

**FY 2013 ANNUAL REPORT**

**Feed the Future Innovation Lab for Collaborative Research on Grain Legumes**

**(Legume Innovation Lab)**

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## **Countries Where the Legume Innovation Lab is Active**

West Africa: Benin, Burkina Faso, Ghana, Niger, Senegal

Eastern and Southern Africa: Malawi, Mozambique, Tanzania, Uganda, Zambia

Latin America and Caribbean: Guatemala, Haiti, Honduras, Ecuador, Nicaragua

# Program Partners in the Legume Innovation Lab

## U.S. Partner Universities and Institutions

Iowa State University  
Kansas State University  
Michigan State University  
North Dakota State University  
University of California-Riverside  
University of Illinois at Urbana-Champaign  
University of Hawaii-Manoa  
University of Nebraska  
University of Puerto Rico  
U.S. Department of Agriculture/ARS- Tropical Agriculture Research Station, Puerto Rico  
U.S. Department of Agriculture/ARS- Michigan

## West African Partner Institutions

- Crops Research Institute, Kumasi, Ghana
- Institut de l'Environnement des Recherches Agricoles (INERA), CRREA-Centre Saria, Burkina Faso
- Institut de l'Environnement des Recherches Agricoles (INERA), Laboratoire d'Entomologie Agricole, Kamboinse, Burkina Faso
- l'Institut National de Recherche Agronomique du Niger (INRAN), Maradi, Niger
- Institut National des Recherche Agricole du Bénin (INRAB), Cotonou, Republic of Benin
- Institut Sénégalais de Recherches Agricoles (ISRA), Bambey, Senegal
- International Institute for Tropical Agriculture (IITA Benin), Cotonou, Republic of Benin
- Savannah Agriculture Research Institute (SARI), Tamale, Ghana

## Eastern and Southern African Partner Institutions

- Instituto de Investigação Agrária de Moçambique (IIAM), Maputo, Mozambique
- Lilongwe University of Agriculture and Natural Resources, Malawi
- National Crops Resources Research Institute (NaCRRI), Namulonge, Uganda
- Makerere University (MUK), Kampala, Uganda
- National Agriculture Research Lab (NARL), Soil Fertility and Control Unit, Uganda
- Sokoine University of Agriculture (SUA), Morogoro, Tanzania
- University of Zambia (UNZA), Department of Agricultural Economics and Extension, Lusaka, Zambia
- Zambian Agriculture Research Institute (ZARI), Misamfu, Zambia

## Latin American and Caribbean Partner Institutions

- Dirección de Ciencia y Tecnología Agropecuaria (DICTA) - Tegucigalpa, Honduras
- Escuela Agrícola Panamericana- Zamorano, Honduras

- Instituto de Ciencias y Tecnologías Agropecuarias (ICTA), Guatemala
- Instituto Interamericano de Cooperación para la Agricultura (IICA), Puerto Prince, Haiti
- Instituto Nacional de Investigaciones Agropecuarias (INIAP), Quito, Ecuador
- Instituto Nicaraguense de Tecnología Agropecuaria (INTA) - Managua, *Nicaragua*.
- National Seed Service (NSS), Ministry of Agriculture, Haiti

## Acronyms

ARS	Agricultural Research Service
BTD	Bean Technology Dissemination
CRSP	Collaborative Research Support Program
CSB	Community Seed Banks
cwt	Hundredweight (100 pounds)
IPM	Integrated Pest Management
MAS	Marker Assisted Selection
MO	Management Office
MSU	Michigan State University
MT	Metric Tons
NA	Not applicable
NARS	National Agricultural Research Systems
NGOs	Non-governmental Organizations
PI	Principal Investigator
SO	Strategic Objective
TMAC	Technical Management Advisory Committee
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

Note: Institutional acronyms for partners found in the previous section: Program Partners in the Legume Innovation Lab.

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## **I. Executive Summary**

The Feed the Future Innovation Lab for Collaborative Research on Grain Legumes (Legume Innovation Lab) is a four and a half year extension (April 1, 2013 – September 29, 2017) of the Dry Grain Pulses CRSP administered by Michigan State University. The program’s research portfolio contributes to USAID’s Feed the Future Global Food Security Research Strategy priority theme of “enhancing nutritional quality of diets through increased consumption of nutrient dense foods” such as grain legumes. The Strategic Objectives for the Legume Innovation Lab’s portfolio of research and capacity building projects include: (1) To substantively and sustainably increase grain legume productivity by improving adaptation to diverse agro-ecologies and reducing smallholder farmer vulnerability to climate change, with special consideration for the livelihoods of women; (2) To transform grain legume-based systems through improved smallholder production management decision making and improved understanding of consumer behavior and decision making; (3) To improve the nutritional quality of diets and to enhance the nutritional and health status of the poor, especially women and young children, through the consumption of edible grain legume-based foods; and (4) To improve outcomes of legume research and capacity building projects and to assess impacts to improve decision making regarding future investments. Nine projects involving multidisciplinary teams of scientists from ten U.S. universities and the USDA/ARS collaborate with national agricultural research system (NARS) and university scientists in 11 Feed the Future focus countries in West and Eastern/Southern Africa and Central America and the Caribbean. Target outputs of Legume Innovative Lab research with the potential to be “game changers” and benefit substantial numbers of smallholder grain legume farmers and consumers include: Mesoamerican climbing bean varieties of the preferred market class, black *bolonillo*, with high yield potential and disease resistances; multiple genes for durable bruchid (bean weevil) resistance bred into varieties of several common bean market classes in Central America and the Caribbean; improved common bean varieties with resistances to economically important diseases, high N fixation capacity and shortened cooking time for Eastern Africa; tepary bean lines with large seed size and adaptation to drought; insect resistance genes (e.g., aphid, thrips, pod sucking insects) identified and molecular markers developed in cowpea; strategies and tools developed to scale up sustainable biological controls for integrated pest management (IPM) of insect pests in cowpea production systems in West Africa; decision management tools developed to aid farmers in sustainable soil fertility management; and new knowledge on the role of grain legumes in diets as related to gut microbiome ecology, intestinal health and function, and nutrition of young children in developing countries. Under the Bean Technology Dissemination Associate Award, over 23,000 farmers were reached with quality seeds of improved varieties in Guatemala, Haiti, Honduras, and Nicaragua, and many of those farmers also received Rhizobium inoculants to improve productivity. Impact assessment is ongoing to evaluate productivity gains as well as the effectiveness of the Community Seed Bank model.

## **II. Program Activities and Highlights**

FY 2013 (October 1, 2012 – September 30, 2013) was a transition year for the Feed the Future Innovation Lab for Collaborative Research on Grain Legumes (Legume Innovation Lab). The

Management Office oversaw the completion of Phase II and III projects under the Dry Grain Pulses CRSP (Pulse CRSP) and the preparation of Five Year Technical and Financial Reports for USAID. At USAID's request, Technical and Cost Applications for the Legume Innovation Lab were also submitted to USAID. On March 28, 2013, USAID and Michigan State University signed a contract extending the program from April 1, 2013 to September 29, 2017 with projected total estimated funding of \$25,500,000.

The priority of the Management Office (MO) during the first six months of the program (4/1/2013-9/30/13) was to align the seven continuing projects with Feed the Future strategic priorities and the Legume Innovation Lab's strategic objectives as defined in the Technical Application. To achieve this, the MO implemented the following four-step process.

1. The Technical Management Advisory Committee (TMAC) reviewed the "prospectuses" for the continuing projects and formulated recommendations to strengthen them (i.e., definition of appropriate research objectives, selection of FTF focus countries, selection of institutional partners, use of effective research approaches and methods, etc.).
2. Project team planning meetings were convened in host countries, with all partners plus representatives from the TMAC, the MO and USAID present, for the six projects to be funded under the Legume Innovation Lab. The following project documents were prepared by each project team.
  - Technical Description for 4.5 year projects (April 1, 2013 – September 29, 2017)
  - Project Budget (April 1, 2013 – September 29, 2017)
  - FY 2013-14 Workplan for project (April 1, 2013 – September 30, 2014)
  - Semi-Annual Milestones of Technical Progress (April 1, 2013 – September 30, 2014)
  - FTF Performance Indicators for FY 13, 14 and 15
  - Project Impact Pathway Plan
3. The TMAC evaluated the continuing projects' documents, discussed various issues with the MO and USAID at a meeting in Madison, Wisconsin (July 20-22, 2013), and prepared written guidance to Lead-U.S. PIs on recommended changes to the continuing projects.
4. In consultation with project teams, the Lead U.S. PIs revised the project documents and resubmitted them to the MO at MSU by mid-September 2013. The MO conducted a final review to ensure satisfactory response to TMAC recommendations.

