FY 2013–14 Workplans

April 1, 2013–September 30, 2014

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

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Genetic Improvement of Guatemalan Climbing Beans for Efficient Production in the Highlands (S01.A1)

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Project Problem Statement and Justification
With approximately 11 million habitants, Guatemala is mostly a rural country, with 60 percent of the population living in farms and 50 percent of the population being indigenous. Maize and beans are the main staple food in most households with a per capita consumption of 9.4 kg per year. Since few other sources of protein are available, this amount is not enough to ensure an acceptable nutritional quality, especially within poor households. As expected, the lack of protein intake has reduced the nutritional quality in many households, significantly affecting children.

Beans are grown on 31 percent of the agricultural land and mostly in the low to mid-altitude regions (0–1500 masl) in a monoculture system. Contrastingly, intercropping (locally known as Milpa) is the main production system in the highlands, where maize–bean is the most common crop association. The system uses climbing beans that grow around the corn stalks. Two main methods are used: direct planting, in which both maize and beans are planted simultaneously, and relay, in which the maize is planted first and the beans are planted at a later date in order to avoid strong competition between the two crops. Unfortunately, on-farm productivity of these climbing beans is approximately one third of their genetic yield potential mostly due to the lack of improved cultivars that are able to withstand biotic and abiotic stresses. Fungal and bacterial diseases as well as pests are the main cause for yield reductions. In addition, production is made with almost no inputs of fertilizers and/or other chemicals. Historically, climbing beans worldwide have received less attention and breeding efforts in comparison with the bush-type beans commonly grown in the lowlands, as shown by the significant yield gap between regions. In addition, there are genetic and environmental interactions among species (maize, bean, squash, etc.) not well understood within the intercropping system that affect crop performance and hence, seed yield. The legume Innovation Lab has been involved in collaborative bean breeding research targeting lowland agroecologies in Central America, but research for the highland bean production systems is still lacking. A significant seed yield differential between the lowlands and the highlands can be observed, especially in Guatemala.

There is an existing collection of approximately 600 accessions of climbing beans collected across all bean production regions in Guatemala. This collection is kept by ICTA and has been characterized morphologically and with few molecular markers (six SSR primers). In addition, some field notes concerning disease resistance (natural pressure) and other agronomic traits of economic importance have been collected as well. Initial results suggest that ½ of the collection consist of duplicates. In addition, some initial crosses among climbing beans and selections have been made by Dr. Fernando Aldana (ICTA-Quetzaltenango) and the rest of the ICTA group. These lines will be used intensively in this study.

Planned Project Activities for the Workplan Period (October 1, 2013 –September 30, 2014)

Objective 1. *Development of germplasm with improved disease resistance and agronomic performance*

Collaborators
NDSU. Juan M. Osorno and Phil McClean.
ICTA. Julio Cesar Villatoro, Fernando Aldana, Edgardo Carrillo.

Approaches and Methods
1A. Field testing of 10 selected accessions (ICTA)
The bean breeding program at ICTA has selected a group of 10 accessions from the germplasm collection that offer agronomic traits of interest such as plant growth type, seed yield, disease resistance, earliness, and seed quality, among others. We will start field testing of these 10 accessions across 10 locations that represent the growing area of climbing bean production. Most locations will be tested under the intercropping system and few under monoculture. The accessions will be planted using a Randomized Complete Block Design (RCBD) with two or three replications depending on space and resources at each location. Plating usually occurs in April–May and harvest occurs in November to early December.

The following agronomic data will be collected across all locations:
- Days to emergence
- Vigor
- Early disease symptoms
- Days to Flowering
- Pod distribution
- Aggressiveness of growth
- Disease symptoms (natural pressure)
- Days to maturity
- Seed yield
- 100-seed weight

1B. Genetic purification of selected material (ICTA)
As explained Technical Project Description, phenotypic variation has been detected within accessions. Therefore, genetic purification of selected lines will be done with the goal of isolating and homogenizing genotypes (increasing homozygocity) with traits of interest for breeding purposes. Whenever a plant within a plot is identified with a trait of interest, the plant will be tagged/labeled and individually harvested. The seed from each individual plant selected will be used for: i) seed increase, and ii) further evaluations.

1C. Field evaluation of Bolonillo-TEXEL (ICTA)

One of the improved lines selected by Dr. Fernando Aldana at advanced breeding stages (known as Bolonillo-Texel) will be also tested at growers' fields. The number and size of testing fields will be mostly dictated by the amount of seed available. The same traits mentioned above will be measured in these fields. Seed yield and other traits will be compared with common varieties and landraces grown in the vicinity of the testing fields (similar to sentinel plots). If Bolonillo-Texel has good acceptability it could be released sooner, which would allow for a significant impact of this project earlier than planned by releasing an improved variety of climbing bean thanks to the previous efforts made by the ICTA bean breeding project.

Objective 2. *Characterization of the genetic diversity of this unique set of germplasm*

Collaborators

NDSU: Juan M. Osorno and Phil McClean.
ICTA: Karla Ponciano, Julio Cesar Villatoro, Fernando Aldana, Edgardo Carrillo.

Approaches and Methods

2A. Evaluation of core collection with the 6k SNP chip (NDSU)

The core collection of approximately 300 accessions will be re-evaluated with a larger number of markers at NDSU. A new set of 6000 Single Nucleotide Polymorphism (SNP) markers is available as product from the BeanCAP project (www.beancap.org) funded by USDA–NIFA. This set of markers is highly precise, reliable, and allow higher resolution and differentiation among genotypes compared to SSR markers. With the goal of having a better understanding of the organization of the genetic diversity of this group, we will extract DNA of the core 300 accessions and screen them with the 6k BeanCAP chip and do a genetic diversity study of possible genetic relationships among the accessions.

Monomorphic markers as well as markers with more than 50 percent of missing information will be discarded. Several parameters of population diversity and structure will be used to assess the organization of the genetic diversity in this group of germplasm. An attempt to do comparisons with other genetic groups/races previously analyzed by the BeanCAP project and others, will also allow having a better understanding of where this group of germplasm could fit into what it is known about bean genetic diversity (gene pools and race organization). In addition, a random group of 20 accessions previously identified as duplicates based on the SSR data will be also screened in order to confirm these results or evaluate the need to include more of these duplicates in the screening.

