestock Research Organization (KALRO) and Jomo Kenyatta University of Agriculture and Technology. The project involved investigations on improved AIV germplasm, agriculture production systems and pest management, methods for improved storage and drying and nutritional composition of the AIVs – Amaranth, Nightshade and Spiderplant and connections of farmers to markets, which is basically the "Value Chain." Emphasis was placed on connecting smallholder farmers with markets in all countries. The second phase of the Horticulture Innovation Laboratory AIV project emphasizes the contributions of AIVs to a nutritious diversified diet and how increased consumption can contribute to improved health of consumers. Additionally, research and outreach on improved production practices and connections to markets are also being conducted. Activities

to date have included surveys of farmer households, market stakeholders and assessments of the health status of populations and their consumption patterns.

Weller attended the annual meeting of the Horticulture Innovation Laboratory project in Zambia in February 2015 and the International Horticulture Congress in Brisbane, Australia, in August 2014, where he presented two talks on the African AIV project and an invited talk on the AIV Value Chain in Eastern Africa.

Weller is involved with IITA in Nigeria on a Gates Foundation-funded project to develop improved weed management systems for cassava production. This project in its second year of a five-year project and involves evaluation of herbicides for weed management and coupling herbicide use with improved cultural practices to better manage problem weeds and improve yield and quality. This project involves collaboration between IITA and various chemical companies in the evaluation project and studies both soil applied herbicides for preemergence weed management and postemergent foliar applied herbicides.

Youth Development and Agricultural Education 2014-15 International Highlights

Allen Talbert traveled with Jerry Peters and 19 agricultural education students to Jamaica for the study abroad courses EDCI 20500 and EDCI 28500. The base of operations for the study abroad program is the College of Agriculture, Science, and Education (CASE) in Port Antonio, Jamaica. This is the largest group in the more than 10 years of this study abroad program. This year one honors students, in conjunction with a graduate student and Renee McKee, presented a 4-H Agriculture Innovator Challenge project, sponsored by Monsanto and National 4-H Council, on alternative energy/windmills. A sophomore in Agricultural Education presented to Jamaican high school students in an Agricultural Education classroom. The project focused on giving youth an opportunity to problem-solve and connect with real-life agricultural issues, while working in teams to create a solution to the proposed problem.

Jerry Peters presented a portion of the effective teaching strategies workshop materials using WebEx. Thanks to Director Andrew Kovarik of the AEMIP Project for his assistance with WebEx. Peters served as a host and mentor to Gilles Kone, a Borlaug Fellow, from the country of Mali during Kone's 10-week stay at Purdue.

Peters also traveled to Wageningen, The Netherlands, to present two research posters at the 2015 AIAEE Conference. His poster — *Follow Up Study of the AF-PAK Workshops on Strengthening Extension Skills of Young Pakistani Professionals: Trainers and Trainees Perspective* — was 1st runner-up in the Poster Presentation – Open Division.

Neil Knobloch presented an abstract, *Parra Salina, C.A., & Knobloch, N.A. (2014, May). Colombian High School Students' Motivation Regarding a Dual-Credit Agricultural Education Program in a Post-Conflict Rural Community*, at the annual meeting of the Association for International Agricultural and Extension Education Conference in Miami, Florida. He also hosted Professor Carlos Parra, Faculty of Agricultural Management, University of Caldas, Manizales, Colombia, in 2014-15 as a visiting scholar at Purdue.

In addition, Dr. Knobloch co- advised and visited a YDAE graduate student from Malawi, Africa (2015).



In Zambia: Students in the service learning course to Zambia utilized crops in Ndola to figure out the best source of protein in an economic and sustainable fashion for swine at Rivendale Farms.