In October and November 2013, the MO proceeded with the preparation of amendments to the subcontracts for seven continuing projects (SO1.A3, SO1.A4, SO1.A5, SO1.B1, SO2.1, SO2.2 and SO4.1) and the obligation of FY 2013-2014 funds.

On Sept. 3, 2013 the MO also issued an RFP for preproposals for the nutrition project (SO3.1).

### **III. Key Accomplishments in FY 2013**

- Prepared a Five-Year Technical Report of the Dry Grain Pulses CRSP that ended in March 31, 2013. The report was distributed to partner U.S. and Host Country institutions, USAID country missions, CGIAR legume scientists and public and private sector stakeholders of the Pulse CRSP.

- At USAID’s request, following a positive review of the Pulse CRSP by the USAID-commissioned External Evaluation Team, the Management Office at Michigan State University submitted Technical and Cost Applications for the Feed the Future Innovation Lab for Collaborative Research on Grain Legumes to Charles Jackson, OAA-USAID on January 20 2013.
  
- The Management Office (MO) facilitated and oversaw a process to ensure TMAC evaluation of seven continuing projects under the Legume Innovation Lab and portfolio alignment with USAID’s Feed the Future strategic priorities and the Legume Innovation Lab’s strategic objectives as defined in the Technical Application. Seven project team planning meetings (see below) were convened with all partners and MO, TMAC and USAID representatives to plan and prepare the following project documents: Technical Descriptions of 4.5 year projects, FY 2013-14 Workplans of research and capacity building activities, Budgets, FTF Performance Indicator Targets for FY2013-15, and Impact Pathway Plans.
  - May 13-18, 2013      SO1.A3 Project Planning Meeting in Quito, Ecuador
  - May 16-18, 2013      SO1.A4 Project Planning Meeting in Mayaguez, Puerto Rico
  - May 29-31, 2013      SO2.2 Project Planning Meeting in Lusaka, Zambia
  - June 5-7, 2013        SO1.B1 Project Planning Meeting in Accra, Ghana
  - June 27-31, 2013     SO2.1 Project Planning Meeting in Maputo, Mozambique
  - June 10-12, 2013     SO1.A5 Project Planning Meeting in Saly, Senegal
  
- The Technical Management Advisory Committee met on July 20-22, 2013 in Madison, Wisconsin, to evaluate technical and budgetary documents for continuing projects and advise the MO, USAID and Lead PIs on recommended changes to strengthen.
  
- MSU proceeded with the preparation of amendments to subcontracts for continuing projects and obligations of FY 2013-14 funds once satisfactory revised project documents were received from Lead U.S. project PIs.
  
- The MO prepared and issued on September 3, 2013 a “Request for Pre-Proposals” for research focusing on *“Improving the Nutrition of the Poor, Especially Young Children and Women, through Grain Legume Consumption”*. A total of 13 pre-proposals were received by the October 2013 deadline and sent out to external peer reviewers without any conflicts of interest.
  
- MSU recruited and hired Angelica Santos as the new Administrative Officer (September 2013). Our previous Administrative Officer, Ben Hassankhani, unexpectedly passed away in April 2013 after more than 10 years of distinguished service.
  
- The Bean Technology Dissemination (BTD) Associate Award distributed seeds and inoculants to farmers in Guatemala, Honduras, Nicaragua and Haiti. In Guatemala, 4,250 farming households were reached with quality seeds of improved varieties and over 3,500 doses of Rhizobium

inoculum were distributed in FY2013. For Honduras, the project funded the production of 15 metric tons of registered seeds of small red bean market class varieties which were multiplied to be able to reach 11,300 farmers, each receiving 20 pounds of quality seed. Collaboration with the Escuela Agrícola Panamericana (EAP)-Zamarano enabled the additional production of 2.3 MT of foundation seed for multiplication and dissemination by nongovernmental organizations (NGOs) in strategic locations in Honduras. The project also succeeded in disseminating Rhizobium inoculum to 5,000 farmers in two different regions of the country. The productivity gains of improved seeds and inoculants are being assessed with the impact assessment study underway.

- The BTD project focused on Community Seed Banks (CSBs) in Nicaragua, supporting 225 CSBs which planted over 230 hectares of quality declared seeds, expected to produce over 148 MT, which will be distributed for the upcoming planting season (December 2013) to reach 15,000 farmers. Also, 11,000 doses of Rhizobium inoculum were also produced by our partners at EAP-Zamorano for distribution by the Instituto Nicaraguense de Tecnología Agropecuaria (INTA). In Haiti, over 8,000 farmers received certified seed of variety Arifi Wuriti and DPC-40, along with a dose of Rhizobium inoculum produced under the project by the University of Puerto Rico.

#### **IV. Research Program Overview and Structure**

The Legume Innovation Lab research program (FY 2013 – 2017) has been organized under four Strategic Objectives that are aligned with the priority research themes in USAID's Feed the Future Global Food Security Research Strategy.

Strategic Objective 1. (SO1) *Advancing the Productivity Frontier: To substantively and sustainably increase grain legume productivity by improving adaptation to diverse agroecologies and reducing smallholder farmer vulnerability to climate change, with special consideration for the livelihoods of women*

Strategic Objective 2. (SO2) *Transforming Grain Legume Systems and Value Chains:*

To transform grain legume-based systems through improved smallholder production management decision making and more effectual governance management of grain legume value chains by stakeholders, including smallholder farmers and consumers

Strategic Objective 3. (SO3) *Enhancing Nutrition: To improve the nutritional quality of diets and to enhance the nutritional and health status of the poor, especially women and young children, through the consumption of edible grain legume-based foods*

Strategic Objective 4. (SO4) Improving Outcomes of Research and Capacity Building: To improve outcomes of legume research and capacity building projects and to assess impacts to improve decision making regarding future investments

Since the Legume Innovation Lab is an extension of the Dry Grain Pulses Collaborative Research Support Program (FY 2007 – 2012), seven of the Legume Innovation Lab projects (SO1.A3, SO1.A4, SO1.A5, SO1.B1, SO2.1, SO2.2, SO4.1) are continuing and two (SO1.A1 and SO3.1) will be new awards. The continuing projects were selected as a result off an extensive evaluation of project technical performance conducted by the Technical Management Advisory Committee. Even though seven projects are continuing for an additional 4.5 years, most of these projects include new U.S. and host country collaborating PIs and the addition of a new FTF focus country.

The SO1.A1 project to be led by North Dakota State University (Dr. Juan Osorno, Lead PI) is a spin-off of the SO1.A4 project lead by the University of Puerto Rico (Dr. James Beaver, Lead PI). This project was established at the advisement of the TMAC in an effort to give greater research focus to the genetic improvement of Middle American Climbing Beans, an under-exploited common bean gene pool. This new research initiative is strongly supported by the USAID Mission to Guatemala which has requested the preparation of Technical and Cost Applications for an Associate Award project (“NutriFrijol”) that would benefit indigenous farmers in the highlands of Guatemala and lead to increased household bean productivity, food security, and consumption for enhanced child nutrition.

The nutrition research project (SO3.1) will be competed through the issuance of an RFP and awarded in FY 2014. This project will be an ideal complement to Strategic Objectives 1 and 2 and enable the Legume Innovation Lab to generate new knowledge on the role of grain legumes in diets (e.g., gut microbiome bacterial ecology and stability, mucosal health and immune function, intestinal nutrient absorption, child nutrition and growth). This new knowledge is expected to inform public health policy, the planning of more effective nutrition interventions and the development of improved technologies.