2B. Assessment of the intra-accession variability (NDSU) A genetic assessment of variation within the 10 selected lines used in objective 1A will be made in order to account for the heterogeneity not only among but within accessions and possibly, extrapolate that information to the rest of accessions. Preliminary phenotypic observations in the field suggest that there is a high amount of genetic heterogeneity (heterozygocity) within accessions. Therefore, 20 plants from each accession will be planted in the greenhouse at NDSU and DNA will be extracted, for a total of 200 DNA samples/individuals. These genotypes will be also screened with a subset of INDEL markers developed in the NDSU bean molecular genetics lab (Moghaddam et al., in press). The INDEL markers were developed from polymorphic SNPs, but their advantage is that they can be easily reproduced by PCR and visualized in an agarose gel. Since the main goal is to assess intra-accession variability, this will be easily detected by looking at the bands in the gels. Polymorphic Information Content (PIC) and other genetic parameters will be estimated. This information will allow a better understanding of the organization of the genetic diversity within this core collection for future use and research. The results obtained in this first phase will allow making informed decisions about the potential parents for the first set of crosses.

Objective 3. *A better understanding of the current socioeconomic status and needs of bean production within the context of intercropping systems in the region*

Collaborators
NDSU: Juan M. Osorno.
ICTA: Julio Martinez, Julio Cesar Villatoro, Fernando Aldana, Edgardo Carrillo.

Approaches and Methods (Julio Martinez-ICTA)
First, an effort to find previous grower surveys made by governmental and nongovernmental institutions will be made. Second, a grower survey will be deployed in the main regions where climbing beans are produced. We will focus on the following departments: Quiche, Huehuetenango, San Marcos, Totonicapán, and Quetzaltenango which represent most of the climbing bean production areas. A proper sample size for accurate statistical analyses and estimates will be decided based on the previous information collected. The survey will include questions about cultivation methods, preferred seed types, household consumption, and marketing of harvested beans, among other things. Results of this survey will be shared not only within the project but with other projects currently working in Guatemala (e.g. Nutrifrijol) and government agencies interested.

Objective 4. *Capacity building: training the next generation of plant breeders for Guatemala and establishing a long-term breeding plan to increase the productivity of climbing bean in the region*

The first step will be to identity/recruit potential students that could start graduate studies at NDSU as soon as possible, hopefully in fall 2014. The project director will interview potential candidates during his visits to Guatemala during the spring, summer, and fall. If suitable candidates cannot be found in Guatemala, good candidates from neighboring countries could be considered. We expect to have two individuals to come and do graduate studies at NDSU (Plant Sciences) with the goal that those individuals will be incorporated into agricultural research back into the region. Research topics will be directly related to the research objectives described above. We foresee research projects focused on the analyses of genetic diversity, genetic resistance to diseases, and production systems, among others. The graduate students will be provided a broad range of training in conventional and molecular plant breeding techniques so that they can assume leadership roles in bean research programs in the target countries.

Contribution of Project to USAID Feed the Future Performance Indicators
See attached table with Future Performance Indicators.

Outputs

Objective 1
1. Field testing of 10 selected accessions (ICTA)
2. Genetic purification of selected material (ICTA)
3. Field evaluation of Bolonillo-TEXEL (ICTA)

Objective 2
1. Evaluation of core collection with the 6k SNP chip (NDSU)
2. Assessment of the intra-accession variability (NDSU)

Objective 3
1. Collection of previous surveys/databases
2. Grower surveys at five departments

Objective 4
1. Identification/recruitment of potential graduate students
2. First two graduate students in graduate studies at NDSU

Engagement of USAID Field Mission(s)
Host country scientists will be responsible of informing local USAID Missions about progress of the Legume Innovation Lab project toward research and training objectives. Opportunities will be sought to obtain USAID Mission support to expand activities in host countries. Local USAID Missions will be contacted when U.S. scientists visit host countries.

Partnering and Networking Activities
The NDSU scientists responsible for this project (Osorno and McClean) are also involved in other projects from the Legume Innovation Lab (e.g. S01-A4). Therefore, some collaboration among projects is expected. The personnel from EAP-Honduras have also expressed their willingness to help in any way possible. Efforts will be made to travel around the same dates to the region in order to discuss the project's evolution. In addition, P. McClean will be directly involved with the project lead by J. Lynch and also funded by USAID.

Several Legume Innovation Laboratory scientists participate in Regional Hatch Project W-2150 which is a multidisciplinary network of U.S. bean researchers. The NDSU dry bean breeding program at NDSU conducts winter nurseries at Puerto Rico and this will allow for further discussion of the projects person-to-person. In addition, most scientists involved in the project will meet every other year at the Bean Improvement Cooperative (BIC) meetings.

Researchers in Central America and the Caribbean often make scientific presentations at the annual meeting of the PCCMCA. The meeting provides an opportunity for the Central American/Caribbean research network which includes national programs, CIAT and the Legume Innovation Laboratory scientists to meet to exchange results from research and plan activities for the upcoming year. Efforts will be made to participate at these meetings in Central America and share the project developments.

Last but not least, efforts will be made to have close collaboration with the Nutrifrijol project funded by the USAID Guatemala mission and lead by Luis Flores from Michigan State Univ. Preliminary conversations suggest that some of the genetic material could be shared with them for field testing and consumer preference. Efforts will be made to meet with members of this group whenever possible to keep both project updated on the current activities.

Leveraging of CRSP Resources
Germplasm exchange is still a common activity among dry bean breeders and even boosted up by some of the networks previously mentioned. The germplasm developed in this project could be useful in other regions growing climbing beans. In addition, the genetic material could have unique genes/sources of resistance/tolerance to production problems also present in the United States.

Some of the genomic resources and tools developed by the BeanCAP project funded by USDA-NIFA will be of great help to start these breeding platforms in Guatemala and other developing countries.

Legume Innovation Lab breeders and pathologists (Kelly, Steadman, Urrea, Osorno, Beaver, Estevez, and Porch) have an opportunity to meet at least once a year in Puerto Rico. This facilitates communication between the Legume Innovation Lab bean breeding projects. In addition, close collaboration with CIAT breeders will allow germplasm exchange and sharing of the scientific knowledge.