## **V. Research Project Reports**

### ***a) Strategic Objective 1: Advancing the Productivity Frontier***

**To substantively and sustainably increase grain legume productivity by improving adaptation to diverse agroecologies and reducing smallholder farmer vulnerability to climate change, with special consideration for the livelihoods of women**

*SO1.A: To substantively enhance the genetic yield potential of grain legumes by exploiting new research tools afforded by genomics and molecular breeding approaches (e.g., marker assisted selection (MAS)), with a focus on improving resistances to economically important abiotic and biotic constraints that limit yield in the agro-ecological regions where legumes are commonly grown in Africa and Latin America*

i) **SO1.A1 Project- *Genetic Improvement of Middle-American Climbing Beans for Increased Yield, Disease Resistance and Adaptation to the Guatemalan Highlands***

(1) Dr. Juan Osorno, Lead PI, North Dakota State University

(2) Project Description and Objectives:

- Breeding and release of two improved varieties of black *bolonillo* grain type climbing beans suited for production under the traditional mixed cropping *milpa* system by smallholder farmers in the Guatemalan highlands.
- Genetic characterization of Middle-American climbing bean germplasm for new trait discovery and the potential identification of markers for important traits.
- Assessment of farmer preferences for bean agronomic and seed traits and for potential domestic market demand for *bolonillo* bean in domestic markets
- Development of a long-term breeding objectives and strategy for the genetic improvement of Middle-American climbing beans to be implemented by ICTA – Guatemala.

(3) Collaborators

- Julio Cesar Villatoro, HC PI, ICTA-Chimaltenango, Guatemala
- Karla Garcia, ICTA, Guatemala
- Dr. Fernando Aldana, ICTA-Quezaltenango, Guatemala
- Dr. Phil McClean, North Dakota State University

(4) Achievements

Convened a new project team planning meeting in Xela, Guatemala, on November 20-23, 2014 to develop a Technical Project Description and Budget for a 45 month (January 1, 2014 to September 29, 2017) project, a FY 2014 workplan, establish FTF Performance Indicators and a project impact pathway plan.

(5) Capacity Building (Not initiated in FY 2013 as project had not yet been subcontracted.)

(6) Lessons Learned (NA)

(7) Presentations and Publications (NA)

ii) **SO1.A3 Project- *Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)***

(1) Dr. James Kelly, Lead PI, Michigan State University

(2) Project Description and Objectives:

Common bean (*Phaseolus vulgaris* L.) is the most important grain legume consumed in Ecuador, Uganda and Zambia. Improved bean genotypes from Ecuador have a potentially significant spinoff in terms of the high potential for adaptation to upland farming systems in East Africa. Building on international bean germplasm, but particularly on the Ecuador germplasm, an opportunity exists to develop and deploy

improved bean varieties, using a combination of traditional and the latest molecular plant improvement techniques. An improved understanding of plant traits and genotypes with resistance to multiple stresses from abiotic (drought) and biotic (root rot and foliar pathogens) sources will provide unique genetic materials for enhanced plant breeding methods and sources to study plant tolerance mechanisms. Improvements in current understanding of the physiology of drought and evapo-transpiration and the genetics of drought tolerance in common bean and the development of effective molecular and quantitative methods for the selection of drought tolerance are needed. The development of improved bean varieties and germplasm with high yield potential, healthy root systems, improved biological nitrogen fixation (BNF) with resistance to multiple diseases, and sustained or improved water use efficiency under limited soil water conditions are needed to increase profit margins, and lower production costs. The project will use QTL analysis and SNP-based genome-wide association mapping to uncover regions associated with drought tolerance, disease resistance, enhanced BNF and shorter cooking time. Results of this project would contribute to improved yield, farm profitability and human resources in the host countries and indirect benefit to participating U.S. Institutions and bean producers.

Objectives:

- Integrate traditional and marker-assisted selection (MAS) approaches to combine resistances to economically important foliar diseases, drought and improved biological nitrogen fixation (BNF) and assess acceptability of fast cooking, high mineral content in a range of large-seeded, high-yielding red mottled, white and yellow Andean bean germplasm for the Eastern Africa highlands (Zambia and Uganda), Ecuador and the U.S.
- Characterize pathogenic and genetic variability of isolates of foliar pathogens collected in Uganda, Zambia and Ecuador and identify sources of resistance to angular leaf spot (ALS), anthracnose (ANT), common bacterial blight (CBB), bean common mosaic virus (BCMV) and bean rust present in Andean germplasm.
- Use single nucleotide polymorphism (SNP)-based genome-wide association mapping to uncover regions associated with drought tolerance, disease resistance, cooking time and BNF to identify QTLs for use in MAS to improve Andean germplasm.
- Develop phenometric approaches to improving the efficiencies of breeding for abiotic stress tolerance, especially drought.
- Contribute to institutional capacity building and training in plant genetics in Zambia and Uganda

(3) Collaborators

- Karen Cichy, USDA-ARS, East Lansing, MI
- Wayne Loescher, Dept. Horticulture, MSU
- James Steadman, University of Nebraska, Lincoln
- Carlos Urrea, - University of Nebraska, Scottsbluff
- Eduardo Peralta – INIAP, Quito, Ecuador
- Stanley Nkalubo – NaCCRI, Namulonge, Uganda
- Kennedy Muimui – ZARI, Kasama, Zambia

(4) Achievements *(NA as amendment to subcontract was not completed in FY 2013)*

(5) Capacity Building *(NA as amendment to subcontract was not completed in FY 2013)*

(6) Lessons Learned *(NA)*

(7) Presentations and Publications *(NA)*

***iii) SO1.A4 Project- Development and implementation of robust molecular markers and genetic improvement of common and tepary beans to increase grain legume production in Central America, Haiti and Tanzania.***

(1) Dr. James Beaver, Lead PI, University of Puerto Rico

(2) Project Description and Objectives:

This Legume Innovation Lab project brings together host country and U.S. scientists with a range of experience using traditional and molecular plant breeding techniques, promising bean breeding lines and germplasm and the capacity to provide the training needed to contribute to the goals of the U.S. Government's global hunger and food security initiative (Feed the Future). The primary output of this project will be the development, release and dissemination of common bean cultivars in Central America, Haiti and Tanzania with enhanced disease/pest resistance and greater tolerance to abiotic stress. Drought and heat tolerant tepary beans will be bred for improved seed and agronomic traits and greater disease resistance. The next generation of breeder-friendly molecular markers linked with pathogen resistance genes will be developed. This should improve the efficiency and effectiveness of selection for traits of economic importance. Graduate and undergraduate training will be supported by the project to address the need to strengthen bean research programs in the target countries. In-service training and workshops will be sponsored to improve the quality and reliability of field research and to permit target country breeding programs to take advantage of molecular tools to increase efficiency of selection of traits of economic importance.

Objectives:

- Genetic improvement of common and tepary beans for Central America and Haiti

- Genetic improvement of common beans for the lowlands of Central America and Haiti
- Improve agronomic traits and disease resistance of climate resilient tepary bean.
- Develop and implement robust molecular markers for disease and resistance genes.
- Institutional capacity building for Central America and Haiti

(3) Collaborators

- Consuelo Estevez de Jensen – Univ. of Puerto Rico
- Timothy Porch – USDA/ARS/TARS
- Phil Miklas – USDA/ARS
- Juan Osorno and Phil McClean – North Dakota State University (NDSU)
- Juan Carlos Rosas – Escuela Agrícola Panamericana (Zamorano), Honduras
- Julio Cesar Villatoro - Instituto de Ciencia y Tecnología Agrícola (ICTA), Guatemala
- Emmanuel Prophete– National Seed Service, Ministry of Agriculture, Haiti
- Paul Kusolwa and Susan Nchimbi-Msolla – Sokoine University of Agriculture (SUA), Tanzania

(4) Achievements *(NA as amendment to subcontract was not completed in FY 2013)*

(5) Capacity Building *(NA as amendment to subcontract was not completed in FY 2013)*

(6) Lessons Learned

The TMAC recommended to the SO1.A4 project team that the National Bean Breeding Program of Tanzania, located in Uyole in the Southern Highlands, be integrated into the project along with SUA. The Tanzanian component of the SO1.A4 project was delayed until partners could meet and effectively plan collaborative research activities.

(7) Presentations and Publications *(NA)*

***iv) SO1.A5 Project- Genetic improvement of cowpea to overcome biotic stress and drought constraints to grain productivity***

(1) Dr. Phil Roberts, Lead PI, University of California-Riverside

(2) Project Description and Objectives

Cowpea is a highly nutritious grain legume crop vitally important to food security in sub-Saharan Africa, especially for women and children, where it complements cereals in diets. However, in the Sudano-Sahel region of West Africa, typical smallholder farmer cowpea yields are only 10-20% of known yield potential. Biotic stresses caused by insect pests and diseases caused by pathogens, parasitic plants and nematodes, and abiotic stresses from drought and low fertility soils are primary constraints to cowpea grain production. This project will focus on cowpea breeding with emphasis on insect tolerance and resistance traits. More specifically, tolerance and resistance to aphids,

flower thrips and pod-sucking bugs will be pursued through trait discovery and molecular-driven breeding selection to generate improved cowpea varieties. Field and laboratory-based phenotyping in Burkina Faso, Ghana and Senegal will be matched with SNP marker high-throughput genotyping to identify and select for target QTL. Advanced breeding lines will be tested regionally across the host countries to broaden their release potential. In addition, several near-release advanced lines will be performance tested for full release decisions in Burkina Faso and Senegal, capitalizing on previous USAID CRSP investment. In California, cowpea dry grain novel market classes of breeding lines will be advanced together with leveraged funding in support of the US dry bean industry. Primary capacity building in each of the host countries will be achieved by graduate degree training in cowpea breeding and genetics, coupled with short-term annual training of NARS scientists in molecular breeding.

Objectives:

- Discover QTL for insect resistance and apply in molecular breeding for target regions in West Africa and the US
- Complete release and validation of advanced cowpea lines developed under the Pulse CRSP in Burkina Faso, Senegal, and US.
- Increase capacity of NARS in Burkina Faso, Ghana and Senegal to serve the cowpea sector.

(3) Collaborators

- Issa Drabo & Jean-Baptiste Tignegre, Institut de l'Environnement et des Recherches Agricole (INERA), Koudougou and Kamboinse, Burkina Faso
- Ibrahim Atokple & Francis Kusi, Savanna Agricultural Research Institute (SARI), Tamale, Ghana
- Ndiaga Cisse, Centre National Recherches Agronomie, Bambey, Institut Senegalais de Recherches Agricole (ISRA) & CERAAS, Thies, Senegal
- Timothy J. Close, Dept. Botany and Plant Sciences, University of California- Riverside

(4) Achievements *(NA as amendment to subcontract was not completed in FY 2013)*

(5) Capacity Building *((NA as amendment to subcontract was not completed in FY 2013)*

(6) Lessons Learned *(NA)*

(7) Presentations and Publications *(NA)*

b) ***Strategic Objective SO1. B: To sustainably reduce the yield gap for selected grain legume crops produced by smallholder, resource-poor farmers in strategic cropping systems***

i) ***SO1.B1 Project- IPM-omics: Scalable and sustainable biological solutions for pest management of insect pests of cowpea in Africa***

(1) Dr. Barry Pittendrigh, Lead PI, University of Illinois at Urbana-Champaign

(2) Project Description and Objectives

Cowpea is an important protein source for tens of millions of West Africans living under \$2 a day. The major biotic constraint on cowpea crops in West Africa is an insect pest complex. Pesticides and/or transgenics will not provide the long-term solutions needed to bring these pest populations below economic thresholds needed by cowpea farmers – the only remaining logical strategy all of these Integrated Pest Management involving a pipeline of diverse pest control solutions. Our program is focused on the development and deployment of scalable pest control solutions involving a combination of traditional pest control and deployment strategies and cutting-edge technologies, including genomics and GIS to help direct the most effective deployment of these approaches, as well as testing and deploying cutting-edge ICT tools as part of the scaling of these solutions. Our program, termed IPM-omics, involves defining the pest problems, bringing forward appropriate solutions through a biocontrol/biopesticide pipeline, and scaling of solutions through multipronged strategies that will include farmer field flora, ICT approaches, women’s cooperatives and partnerships with small-scale industries. We have and will continue to develop online interfaces that make our outcomes easily available to other groups who can benefit from the materials and we will continue develop approaches where we can share solutions with outsiders groups that can help in the scaling and sustainability of these solutions. We will develop, deploy, and test training/technology packages/programs that will be passed-off to groups (e.g., NGOs, national/ international agencies) and we will determine the potential for impact with this approach.

Objectives:

- Define the pest problems – Use a mixture of field studies and molecular tools to define the pest population on cowpea across multiple ecological zones in Ghana, Burkina Faso, Niger, and Benin.
- Discover, document, and set the stage for scaling of appropriate solutions. This will involve the continued development of appropriate solutions, through host plant resistance traits, a biocontrol/biopesticide pipeline, and other solutions that can involve local educational programs.
- Scaling of solutions – Develop and deploy tangible outputs for scaling of our IPM solutions
- Capacity building – Build institutional capacity through a diversity of educational programs that range from graduate student and technician training to ICT technologies

(3) Collaborators

- Dr. Manuele Tamò, IITA-Benin
- Dr. Clémentine Dabiré-Binso, INERA-Burkina Faso
- Dr. Ibrahim Baoua, INRAN-Niger
- Dr. Stephen Asante, SARI, Ghana
- Dr. Haruna Braimah, CRI- Ghana
- Dr. Julia Bello-Bravo, UIUC Co-PI
- Dr. Leonard Hinnou, INRAB-Benin

- (4) Achievements (*NA as amendment to subcontract was not completed in FY 2013*)
- (5) Capacity Building (*NA as amendment to subcontract was not completed in FY 2013*)
- (6) Lessons Learned (*NA*)
- (7) Presentations and Publications (*NA*)

**c) Strategic Objective 2. (SO2) Transforming Grain Legume Systems and Value Chains**

***To transform grain legume-based systems through improved smallholder production management decision making and more effectual governance management of grain legume value chains by stakeholders, including smallholder farmers and consumers***

**ii) SO2.1 Project- *Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize-Bean Production Systems***

- (1) Dr. Robert Mazur, Lead PI, Iowa State University
- (2) Project Description and Objectives

Poor and declining soil fertility is the primary constraint to common bean productivity among smallholder farmers in Africa, affecting cropping systems, food security, nutrition, incomes, and livelihoods. Adoption of improved crop management practices, particularly regarding soil fertility, has been modest. Our central premise is that addressing soil-related constraints requires understanding farmers' current practices and enhancing their capabilities in diagnosing and finding solutions to yield constraints.

To contribute to widespread and sustainable improvements in bean productivity and soil fertility, our research objectives are to: (1) characterize smallholder farmers' agricultural motivations, current knowledge and practices, problem diagnoses, and livelihood and risk management strategies; (2) develop and refine models about their decision making; (3) develop and validate appropriate diagnostic and decision support aids; and (4) develop and assess the effectiveness of innovative approaches for dissemination of information and decision support aids, training, and follow-up technical support.

Working with smallholder farmers in rain-fed maize-bean cropping systems in Masaka district in Uganda and Gurué district in Mozambique, at 1000-1200m altitude with

annual rainfall 1000-1500mm, our approach and methods involve: (1) participatory rural appraisal and baseline surveys for activity planning, taking into account critical social, economic and cultural factors that impact decision making and adoption of new strategies and technologies, and for monitoring changes over time; (2) farmer innovator and scientific analyses of soil-related constraints; (3) participatory on-farm studies using identified possible solutions; (4) participatory, gender equitable development and validation of diagnostic and decision support aids; and (5) development and pilot-testing of innovative socio-technical approaches for communication, dissemination, and scaling up.

Objectives:

To contribute to widespread and sustainable improvements in bean productivity and soil fertility management, our research objectives are to:

- Characterize farmers' motivations, current knowledge and practices, problem diagnoses and solutions, and livelihood and risk management strategies;
- Develop and refine models about farmers' decision making;
- Develop and validate appropriate diagnostic and decision support aids;
- Develop and assess the effectiveness of innovative approaches for dissemination of information and decision support aids, training, and follow-up technical support; and
- Enhance institutional research capacity relative to grain legumes.