Timeline for Achievement of Milestones of Technical Progress
See attached file with project Milestones.

Training/Capacity Building Workplan for FY 2013 –2014

Degree Training
Two graduate students are expected to start M.S. at NDSU in the fall 2014. Recruitment efforts are currently underway.

Short-term Training
None for this year.

Informal training will be given to the ICTA personnel when the NDSU scientists visit the country.

Equipment (costing >$5,000)
None

Performance Indicators for FY 13-FY14
Genetic Improvement of Guatemalan Climbing Beans (S01.A1)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 14 and FY 15

Project Name: SO1.A1 Genetic improvement of Middle American climbing beans for Guatemala

Institution 1 Name (one sheet per instititon): NDSU

Indic. numbe	Output Indicators	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	2	0	0	2	0	0
	Number of women	1			1		
	Number of men	1			1		
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training						
	Total number	10	0	0	30	0	0
	Number of women	5			15		
	Number of men	5			15		
	Numbers by Type of individual						
	Producers	5			20		
	People in government	5			10		
	People in private sector firms						
	People in civil society						
3	4.5.2(13) Beneficiaries: (numbers of households)						
	New/Continuing (total)	10	0	0	30	0	0
	New	10			30		
	Continuing	0			0		
	Gendered Household Type						
	Adult Female no Adult Male (FNM)						
	Adult Male no Adult Female (MNF)						
	Male and Female Adults (M&F)						
	Child No Adults (CNA)						

4	based organizations (CBOs) receiving USG assistance						
	Type of organization	NA	NA	NA	NA	NA	NA
	Private enterprises (for profit)						
	Producers organizations						
	Water users associations						
	Women's groups						
	Trade and business associations						
	Community-based organizations (CBOs)						
	New/Continuing (total)	0	0	0	0	0	0
	New						
	Continuing						
5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance						
	Number by type of partnership (total)	0	0	0	0	0	0
	Agricultural production						
	Agricultural post harvest transformation						
	Nutrition						
	Multi-focus						
	Other						

6	4.5.2(2) Developmental outcomes:						
	Number of additional hectares under improved technologies or management practices						
	Number under specific technology types (total)	10	0	0	20	0	0
	crop genetics	10			20		
	animal genetics						
	pest management						
	disease management						
	soil-related						
	irrigation						
	water management						
	post-harvest handling and storage						
	processing						
	climate mitigation or adaptation						
	fishing gear/technique						
	other						
	total w/one or more improved technology						
	New/Continuing hectares						
	New	10			20		
	Continuing				10		
	Sex of person managing hectare						
	Male	9			20		
	Female	1			10		
	Association-applied						

7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	10	0	0	20	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	10			10		
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	0			10		
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	0			0		

8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)						
	Sector (total)	0	0	0	0	0	0
	Inputs						
	Outputs						
	Macroeconomic						
	Agricultural sector-wide						
	Research, extension, information, and other public service						
	Food security/vulnerable						
	Climate change adaptation or natural resource management (NRM) (ag-related)						
	Stages of development						
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed						
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation						
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree						
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved						
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun						
	Notes:						
	These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approv						
	This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the						
	Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for						
	There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf						

Budget for FY 13-FY14
Genetic Improvement of Guatemalan Climbing Beans (S01.A1)

	10/01/13-09/30/2017				
	FY 14	**FY 15**	**FY 16**	**FY 17**	**Total**
a. Personnel Cost					
Salaries	$34,000	$31,320	$31,646	$31,979	$128,945
Fringe Benefit	$10,050	$10,146	$10,244	$10,344	$40,784
b. Travel	$30,500	$27,000	$28,000	$27,000	$112,500
c. Equipment ($5000 Plus)	$0	$0	$0	$0	$0
d. Supplies	$27,000	$23,200	$30,000	$18,000	$98,200
e. Training					
Degree	$38,760	$39,535	$40,326	$41,132	$159,753
Non-Degree	$0	$0	$15,000	$0	$15,000
f. Other	$0	$0	$0	$0	$0
g. Total Direct Cost	**$140,310**	**$131,201**	**$155,216**	**$128,455**	**$555,182**
h. Indirect Cost	$32,223	$30,680	$34,100	$29,845	$126,848
i. Indirect Cost on Subcontracts (First $25000)	$11,250	$0	$0	$0	$11,250
j. Total Indirect Cost	$43,473	$30,680	$34,100	$29,845	$138,098
Total	**$183,783**	**$161,881**	**$189,316**	**$158,300**	**$693,279**
Grand Total					

Cost Share	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
In-kind	$0	$0	$0	$0	$0
Cash	$11,180	$11,515	$11,861	$12,216	$46,772
Total	$11,180	$11,515	$11,861	$12,216	$46,772

Attribution to Capacity Building					
Percentage of effort	85%	88%	104%	92%	93%
Amount corresponding to effort	$119,930	$115,877	$161,906	$118,419	$516,132

Milestones for FY 13-FY14
Genetic Improvement of Guatemalan Climbing Beans (S01.A1)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
Research, Training and Outreach Workplans
(October 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: **SO1.A1 Genetic improvement of Middle American climbing beans for Guatemala**

	NDSU		ICTA		Institution 3		Institution 4		Institution 5		Institution 6	
Identify Milestones by Objectives	**4/1/14**	**10/1/14**	**4/1/14**	**10/1/14**	**4/1/14**	**10/1/14**	**4/1/14**	**10/1/14**	**4/1/14**	**10/1/14**	**4/1/14**	**10/1/14**
Objective 1:												
1.1 Evaluation of Bolonillo-Texel in farmer fields			X	X								
1.2 Evaluation of Selected 10 accessions			X	X								
1.3 Individual plant selections for homozygocity				X								
1.4												
1.5												
Objective 2:												
2.1 Analysis of genetic diversity of core 300 with 6k SNP chip		X										
2.2 Analysis of within-accesion variation of 10 selected accessions		X										
2.3 Field evaluation of selected accessions				X								
2.4												
2.5												