(3) Collaborators

- Eric Abbott - Iowa State University (ISU)
- Andrew Lenssen - Iowa State University (ISU)
- Ebby Luvaga - Iowa State University (ISU)
- Russell Yost - University of Hawai'i at Manoa (UHM)
- Julia Bello-Bravo - University of Illinois at Urbana-Champaign (UICU)
- Barry R. Pittendrigh - University of Illinois at Urbana-Champaign (UICU)
- Moses Tenywa - Makerere University (MUK), Uganda
- Onesimus Semalulu - Soils & Agro-meteorology Unit, National Agricultural Research Laboratories (NARL), Uganda
- Ricardo Maria - Institute of Agriculture Research of Mozambique (IIAM)

(4) Achievements *(NA as amendment to subcontract was not completed in FY 2013)*

(5) Capacity Building *(NA as amendment to subcontract was not completed in FY 2013)*

(6) Lessons Learned *(NA)*

(7) Presentations and Publications *(NA)*

iii) **SO2.2 Project- Enhancing Value Chain Performance through Improved Understanding of Consumer Behavior and Decision-Making**

(1) Dr. Vincent Amanor-Boadu, Lead PI, Agriculture Economics, Kansas State University

(2) Project Description and Objectives

Despite their high nutritional profile and knowledge about their nutritional benefits, grain legumes are not high on the food hierarchy in Malawi, Tanzania and Zambia. The challenge confronting producers and their supply chains is how to enhance their competitiveness in their local markets and get the necessary policy support from their government to sustain it. This project seeks to make two critical contributions to this challenge. First, it seeks to develop a clearer appreciation of the factors influencing grain legume consumption in the three countries to provide empirical direction for market and policy development. Second, it seek to provide training and capacity building support for the industry's stakeholders to seize identified opportunities and address existing and emerging challenges. When this project succeeds, it will contribute to creating value in the grain legume value chain.

The project has three integrated dimensions: An empirical foundation for understanding factors and their influence on food choices; application of the empirical results in crafting policies and facilitating knowledge and skill development in managing value chains; and developing and delivering outreach programs to help both private and public stakeholders improve the performance of grain legume value chains. These activities contribute to supporting strategies and initiatives that enhance the wellbeing of smallholder producers. This project, therefore, provides innovative and unique pathways that bring smallholder producers and public and private stakeholders together to help achieve the underlying objectives of the Feed the Future initiative.

Objectives:

- Identify and analyze the factors shaping bean/cowpea consumption and their relative positions in consumers' food rankings in the selected countries.
- Conduct situation analyses for bean/cowpea production and marketing/distribution systems with a view to identifying the nature and extent of the gaps in their value chains.
- Implement formal and informal capacity building initiatives to address identified gaps and support value chain management capacity across the grain legume industry in the focus countries.

(3) Collaborators

- Gelson Tembo, University of Zambia
- Lawrence Mapemba, Lilongwe University of Agriculture and Natural Resources
- Fredy Kilima, Sokoine University of Agriculture
- Allen Featherstone, Kansas State University
- Kara Ross, Kansas State University

- (4) Achievements (*NA as amendment to subcontract was not completed in FY 2013*)
- (5) Capacity Building (*NA as amendment to subcontract was not completed in FY 2013*)
- (6) Lessons Learned (*NA*)
- (7) Presentations and Publications (*NA*)

**d) Strategic Objective 3. (SO3) Enhancing Nutrition**

***To improve the nutritional quality of diets and to enhance the nutritional and health status of the poor, especially women and young children, through the consumption of edible grain legume-based foods***

- iv) SO3.1 Project- TBD. The Management Office issued an RFP that will hopefully lead to the award in early 2014 of a \$3 million four-year nutrition research project.

**e) Strategic Objective 4 (SO4) Improving Outcomes of Research and Capacity Building**

***To improve outcomes of legume research and capacity building projects and to assess impacts to improve decision making regarding future investments***

**v) SO4.1 Project- Impact Evaluation**

- (1) Dr. Mywish Maredia, Lead PI, Michigan State University

(2) Project Description and Objectives

Building on the momentum and experience gained over the last three years, this project proposes to contribute towards evidence-based rigorous ex ante and ex post assessments of outputs, outcomes and impacts of research with the goal of assisting the Legume Innovation Lab program and its Management Office (MO) to achieve two important goals--accountability and learning. Greater accountability (and strategic validation) is a prerequisite for continued financial support from USAID and better learning is crucial for improving the effectiveness of development projects and ensuring that the lessons from experience – both positive and negative – are heeded. Integrating this culture of ‘impact assessment’ in publicly funded programs such as the Legume Innovation Lab will ultimately help increase the overall impact of such investments. The project team proposes to provide technical leadership in the design, analysis and collection of baseline and end line data to conduct ex ante (i.e., potential) and ex post (i.e., realized) impact assessment of the Legume Innovation Lab’s investments in research, institutional capacity building and technology dissemination in Africa, Latin America and the U.S. It also proposes to conduct systematic analysis of existing data or

conduct field studies to address strategic research questions on the role of grain legumes in household food security, nutrition and income.

Objectives:

- Provide technical leadership in the design, collection and analysis of data for strategic input and impact evaluation
- Conduct ex ante (i.e., potential) and ex post (i.e., realized) impact assessment of the Legume Innovation Lab’s investments in research, institutional capacity building and technology dissemination in Africa, Latin America and the U.S.
- Build institutional capacity and develop human resources in the area of impact assessment research

(3) Collaborators

- Eric Crawford, Agriculture, Food and Resource Economics, Michigan State University
- Byron Reyes, Agriculture, Food and Resource Economics, Michigan State University

(4) Achievements *(NA as amendment to subcontract was not completed in FY 2013)*

(5) Capacity Building *(NA as amendment to subcontract was not completed in FY 2013)*

(6) Lessons Learned *(NA)*

(7) Presentations and Publications *(NA)*

## VI. Associate Award Project Reports

***a) Improving Seed Systems in Central America and Haiti: Lessons Learned from the Strategic Investment in Rapid Technology Dissemination Project in Guatemala, Nicaragua, Honduras and Haiti (Bean Technology Dissemination-BTD)***

(1) Bureau of Food Security, USAID/Washington; Associate Award No. AID-OAA-LA-10-00007

(2) Project Description

The Bean Technology Dissemination (BTD) project (“Strategic Investment in Rapid Technology Dissemination: Commercialization of Disease Resistant Bean Varieties in Guatemala, Nicaragua, Honduras and Haiti”) addresses the shortage of high-quality bean seed of improved varieties available to resource-poor farmers in Haiti, Guatemala, Honduras and Nicaragua. Besides the dissemination of improved seed varieties, the technology package included training on other productivity-enhancing practices such as the use of *Rhizobium* inoculum. In Guatemala, Honduras and Nicaragua, the program also focused on organizing groups of smallholder farmers to multiply quality-declared seed of improved varieties to achieve sustainable “seed security” at the community level following the “Community Seed Bank”(CSB) model.

In FY 2013, the BTD project is proud to have successfully completed three years of activities that started in October 1, 2010. The project built a strong foundation with National Agriculture Research Systems (INTA-Nicaragua, DICTA-Honduras and ICTA-Guatemala) plus other private and public sector partners (EAP-Zamorano Honduras, UPR, IICA-Haiti, and several NGOs) to achieve the bean seed dissemination goals. Of particular importance were the projects in Guatemala and Haiti, two of the Feed the Future's focus countries where rapid technology dissemination reached over 50,000 households.

### (3) Collaborators

In Guatemala, the BTD Project continued to work with the Fundacion para la Innovacion Tecnologica, Agropecuaria y Forestal-FUNDIT. The role of FUNDIT as the principle subcontractor for the BTD project in Guatemala, involved the effective and timely management of funds invested with the Instituto de Ciencia y Tecnologia Agricolas-ICTA. FUNDIT worked closely with ICTA's technical personnel to ensure that activities were carried out in accord with the annually developed Scope of Work and Budget.