Objective 3:												
3.1 Search of historic information			X	X								
3.2 First grower survey				X								
3.3												
3.4												
3.5												
Objective 4:												
4.1 Recruitment of potential graduate students	X	X	X									
4.2 First student admitted at NDSU		X										
4.3												
4.4												
4.5												
Name of the PI responsible for reporting on milestones												
Signature/Initials:												
Date:												

Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF) (S01.A3)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
James D. Kelly, Michigan State University, East Lansing, Michigan, USA

Collaborating Host Country and U.S. PIs and Institutions
Wayne Loescher, Dept. Horticulture, MSU
James Steadman, University of Nebraska, Lincoln and Scottsbluff
Carlos Urrea, University of Nebraska, Lincoln and Scottsbluff
Eduardo Peralta, INIAP, Ecuador
Stanley Nkalubo, NaCCRI, Uganda
Kennedy Muimui, ZARI, Zambia
Karen Cichy, USDA-ARS, East Lansing, Michigan

Project Problem Statement and Justification

Beans are the second most important food legume crop after ground nuts in Zambia and are a major source of income and cheap protein for many Zambians. Most of the bean crop (62 percent) is produced on 60,000 ha in the higher altitudes, cooler and high rainfall zones of the northern part of Zambia. Andean beans are predominant and land races are the most widely grown although a few improved cultivars are also grown as sole crops or in association mainly with maize. Bean production is constrained by several abiotic and biotic stresses that include diseases, pests, low soil fertility and drought. All the popular local landraces in Zambia are highly susceptible to pests and diseases that severely limit their productivity. This is reflected in the very low national yields ranging from 300 to 500 kg/ha that result in annual deficit of 5,000MT.To avert future food shortages and feed the growing population of 13M, there is critical need for increasing the productivity of most food crops including beans. Zambia ranks 164 out of 184 countries in the Human Poverty Index.

Ecuador has the only active Andean bean breeding program and past advances made in combining different disease resistances in bush beans need to be transferred to the climbing beans that play a vital role in the farming system and livelihood of small producers, second only to maize in importance. The traditional intercropping system with maize predominates in Ecuador where 90 percent of the beans are grown in the highlands on landholdings that vary in size from 0.2 to 50 ha. Climbing beans are cultivated mainly in association with maize and partly under trellis systems. The area cultivated with climbing beans has fluctuated annually, but is currently estimated at 97,000 ha. It is estimated that 90 percent of the area is planted with landrace or local varieties and the majority are susceptible to foliar diseases such as rust, anthracnose (ANT), angular leaf spot (ALS), and Bean Common Mosaic Virus (BCMV), and seed borne diseases are particularly problematic. Improvements in climbing beans can easily be transferred to many African countries that grow similar seed types.
Beans are an important crop in Uganda and are grown on over 660,000 ha of land and consumed throughout the country. Beans are a major source of food and income for the rural smallholder farmers especially the women and children. As a nontraditional agricultural export crop, beans have gained a major dominance in terms of tonnage and monetary value among Uganda’s

exports. That beans are produced in every district illustrates the dependence on beans as a major food security crop and their importance in farmers' household incomes. The crop is ranked fourth in terms of export volume and eighth in terms of export value. The crop is also the most important source of protein for the Ugandan population providing 45 percent of the total human dietary protein and plays a significant role in ensuring food security. Beans provide a cheap source of protein to most vulnerable groups such as children below five years, pregnant mothers and AIDS patients. The majority of bean production in Uganda is dependent mainly on the use of inferior landrace varieties which are generally low yielding due to susceptibility to the major biotic (ALS, ANT, root rots, BCMV) and abiotic (drought, low soil fertility) stresses. These stresses gravely undermine the potential of the bean as a food security crop, a source of income, and as a main source of dietary protein for the majority of Ugandans.

Drought affects 60 percent of global bean production and the severity of yield reduction depends on the timing, extent, and duration of the drought stress. The presence of other stresses such as high temperature, root diseases, shallow infertile soils and climate change all contribute to intensify the problem. Improvements in current understanding of the physiology of drought and evapotranspiration 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 therefore needed. The development of improved varieties and germplasm with high yield potential, healthy root systems, improved BNF with resistance to multiple diseases, and sustained or improved water use efficiency under limited soil water conditions are needed to increase profit margins, 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 faster 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.

Planned Project Activities for FY 2013–14

Objective 1 *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 Andean bean germplasm for the Eastern Africa highlands (Zambia and Uganda), Ecuador and U.S.*

Collaborators
Jim Steadman, Carlos Urrea, Nebraska
Eduardo Peralta. Ecuador
Stanley Nkalubo. Uganda
Kennedy Muimui, Zambia
Karen Cichy, USDA-ARS, Michigan

Approaches and Methods

1. Assemble a common nursery across participating countries of about 80 lines considering the differential information for ANT, ALS, CBB, and rust. Collaboration with S01.A4 will be explored.
2. Assemble a drought nursery of 60 lines and develop the drought screening protocol to be used. Collaboration with S01.A4 will be explored.
3. Seed increase in each country. Each participant country will receive 100 seeds of each line and increase them.
4. Screen the disease nursery to different pathogens in greenhouse in Zambia. The races to be used will be determined from objective 2.
5. Initiate selection for disease resistance under screen house inoculation condition in Zambia.
6. Screen the disease nursery to different pathogens in greenhouse in Uganda. The races to be used will be determined from objective 2.
7. Initiate selection for disease resistance under screen house inoculation condition in Uganda.
8. Ecuador will screen elite lines/cultivars to ALS, ANT, CBB, and rust in greenhouse facilities.
9. Screen the disease nursery to CBB in North Platte, NE.
10. Screen a subset of the Andean panel and Andean Bean-CAP lines to terminal drought in Scottsbluff, NE.06/13-08/13.
11. Screen the drought nursery in Zambia to intermittent drought stress.
12. Screen the drought nursery in Uganda to intermittent drought stress.
13. Screen the drought nursery in Michigan to intermittent drought stress.
14. Screen the drought nursery in Ecuador to terminal drought stress.
15. Screen the drought nursery in Nebraska to terminal drought stress.
16. Cross sources of resistance for angular leaf spot (ALS), rust, anthracnose, common bacterial blight, and drought tolerance into large seeded lines with contrasting colors in Ecuador, Uganda, Zambia, Nebraska and Michigan.
17. Few selected climbers in each country will be crossed to sources for ALS, ANT, CBB, and rust resistance.
18. Use of markers identified in objective 3 to make selections in each country
19. Increase seed of the BNF RILs in Ecuador.
20. Evaluate BNF RIL population (Puebla/Zorro) in Ecuador in low N soils.
21. Screen Andean lines for cooking time using a pin drop (Mattson cooker) method.
22. Canning of advanced Andean lines in Ecuador.
23. Evaluation of Andean elite lines for micronutrient bioavailability in MI and NE.
24. Conduct sensory evaluation of elite lines with superior cooking time and mineral bioavailability in Michigan, Uganda, and Zambia.
25. Identify nondestructive, high throughput methods to measure cooking time and seed chemical composition.
26. Cross lines with superior disease resistance to those with shorter cooking time and high mineral bioavailability.