For the third consecutive year, the leadership of the BTD project in Honduras was vested in Escuela Agricola Panamericana (EAP/Zamorano). Within EAP/Zamorano, the Bean Research Program (PIF) led by Dr. Juan Carlos Rosas, was responsible for coordinating, planning and implementing the work plan and for monitoring the use of funds allocated for these purposes. To accomplish the BTD project's ambitious goals during Year 3, MSU extended a subcontract with the Direccion de Ciencia y Tecnologia Agropecuaria (DICTA) to reach in geographic areas where EAP/Zamorano did not have strong partners such as in the eastern region of the country, the Departments of Olancho and Atlantida. Although DICTA continued to receive funds directly from MSU, the MO specified in the sub-contract with DICTA that planning and implementation of BTD activities needed to be closely coordinated with EAP/Zamorano as the lead institution for the project in Honduras.

In Nicaragua, Instituto Nicaraguense de Tecnologia Agropecuaria (INTA)'s Bean Program (PF) has been a partner from the beginning of the BTD initiative in October, 2010. As the government's institution with a mandate to produce basic and registered seed, INTA is held in high regard by Government of Nicaragua authorities as the designated institution to bring technology to small- and medium-holder farmers. INTA has been a good partner for the BTD project and has invested consistently in the BTD project with new and ambitious ideas to achieve sustainability in rural bean seed systems, particularly through Community Seed Banks (CSBs).

The MO also collaborated with the Inter-American Institute for Cooperation on Agriculture (IICA) as the major partner to help us accomplish project objectives in Haiti.

IICA's long term presence in Haiti has been vital to establishment of close relationships with the Government of Haiti and a network of NGOs involved in agriculture development in the country. Another key partner to the BTB project's success in Haiti has been the University of Puerto Rico (UPR). UPR played an integral role in the BTB project's implementation in Haiti providing technical know-how, materials and ready-to-apply *Rhizobium* inoculum of different strains tested in field settings in Haiti.

#### (4) Achievements in FY 2013

##### Guatemala Highlights

The BTB project completed the multiplication of 2000 qq (91 MT) of four major improved common bean varieties making it possible to reach over 18,000 farmers with a 10 lb bag of quality declared seed. Although the final monitoring and evaluation results have not been computed, anecdotal experience confirms that farmers receiving seed this year experienced increases in productivity, particularly in the Western Highlands where over 4,250 farming households were reached. This year, the project also disseminated over 3,500 doses of *Rhizobium* inoculum. Although the technology has been welcomed by farmers, the impact of this practice continues to provide inconsistent results from one production region to another. A final project report will take a closer look at the return on investment of the *Rhizobium* technology in enhancing bean productivity based on the three years of experience gained through the BTB project.

##### Honduras Highlights

In FY 2013 in Honduras, the BTB project supported the production of 330 hundredweight (cwt) of "registered" seed of improved varieties of the small-red bean market class, which was later multiplied into qualified seed to reach a target of 11,300 farmers. In addition, EAP-Zamorano also produced over 50 cwt of "foundation" seed for Honduras that was distributed to collaborating NGOs in strategic locations in the country for additional multiplication and dissemination.

In Honduras, 20 pound sacks of seed were the unit of distribution to smallholder farmers, higher than other countries. Nearly 2,300 cwt was distributed to 11,300 new pre-selected bean producers in targeted communities in FY 2013 during two growing seasons. EAP/Zamorano supervised the production and distribution of over 1,400 cwt of qualified seed, while DICTA reproduced 600 cwt with individual farmers and 260 cwt in their own experimental stations.

The project also succeeded in disseminating *Rhizobium* inoculum to 5,000 farmers in two different regions of the country. Although the value of this technology to low input smallholder bean production remains to be validated, EAP-Zamorano and the University of Puerto Rico (UPR) have reported a significant increase in bean productivity in field

research demonstration plots where *Rhizobium* inoculum was applied. These findings continue to motivate the distribution and promotion of this technology in the four target countries.

#### Nicaragua Highlights

As the project entered this third year of activities, INTA reconsidered its selection of beneficiary Community Seed Banks (CSBs) and decided to expand its efforts into new regions of the country with demonstrated higher productivity potential. As a result, 225 CSBs were supported in FY 2013 and planted over 230 hectares of quality declared seed of improved red bean varieties, expected to produce 148 MT. Although the dissemination of the produced seed is taking place from December through January, the expected amount of beneficiaries this year is 15,000 with 20lb each, allowing room for potential production shortages as is typical in bean production. Nicaragua also focused on acquiring 11,000 doses of *Rhizobium* inoculum this year. The inoculum was produced by EAP/Zamorano. Since the project was awarded a no-cost extension, the dissemination of the produced seed is taking place from December 2013 through January 2014 to supply farmers with bean seed for the “apante” season. The expected number of beneficiaries this year is 15,000 each receiving 20 lb from the 3,250 cwt produced. Even with large dissemination effort, seed shortages are projected as is typical in many regions of Nicaragua. INTA also acquired and distributed 11,000 doses of *Rhizobium* inoculum this year. The inoculum was produced by EAP/Zamorano.

#### Haiti Highlights

This year, 45 metric tons of certified seed DPC-40 and Arifi Wuriti were disseminated to over 8,000 farmers in Haiti. For the December 2012 growing season, the project targeted farmers in low valleys disseminating 5 MT of Arifi Wuriti and 5 MT of DPC-40. During the March 2013 (the start of the largest growing season in the highlands), 5 MT of Arifi Wuriti and 25 MT of DPC-40 were disseminated. The July 2013 season targeted production areas in the highlands and low valleys with 10 MT of DPC-40. Most of the farmers that received seed were also provided a dose of *Rhizobium* inoculum multiplied by UPR.

#### (5) Capacity Building

Various training activities were carried out in the four project countries during Year 3 (FY 2013). Among the most salient were training sessions to technicians supporting the technology dissemination process in Guatemala where MAGA extension agents were critical to reaching farmers in rural communities. These trainings included themes covering seed production, agronomic crop management practices, use of *Rhizobium* inoculum, harvest practices, post-harvest handling of grain and seed conditioning practices. Training to technicians from partner organizations and leaders of Community

Seed Banks has been a worthy activity and vital to achieving technology dissemination goals.

Two training courses for 50 technicians involved in the production and distribution of seed were also conducted at EAP/Zamorano. These trainees, in turn, were tasked with the training of seed producers and the final beneficiaries through local training activities in each participant country. The courses included technicians from Honduras, Nicaragua, Guatemala and Haiti. The principal topics of focus in FY 2013 were seed production, crop management, seed conditioning and postharvest handling, taught by staff of the PIF and Bean Seed Unit in EAP/Zamorano.

Regional-level training was also carried out by EAP/Zamorano during the third year at the Applied Biotechnology Laboratory. The training was designed for 15 technical personnel from BTD partner institutions in the four countries. The feedback on the benefits of this training was immediate. For instance, in Guatemala, one of the trainees (Karla Ponciano) has already made excellent progress in culturing *Rhizobium*. Inoculants from her lab have been produced and used for validation in on-farm trials by ICTA. In Haiti, slow progress has been made in spite of the training provided to four trainees, two of them with doctorate degrees, and the continuing strong support of Dr. Consuelo Estevez from UPR. In Nicaragua, in spite of good lab facilities and equipment and trained personnel at INTA under this project, inoculant production has not been initiated yet. As a result, it was necessary to prepare a large amount of inoculant for Nicaragua at Zamorano for distribution in FY 2013. Dr. J.C. Rosas visited INTA and its technical personnel during the second half of the year to review assistance need for *Rhizobium* culture as related to inoculant production for national seed distribution programs.

A short course on bean seed production management practices was also offered in Honduras to PRR technicians and farmers from CIALs from the Lago Yojoa region in October 2012. During the following months seed training activities were focused farmer groups (CIALs) involved in “qualified” seed production and distribution under the project. During FY 2013, more than 50 farmers were trained on various aspects of seed production, including field site selection, planting density, fertilization, disease, insect and weed management practices, identification and elimination of atypical plants (rogueing) and harvest practices. During the postharvest stage, training was provided seed handling and drying using such technologies as plastic tunnels, seed classification, storage and packaging.