<u>Objective 2.</u> *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.*

Collaborators
Jim Steadman, Carlos Urrea, Nebraska
Eduardo Peralta, Ecuador
Stanley Nkalubo, Uganda
Kennedy Muimui, Zambia

Approaches and Methods

1. Initiate the collection of isolates of ANT, ALS, CBB, and Rust in different bean production regions of Zambia.
2. Initiate the collection of isolates of ANT, ALS, CBB, and Rust in different production regions of Uganda.
3. Continue the collection of isolates of ANT, ALS, CBB, and Rust in Ecuador from diverse agroecological zones for race typing and compile a data base of all previously characterized pathogenic races for publication.
4. Increase seed of the differentials for ANT, ALS and rust in Zambia and Uganda
5. Race characterization of ANT, ALS and Rust in Zambia.
6. Race characterization of ANT, ALS and Rust in Uganda.
7. Update race characterization of same pathogens from different regions in Ecuador.
8. Utilize the mobile nursery protocol to determine the effectiveness or rust resistance genes in genotypes.
9. Leverage the NIFA nurseries and collect information on foliar pathogens on the ADP and UNL drought tolerant germplasm nurseries for reaction to different foliar pathogens on surviving lines in Zambia and Uganda.
10. Ship to and increase seed of ADP and UNL nurseries in Ecuador.
11. Follow up with evaluation of the two nurseries for reaction to foliar pathogens in Ecuador.
12. Select the most informative genotypes for each country/location to include in future mobile nursery evaluations in individual countries and /or locations.
13. Increase seed of these selected genotypes for inclusion in the mobile nursery.
14. Choose the most relevant races of ANT, ALS and rust and strains of CBB for screening breeding nurseries in Zambia.
15. Choose the most relevant races of ANT, ALS and rust and strains of CBB for screening breeding nurseries in Uganda.
16. Choose the most relevant races of ANT, ALS and rust for screening breeding nurseries in Ecuador.
17. Partner with S01.A4 project to characterize isolates of web blight in different host countries to use in search for an improved screening method for resistance. The only current control methods are use of chemicals, so alternative control methods are needed.
18. The project will actively collaborate with MSU and UNL NIFA projects in Zambia and Uganda and with the S01.A4 project to address issues with a variety of pathogens that are not being directly addressed in current workplan.

19. Seed health will be addressed in the second phase in different countries.

Objective 3 *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.*

Collaborators
Jim Steadman, Carlos Urrea, Nebraska
Eduardo Peralta, Ecuador
Stanley Nkalubo, Uganda
Kennedy Muimui, Zambia
Karen Cichy, Michigan
Kelvin Kamfwa, Michigan

Approaches and Methods

1. Conduct Association Mapping (AM) of the Andean Diversity Panel (ADP) for improved BNF on nurseries grown in MI and Zambia using 6K SNP chip from BeanCAP project.
2. Conduct field phenotypic evaluation of the ADP for BNF in Zambia.
3. Conduct greenhouse phenotypic evaluation of the ADP for BNF at MSU.
4. Develop populations of RILs for linkage mapping of BNF.
5. Conduct greenhouse phenotypic evaluation of RIL populations for BNF at MSU.
6. Collect DNA from RIL populations.
7. Genotype RIL populations using 6K SNP Chip from BeanCAP project.
8. Conduct Association Mapping of the ADP for improved mineral bioavailability on nurseries grown in MI and Zambia using 6K SNP chip from BeanCAP project.
9. Develop tightly linked SNP markers for major anthracnose resistance genes in collaboration with S01.A4 project that will develop markers for other resistance genes.
10. Sequence information from the bean genome will be used to focus on specific genomic regions where major anthracnose resistance genes have been mapped–MSU.
11. Phenotypic evaluation of specific mapping populations will be conducted in Ecuador for anthracnose and the DNA shipped to MSU to genotype and identify tightly linked markers.
12. Bean bioinformatic sources such as Bean Genes at UCD will be used as sources to identify new sequence based markers that are located near major resistance genes for mapping in populations segregating for major foliar pathogens.
13. Emphasis will be given to identify agarose based markers that could be implemented in country in addition to using SNP based markers.
14. The program will access current published information on improved markers for ALS that has been developed by colleagues in Brazil for use in MAS in Uganda and Ecuador.
15. Panelists will be asked to rate the sensory characteristics of the beans with respect to appearance, color, flavor, mouth feel, and overall likeability using a hedonic scale of 1-7 with 1 being highly undesirable and 7 being highly desirable.
16. The lines with the highest likeability will be grown in on farm trials and will be evaluated for farmer acceptability based on agronomic and cooking characteristics.

<u>Objective 4</u> *Develop phenometric approaches to improving the efficiencies of breeding for abiotic stress tolerance, especially drought*

Collaborators
Wayne Loescher, Coordinator Obj. 4, MSU
Carlos Urrea, Nebraska
David Kramer, Jim Kelly ,MSU
Eduardo Peralta, Ecuador
Stanley Nkalubo, Uganda
Kennedy Muimui, Zambia
Idupulapati Rao, CIAT

Approaches and Methods
We will extensively rely on new instrumentation and techniques now available at MSU (at the Center for Advanced Algal and Plant Phenometrics).These allow exposing lines of plants to a set of distinct dynamic environmental conditions that mimic those experienced under realistic field conditions, or allow sophisticated experimental manipulations. These also allow non-destructive and continuing measurements of photosynthetic properties (e.g., gas exchange and chlorophyll fluorescence), growth and plant architecture, and more detailed measurements of photosynthesis. These will contribute to identifying new traits based on relationships between genotype and drought and heat responses.

Initially for Stage 1 of this project, we will:

1. Assemble selected sets of physiologically contrasting genotypes from breeders (e.g., Urrea, Kelly, and Peralta)
2. Conduct initial phenometric measurements and evaluations of contrasting genotypes (e.g., Loescher, Kramer)
3. Identify differences among genotypes with contrasting responses to high light and high temperature stresses
4. Extend methodology to include drought stress

<u>Objective 5.</u> *Institutional Capacity Building*
MSU Doctoral student, Kelvin Kamfwa in plant breeding, genetics and biotechnology will conduct field research on BNF on genetic population(s) in Michigan and Zambia. A second doctoral student Grady Zuiderveen from the US will be involved in SNP marker development. In addition short-term trainings for collaborators in host countries will be designed to assist them to undertake the implementation of the project objectives and activities using the latest technologies that are existing at MSU and Nebraska. Also training will be provided by in country collaborators to graduate students, technicians on the use of new screening techniques in drought and diseases. Where applicable, extension staff and users (farmers) will be trained on the use of the new technologies developed.

1. Provide short-term training in the areas of bioinformatics, use and management of SNPs for PIs of participating countries (Uganda, Zambia and Ecuador).

2. Provide short term training in the use of various drought and diseases screening methods for PIs of participating countries and institutions personnel (technicians) and where applicable extension staff and users (farmers) in Uganda and Zambia.
3. Provide short term training of graduate students, collaborators, and visiting scientists on phenometrics at MSU.

Contribution of Project to USAID Feed the Future Performance Indicators

The Performance Indicators –Targets forms for each country have been completed for the project for FY 2013, 2014 and 2015 following FTF guidelines. One student is currently in doctoral degree training, and plans exist for short term training for other technicians in the program. The scientific assistance provided to farmers is shared among men and women as both genders are active in bean production in Ecuador, Uganda and Zambia.

Target Outputs

1. The development and release of locally adapted, acceptable, drought and disease resistant bean cultivars for the major production regions in Ecuador, Uganda, Zambia and Michigan.
2. Increased sustainable productivity and profitability of bean production due to increased yield and reduced inputs.
3. Improved grower income and stability of bean production will contribute to better nutrition and health of farm families.
4. Increased awareness and knowledge of genomic and phenomic research methods on drought stress, major foliar diseases, enhanced fixation and nutritional quality will further improve bean productivity, long-term land management, and environmental risk, thus contributing to sustainability of bean production and agricultural communities and improved dietary patterns.
5. Identification of germplasm sources that are of benefit in the improvement of selected bean traits for the U.S. market.
6. Enhanced human resource development, gender equity and improved infrastructure capacity of participating institutions in Ecuador, Uganda and Zambia.

Outputs

- Training of six staff (four male and two female) at ZARI in disease and pest identification
- Seed of different nurseries increased in Zambia
- Angular Leaf Spot Nursery evaluated and source of resistance identified in sites in Zambia
- Common Bacterial Blight Nursery evaluated and source of resistance identified in sites in Zambia
- Anthracnose Nursery evaluated and source of resistance identified in sites in Zambia
- Rust Nursery evaluated and source of resistance identified in sites in Zambia
- Isolates of ANT, ALS, CBB, and Rust collected from different bean production regions of Zambia.
- Initiate crossing of landraces with resistant sources of ALS, ANT, CBB, and Rust in Zambia
- At least five nurseries assembled for drought, ANT, ALS, CBB, and rust

- Drought nursery established, evaluated and contrasting drought tolerant lines identified
- Anthracnose Nursery established, evaluated and source of resistance identified
- Angular Leaf Spot Nursery established, evaluated and source of resistance identified
- Common Bacterial Blight Nursery established, evaluated and source of resistance identified
- Rust Nursery established, evaluated and source of resistance identified
- Seed of different nurseries increased in country
- Isolates of ANT, ALS, CBB, and Rust obtained from different bean production regions of Uganda.
- ANT, ALS and Rust pathotypes/races characterized in Uganda.
- Crosses initiated between Ugandan landraces with tolerant/resistant sources of drought ANT, ALS, CBB, and Rust.
- Progeny screening for different for resistance (drought, ANT, ALS, CBB and Rust) initiated.
- At least 10 persons(six male and four female) trained in disease and pest identification and screening in Uganda
- Compile information for an Andean variety release by MSU
- Assemble an elite trial by INIAP for future variety release
- Identification of Andean drought tolerant lines from a trial tested in Scottsbluff, NE
- Identification of Andean lines with superior mineral bioavailability and short cooking times from trials in MI and NE.
- Begin crossing for genetic improvement of Andean lines with superior mineral bioavailability, short cooking time and disease resistance.
- Develop high throughput/nondestructive methods for determining cooking time
- Develop drought screening protocols (using both field and next generation phenometric based techniques)and assemble a drought nursery to be tested across locations in Africa and the US
- Assemble multiple disease resistance nurseries to be tested in Africa and Ecuador
- Assemble the rust mobile nurseries and deploy in Africa and Ecuador
- Seed multiplication and distribution to participant countries—work through PABRA
- Begin characterization of relevant pathogens in Ecuador and Africa
- Begin characterization of biophysiological (gas exchange and chl fluorescence) characteristics associated with drought
- Begin the improvement of both bush and climbing Andean beans introgressing sources of drought and multiple disease resistance
- Enhance country capacity building training two PhD students for Africa and one MS for Ecuador
- Conduct Field Book training in Ecuador and disease nursery workshops in Uganda and Zambia
- SNP data available to initiate the Association Mapping at least in BNF
- Identified more robust markers for major anthracnose gene(s)

Engagement of USAID Field Mission(s)

The project PI plans to visit field missions in each country to inform them of the research being undertaken