## (6) Lessons Learned

Over the past three years, the BTB project has enabled over 100,000 farmers to access and to plant improved bean varieties, provided critical training to leader farmers on seed multiplication, and strengthen ties between smallholder farmer groups and extension and technical staff of NARS, particularly in Guatemala, Honduras and Nicaragua. This relationship is critical for smallholder farmer to be able to access technical assistance. In addition, the BTB project was able to reach farmers in extremely remote rural communities through partnership with NGOs such as in Honduras, Guatemala and Haiti. As the MO evaluates its achievements in bean seed dissemination, several questions remain to be answered. Where will farmers in these four countries be able to access quality seed of improved bean varieties in the future? How sustainable was the community seed bank model for bean seed multiplication and dissemination? What elements are important and provide incentives for sustainable bean systems to continue and to provide smallholder resource poor farmers access to quality seed of improved varieties at an affordable price. Through the assessment study that was conducted by Dr. Mywish Maredia and her team in Honduras, Guatemala and Nicaragua, we hope to learn from the experience of the BTB project.

In assessing the situation in Haiti, a hard reality is that a high percentage of smallholder bean farmers reached by the BTB project will continue to face limitations to accessing to seed of improved bean seed varieties in the future. This is due both to the financial means of the Haitian farmers but also to the wide geographic locations of the bean production areas. The cost for transport of bulky bean seed from the site of production/packaging to the sites of need for commercial planting by farmers is high, thus limiting access to resource poor farmers. It has been the experience of the project that, on average, for every \$1 invested in seed multiplication at least \$1.25 was spent on transportation and distribution to farmers in rural communities. The cost of reaching remote communities in Haiti was much higher than in any other location targeted by the project.

Clearly, therefore, the lowest cost system for seed production involves farmer ownership of the seed multiplication enterprise and the production of seed in the rural communities, close to where farmers will be planting their bean crops. The community seed bank model is also attractive because of the multiplier effect and the potential to disseminate seed to large numbers of farmers at relatively low cost for a NARS.

## **VII. Human and Institutional Capacity Development**

FY 2013 was primarily a period for planning activities under the Feed the Future Legume Innovation Lab. Planning meetings were convened in host countries for each project, ensuring the participation of all principal investigators and lead researchers. A key component of the

planning meetings was to develop more fully the human and institutional capacity building plans of the partners, taking into account national priorities as well as program needs and the country-level Feed the Future Strategy. In many cases, the team took the opportunity to meet with local USAID Mission staff to ensure that country priorities were included, both in the overall work plan and in the capacity building investments.

During these dynamic planning meetings, the projects indicated investing in long term training for thirty students in doctoral and masters' programs in the US, Africa and Central America, with more being recruited to start in the Fall of 2014. Approximately 30% will be doctoral level students with the remaining in MS or MBA programs, and researchers expect twenty two of the trainees to come from sub-Saharan Africa. Until candidates for training are recruited and meet the entrance requirements for the training institution, we are unable to give more specific numbers of trainees per country, sex, and area of study. During the planning meetings, needs for formal training programs were identified in plant breeding and genetics, entomology, agribusiness, soil science, sustainable agriculture, and other fields. In many cases, researchers identified the need to train young scientists before a large cadre of senior scientists retires, as with Sahelian cowpea breeding. Initially, seventeen trainees are expected to have full funding under the Legume Innovation Lab with eight trainees on partial funding and five more students with funding levels yet to be determined. By leveraging funds from different sources the researchers are able to work with a larger number of trainees. Host country institutions include Mozambique's Institute for Agricultural Research (IIAM), Uganda's Makerere University, University of Zambia, Ghana's Savanna Agricultural Research Institute (SARI), and Burkina Faso's Institute for Environmental and Agricultural Research (INERA).

Key components in the Legume Innovation Lab projects are the short term training activities that are programmed for Central America, West Africa and East and Southern Africa in FY2014 for an estimated 3190 men and 2940 women. Training topics include the following: 1) design and use of discrete choice experiments in consumer preferences in Zambia, Tanzania and Malawi; 2) use of molecular markers in a range of sub-Saharan and Central American sites; 3) drought and disease screening methods in Zambia and Uganda; 4) integrated pest management (IPM) and use of biocontrols with a West African regional training program focused on cowpeas; 5) use of information and communication technologies with IPM in West Africa, 6) training on identification of soil quality and constraints in Mozambique and Uganda; and 7) approaches to impact assessment in many of the host countries with the Management Office's impact assessment team and the impact assessment project (SO4.1). Coordination among the projects during and after the planning meetings is enabling projects to develop joint training sessions or a sequence of training programs on molecular markers, across cowpeas and common beans. Other opportunities may arise in future years for increasing the impact of short term training materials.

In addition to the training programs, the Legume Innovation Lab allocates funding for institutional capacity development. The planning workshops enabled principal investigators and

leading researchers in host countries to identify specific areas of investment. In the case of Mozambique, a vehicle will be purchased in FY 2014 to enable legume researchers of IIAM to operate in the central production zones, funded out of the project budget since it will be critical for bean researchers to operate in Central Mozambique, under project SO2.1.

The Legume Innovation Lab also has a special funding mechanism for capacity building investments requested by the host countries to leverage the project funding and expand the institutional base for the research. There will be a call for proposals from host country institutions issued in January 2014 for final selection in May after TMAC and Management Office review. In the past, host country institutions have appreciated the added flexibility of these special funds directed to their institutions. Additional funds have been requested for investments such as irrigation pumps for seed production and special training programs for their researchers that have not been funded in the country budgets.

- a. Training by Country
  - i. Short-Term *(TBD and reported in FY 2014 once projects are initiated)*
  - ii. Long-Term *(TBD and reported in FY 2014 once projects are initiated)*

## **VIII. Governance and Management Entity Activity**

As highlighted in the Key Accomplishments of this document, this has been a period of major activities for both the MO and the TMAC.

- MSU and USAID signed a modification (on 3/28/2013) for (1) a four-and-a-half-year program extension of the performance period (April 1, 2013 through September 29, 2013); (2) an increase in the total estimated amount by \$25,500,000 from \$14,014,000 to \$39,514,000; (3) an increase in the total obligated amount by \$4,469,908 from \$14,014,000 to \$18,483,908; (4) revision of the budget and inclusion of international travel approval delegation language; (5) incorporation of the Recipient's revised proposal, dated March 4, 2013, into Attachment B of award; (6) incorporation of a revised Branding Strategy and Marking Plan into Attachment D of the award; (7) revision of the cost share amount contained in the award; and (8) change of the name of the project activity.
- The Management Office (MO) facilitated and coordinated the TMAC's review of seven continuing project prospectuses to ensure alignment with USAID's Feed the Future Global Food Security Research Strategy (including definition of appropriate research objectives, selection of strategic focus countries, etc.), partnership with appropriate U.S. and host country institutions to achieve research goals, and priority attention to host country institutional capacity building. The TMAC provided comments and recommendations to guide project teams in the planning of research and capacity building projects for FY 2013 – 2017.

- Subcontracts with continuing Lead U.S universities were amended to fund project team planning meetings. Six planning meetings were convened in May and June 2013 which resulted in the preparation of project documents that would be the basis of future amendments and obligations of funds. Planning meetings included further training of the teams on the development of impact pathways, with MO support.
- A meeting of the Technical Management Advisory Committee in Madison, Wisconsin, was organized and held on July 20-22, 2013 during which technical and budgetary documents for continuing projects were reviewed and guidance provided to the Management Office, USAID and to Lead PIs regarding recommended changes to strengthen these future projects.
- The MO provided guidance to project teams to prepare revised technical and budgetary documents for the seven continuing projects to ensure that they satisfactorily responded to the TMAC recommendations, and initiated the establishment of amendments to the Lead U.S. universities to obligate new funds. The goal was to have the subcontracts in place so that planned research and capacity building activities might commence in 2014. During November and December 2014, the Legume Innovation Lab was able to amend the subcontracts of the extended projects.
- After extensive consultations with nutritionists and other scientists, the Directors prepared and issued on September 3, 2013 a “Request for Pre-Proposals” for research focusing on “Improving the Nutrition of the Poor, Especially Young Children and Women, through Grain Legume Consumption”. A total of 13 pre-proposals were received before the October 2013 deadline and sent out to external peer reviewers without any conflicts of interest. In early FY2014, selected institutions will prepare full proposals for further review by MO, TMAC and selected scientists at US universities who have no conflict of interest.
- Under the BTD Associate Award in FY 2013, the Management Office of the Legume Innovation Lab completed the third and final year of the Bean Technology Dissemination (BTD) associate award funded by USAID’s Bureau of Food Security. The project is believed to have exceeded its goal of disseminating quality seed of improved common bean varieties and rhizobium inoculum developed with USAID investments through the Bean/Cowpea and Pulse CRSPs to 120,000 farmers in Guatemala, Honduras, Nicaragua and Haiti. A six-month no-cost extension was approved by USAID (until March 31, 2014) for the project to ensure that the most recent planting season results can be assessed. The success of this project in contributing to the establishment of sustainable seed multiplication systems (following the Community Seed Bank model) and improving smallholder productivity of common bean has caught the attention of the Guatemalan and Honduran USAID Missions.