Partnering and Networking Activities

- Collaborate with S01.A4 Legume Innovation Lab Project to collaborate on regional nursery and disease screening to improve Mesoamerican beans–Beaver et al.
- Collaborate with BeanCAP project in accessing SNP Markers developed through that program.
- NGOs in Uganda include: Community Enterprise Development Organization (CEDO), Farm Africa, VEDCO, World Vision, CARE, ADRA, SHUPO., SASAKAWA Global 2000; Nyakatozi Growers Cooperative Union, Appropriate Technology (Uganda); Seed companies such as (Pearl, Victoria, NASECO, East African Seed, Green Nile Agrotech Limited; FICA seed).
- NGOs in Ecuador: Technical Committee of Beans. Agricultural Organizations; Ecuadorian Cooperation of Legume Producers and Industry (Corporación Ecuatoriana de Productores y Comercializadores de Leguminosas), 17 CIALs, CORPOCIALs, (Chota, Mira, Salinas, Intag, Pallatanga), Grupo de Evaluadores de Frijol de Bolivar, Assoc. de Productores de Frejol de INTAG. Government Organizations; MAGAP, MIES, INIAP, Univ. Private companies: involve in purchase and sale of bean seed, companies involved in canning industry.
- African Farm Radio Research Initiative (AFRRI) for radio broadcast delivery of new information being implemented by Farm Radio International, and funded by the Bill & Melinda Gates Foundation, to communicate with farmers in remote areas overcoming geographic, economic and literacy barriers.
- Freshpkt-Food Canning Company in Lukasa works with farmers to increase bean production for the canning industry and would be a logical partner for this project.
- The bean program at ZARI is also interacting with the Foundation for Wildlife and Habitat Conservation (FWHC) in Mpika in an innovative project to help former poachers to turn to agriculture and conserve the Game Management Areas that they inhabit. This foundation supports sustainable agriculture by promoting new and improved bean varieties to diversify local diets and improve their nutrition through regional markets. It is expected that over 200,000 traditional and new bean growers can be reached through this diverse network.
- The Bean program in Zambia has strong partnership with a number of NGOs and CBOs who include Self Help Africa, World Vision, Shangila Seed Growers Association, Concern World Wide, IITA Miracle Project, Action Aid to mention but a few. These are partners who are working with communities in disseminating improved technologies.
- In Uganda, funding was secured through AGRA–Alliance for a Green Revolution in Africa and PABRA network. Funding prospects from Kirkhouse Trust in NaCRRI with Annet Namayanja and Pamela Paparu.
- Root rot project Funded by BBSRC (UK): Pathogen Distribution, Characterization and Identification of Resistance Markers Associated with Root Rot Resistance in Common Beans in East and Central Africa –PI–Pamela Paparu, NaCRRI, Uganda.
- USAID funded Feed the Future Project: Development and dissemination of multiple pathogen and drought resistant/tolerant nutritionally enhanced bean varieties for the semi-arid and other regions of Uganda –PI-M.A. Ugen, NaCRRI, Uganda.

- Bean utilization project funded by ASARECA: Utilization of Bean Innovations for Food Security and Improved Livelihoods in Eastern and Central Africa - PI-M.A. Ugen, NaCRRI, Uganda.
- Bean value chain project funded by Maendeleo Agricultural Enterprise Fund: Enhancing women smallholder farmers' capacities to produce and market a sugar bean in domestic, regional and international markets, "The Sugar bean value chain" - PI Annet Namayanja, NaCRRI, Uganda.

Leveraging of Legume Innovation Lab Resources

- USDA-ARS FTF Dry Bean project which is genotyping and phenotyping the Andean Diversity Panel for numerous traits in multiple locations in the US and Africa.
  - USDA- NIFA projects: To Develop Common Bean (*Phaseolus vulgaris*) Germplasm with Resistance to the Major Soil Borne Pathogens in Uganda with MSU
  - USDA-NIFA: Genetic Approaches to Reducing Fungal and Oomycetes Soilborne Problems of Common Bean in Eastern and Southern Africa with UNL with partners USDA-ARS in Zambia and Mozambique
- PABRA/SABRN. This project will be in line with the PABRA agenda in Africa and will complement each other and provide opportunity to leverage resources. The choice of Zambia will be an entry point in sharing outputs with other countries as well as link with FTF projects in the region, where Zambia is partnering.
- Agricultural Productivity Program for Southern Africa (APPSA) under the Regional Centre of Leadership-Legumes is set to leverage the project in Zambia with research and capacity building.
- Leverage of out of country master degree program in Ecuador to support training of INIAP staff person in intensive English class to qualify for graduate program in plant pathology at UNL.
- Ugandan MS student in Food Science at MSU funded through MasterCard will work on the project.
- Uganda Ph.D. student in plant breeding, genetics and biotechnology at MSU to work on drought physiology funded through the BHEARD program will work in the project.

Timeline for Achievement of Milestones of Technical Progress

The Milestones for Technical Progress form for the workplan period for FY13 and FY14 have been completed for each objective listed in the workplan.

Training/Capacity Building

Degree Training

First and Other Given Names: Kelvin
Last Name: Kamfwa
Citizenship: Zambian
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: James D. Kelly
Degree Program for training: Doctorate
Program Areas or Discipline:Plant Breeding, Genetics and Biotechnology

If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training:University of Zambia
Thesis Title/ Research Area: Genetic dissection of biological nitrogen fixation in common bean using genome-wide association analysis and linkage mapping.
Start Date: August 2008
Projected Completion Date: September 2014
Training Status: Active
Type of Legume Innovation Lab Support (full, partial or indirect): Full

First and Other Given Names: Grady
Last Name: Zuiderveen
Citizenship: US
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: James D. Kelly
Degree Program for training: Doctorate
Program Areas or Discipline:Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: MSU
Thesis Title/ Research Area: SNP marker development for major resistance genes
Start Date: August 2013
Projected Completion Date: September 2017
Training Status: Pending
Type of Legume Innovation Lab Support (full, partial or indirect): Full

First and Other Given Names: Jesse
Last Name: Traub
Citizenship: US
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: Wayne Loescher
Degree Program for training: Doctorate
Program Areas or Discipline:Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: MSU
Thesis Title/ Research Area: Physiological differences among *Phaseolus vulgaris* cultivars differing in drought tolerance.
Start Date: August 2013 on Legume Innovation Funding
Projected Completion Date: September 2017
Training Status: Current graduate student with University Distinguished Fellowship from MSU for his first and final years of study FY11 and FY15 at MSU.
Type of Legume Innovation Lab Support (full, partial or indirect): Partial–one year funding FY14