- After the unexpected loss of Ben Hassankhani in April 2013, the MO was able to bring Angelica Santos onto the staff, replacing temporary hire Patty Cotter. Ms. Santos has been working to clear a large backload of contracts and payments, with the assistance of MSU's Contracts and Grants Office as well as the Office of Sponsored Programs and administrators of the College of Agriculture and Natural Resources.

## **Appendix: Success Stories**

Success Story 1: Farmer and Youth Groups in Niger Learn Biological Pest Control for Cowpea

Success Story 2: Grain Legume Value Chains in Zambia Benefit Diverse Stakeholders

Success Story 3: New High Yielding Cowpea Varieties Afford Hope to Smallholder Farmers in the Sudano–Sahel Region of West Africa

Note: Higher resolution photographs in attached JPG files.

## Success Story 1: Farmer and Youth Groups in Niger Learn Biological Pest Control for Cowpea

Contact: Dr. Barry Pittendrigh, University of Illinois, Urbana Champaign; Email: [pittendr@illinois.edu](mailto:pittendr@illinois.edu)

More than 500 boys and girls in the villages of Boutotchi and Garin Jari in southern Niger now possess the tools to identify and address the problems of field pests, specifically the pod borer *Maruca vitrata*, in their family's cowpea fields, helping secure their villages' food and income sources.



Youth from the village of Garin Jari in Southern Niger who attended one of the Farmer Field Schools to learn biological cowpea pest control. Photograph by Laouali Amadou.

Cowpea is a staple crop that helps ensure food security in many parts of Niger. Pod borers can devastate cowpea production in the field, so addressing the problem is critical for smallholder farmers. In this particular region, losses from *Maruca vitrata* can reach 70 to 80 percent.

Through collaboration between the University of Illinois at Urbana Champaign and the l'Institut National de la Recherche Agronomique du Niger, modified Farmer Field Schools in the villages have provided these youth (50 percent girls) with in-field training on how to use neem seed extracts in combination with the *Maruca vitrata* virus to kill cowpea pests in the field. Teaching these pest management skills to young people, who are often more

open to new technologies than their parents, not only brings these innovations into their families' current cropping and management systems but also ensures greater pest management on these farms in the future, when these youth will play a more active role in the farm's management.

The value of this pest control combination is high. Neem spray is a liquid insecticide processed from the seeds of the neem tree, a drought-tolerant tree widely available in parts of Sub-Saharan Africa. The *Maruca vitrata* virus is not only specific to the target pest—the pod borer—but is environmentally benign and completely safe for use by humans, resulting in a health and environmental win-win over traditional pesticides. This inexpensive and accessible approach to diminishing *Maruca vitrata* is of particular importance in these regions where access to commercial pesticides is often financially prohibitive for smallholder farmers.

In addition to providing youth with a practical agricultural skill, these programs have increased interest in this novel and safe technique for fighting cowpea pests, both in these villages and in surrounding communities, helping make the affordable technique available to a greater number of cowpea farmers.

Since the program's inception, use of the insecticide developed from neem seeds in combination with the *Maruca vitrata* virus against the pod borer has been demonstrated to 157 farmers (70 women) in 16 additional villages in Southern Niger. Overall, farmers were astonished—and pleased—that with simple techniques and naturally available resources they were able to achieve crop yields similar to those obtained with chemical controls. Overall, this neem–pod borer virus combination offers a pest management technique that is healthy for their families, their environment, and their pocket books.

## Success Story 2: Grain Legume Value Chains in Zambia Benefit Diverse Stakeholders

Contact: Dr. Vincent Boadu-Amanor, Kansas State University; Email: [vincent@agecon.ksu.edu](mailto:vincent@agecon.ksu.edu)

Catherine Tanda, a 32-year-old widow with two children, who has been trading beans, cowpeas, and other commodities for the past five years, recently increased her income and reduced her work-related travel time by implementing more efficient marketing practices introduced by Vincent Boadu-Amanor and other agricultural economists from Kansas State University and the University of Zambia.



Catherine Tanda, a common bean trader, is all smiles with Dr. Vincent Boadu-Amanor, whose training in marketing strategies has helped improve her livelihood significantly. Photograph by Kara Ross.

Prior to these implementations, Tanda and her trader colleagues were too busy to explore changes to their trading practices, even though changes could have improved their livelihoods.

These agribusiness teams worked collaboratively to engage Tanda and a dozen other common bean traders to provide education and support that have improved their purchasing strategies. The trading group, organized in April 2012 after nearly six months of conversations and training, implemented procedures that streamlined their purchasing decisions and activities. By working in

cooperation and using bank machines and cellphones to coordinate, group members have reduced their procurement costs and used these savings to increase their procurement volumes.

“My life has become a lot more comfortable since you and your friends came to help us,” says Tanda, during a recent visit to Lusaka.

In addition to higher income, Tanda can now spend more time with her young children because of the purchasing systems the project has helped her and other bean traders put in place.

The research team is developing expansion protocols to bring more traders into the program to increase their incomes and contribute to reducing poverty.

“The gratitude [from these traders] goes to the people of the United States for seeing the world beyond their borders,” Amanor-Boadu says.

### Success Story 3: New High Yielding Cowpea Varieties Afford Hope to Smallholder Farmers in the Sudano–Sahel Region of West Africa

Contact: Dr. Philip A. Roberts, University of California, Riverside. Email- [philip.roberts@ucr.edu](mailto:philip.roberts@ucr.edu)

Several improved cowpea varieties with enhanced yield and grain quality traits combined with resistances to critical insects and diseases have been released in Burkina Faso and Senegal over the past two years.



A farmer stands in an on-farm trial field in Senegal where four new cowpea varieties, developed from crosses between Melakh and Monteiro grain type genotypes, are growing.

Photograph courtesy of Ndiaga Cisse.

One of these varieties, *Pakau*, released in Senegal, is an early maturing (60 days) cowpea variety with enhanced resistance to aphid and thrips. Aphid and thrips are cowpea pests whose destructiveness is economically significant; resistance to their destructiveness helps increase crop yields significantly.

*Pakau*'s early maturing quality makes it particularly valuable during the hunger period in the Sahel; the "hunger period" refers to that time of the agricultural year when stored harvests from the previous growing season have been depleted but new harvest yields have not yet been realized. An early maturing cowpea

such as *Pakau* helps bridge the gap between these two food supplies—a significant advantage in regions lacking food security.

An added benefit of *Pakau* is its excellent taste, which has been greatly appreciated by Senegalese farmers. Momar Ndiaye Ka, a smallholder farmer from the village Keur Mballo in the Louga area of Senegal, indicated that the taste of *Pakau* was so good that he didn't need to buy imported beans during the most recent Eid celebration.

Five additional cowpea varieties, along with *Melakh*, a cowpea variety bred in Senegal that was found to be an excellent performer in Burkina Faso, have also been released to smallholder farmers for planting. Average yields of 1,250 kg/ha have been obtained from these new varieties—approximately 50 to 100 percent greater than cowpea yields commonly obtained by smallholder farmers in the region.

To ensure farmer access to quality seed of these newly released cowpea varieties, the Pulse CRSP supported the production of 2,000 Kg of Foundation Seed in Senegal and 50 MT of Foundation Seed in Burkina Faso; this seed has been distributed to Certified Seed Producers for multiplication. Farmer and consumer assessments of these varieties indicate a potential for wide adoption and acceptance, including in neighboring countries (e.g., Mali, Ghana, and Niger) with similar agroecologies.