First and Other Given Names: Isaac
Last Name: Dramadri

Citizenship: Uganda
Gender: M
Training Institution: MSU
Supervising Legume Innovation Lab PI: James D. Kelly and Wayne Loescher
Degree Program for training: Doctorate
Program Areas or Discipline:Plant Breeding, Genetics and Biotechnology
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: MSU
Thesis Title/ Research Area: Physiological studies on drought tolerance in Andean beans.
Start Date: August 2013 on Legume Innovation Funding
Projected Completion Date: September 2017
Training Status: BHEARD Fellowship from USAID Mission, Kampala.
Type of Legume Innovation Lab Support (full, partial or indirect): Indirect–research support

Short-term Training

Type of training : Drought and Disease Screening methods
Description of training activity: To orient staff that will be involved in the day to day data collection and monitoring of drought and disease nurseries so as to get reliable and common parameters
Location: Kabwe Research Centre under ZARI, Kasama, Zambia
Duration: One week (five working days)
When will it occur? October /November 2013
Participants/Beneficiaries of Training Activity: Research Technicians and Professionals
Anticipated numbers of Beneficiaries (male and female): 12 (five females and seven males)
PI/Collaborator responsible for this training activity: James Kelly/Kennedy Muimui could seek CIAT/PABRA for resource person
List other funding sources that will be sought (if any): PABRA/SABRN support will be sought
Training justification: Having good data collection and evaluation methods will is a pre-requisite for good research results. It is important that all those involved will have a common understating and methods of evaluation and data collection

Type of training: Drought and Disease Screening methods
Description of training activity: Take staff through drought screening protocol, isolation and inoculation techniques for ALS, Rust, CBB
Location: National Crops Resources Research Institute, Namulonge, Uganda
Duration seven-10 days
When will it occur: Between Oct-Dec 2013
Participants/Beneficiaries of Training Activity: Research and technicians and Ugandan PI
Anticipated numbers of Beneficiaries (male and female) 10 (six males and four females)
PI/Collaborator responsible for this training activity James Kelly/ Jim Steadman/Stanley Nkalubo
List other funding sources that will be sought (if any) CIAT/AGRA
Training justification: Understanding the different screening methods and how they are applied for the different stresses is important to avoid escapes

Performance Indicators for FY 13-FY14

Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 13 (Second Semester only), FY 14, and FY 15

Project Name:S01.A3 Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

Summary of all institutions: INIAP - Ecuador, NaCCRI - Uganda, ZARI - Zambia

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	0	0	0	2	0	0	5	0	0
	Number of women	0	0	0	1	0	0	3	0	0
	Number of men	0	0	0	1	0	0	2	0	0
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	0	0	0	86	0	0	92	0	0
	Number of women	0	0	0	43	0	0	5	0	0
	Number of men	0	0	0	43	0	0	7	0	0
	Numbers by Type of individual									
	Producers	0	0	0	60	0	0	60	0	0
	People in government	0	0	0	26	0	0	32	0	0
	People in private sector firms	0	0	0	0	0	0	0	0	0
	People in civil society	0	0	0	0	0	0	0	0	0
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	60	0	0	330	0	0	430	0	0
	New	0	0	0	270	0	0	350	0	0
	Continuing	60	0	0	60	0	0	80	0	0
	Gendered Household Type									
	Adult Female no Adult Male (FNM)	0	0	0	0	0	0	0	0	0
	Adult Male no Adult Female (MNF)	0	0	0	0	0	0	0	0	0
	Male and Female Adults (M&F)	0	0	0	0	0	0	0	0	0
	Child No Adults (CNA)	0	0	0	0	0	0	0	0	0

4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization									
	Private enterprises (for profit)	2	0	0	2	0	0	2	0	0
	Producers organizations	1	0	0	2	0	0	3	0	0
	Water users associations	0	0	0	0	0	0	0	0	0
	Women's groups	0	0	0	1	0	0	5	0	0
	Trade and business associations	0	0	0	0	0	0	0	0	0
	Community-based organizations (CBOs)	15	0	0	35	0	0	50	0	0
	New/Continuing (total)	18	0	0	40	0	0	56	0	0
	New	3	0	0	22	0	0	16	0	0
	Continuing	15	0	0	18	0	0	40	0	0
5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	3	0	0	3	0	0	3	0	0
	Agricultural production	2	0	0	2	0	0	2	0	0
	Agricultural post harvest transformation	0	0	0	0	0	0	0	0	0
	Nutrition	0	0	0	0	0	0	0	0	0
	Multi-focus	0	0	0	0	0	0	0	0	0
	Other	1	0	0	1	0	0	1	0	0
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	100	0	0	230	0	0	415	0	0
	crop genetics	100	0	0	230	0	0	415	0	0
	animal genetics	0	0	0	0	0	0	0	0	0
	pest management	0	0	0	0	0	0	0	0	0
	disease management	0	0	0	0	0	0	0	0	0
	soil-related	0	0	0	0	0	0	0	0	0
	irrigation	0	0	0	0	0	0	0	0	0
	water management	0	0	0	0	0	0	0	0	0
	post-harvest handling and storage	0	0	0	0	0	0	0	0	0
	processing	0	0	0	0	0	0	0	0	0
	climate mitigation or adaptation	0	0	0	0	0	0	0	0	0
	fishing gear/technique	0	0	0	0	0	0	0	0	0
	other	0	0	0	0	0	0	0	0	0
	total w/one or more improved technology	0	0	0	0	0	0	0	0	0
	New/Continuing hectares									
	New	0	0	0	115	0	0	195	0	0
	Continuing	100	0	0	115	0	0	220	0	0
	Sex of person managing hectare									
	Male	0	0	0	0	0	0	0	0	0
	Female	0	0	0	0	0	0	0	0	0
	Association-applied	0	0	0	0	0	0	0	0	0

7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	1	0	0	5	0	0	10	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	1	0	0	4	0	0	7	0	0
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	0	0	0	1	0	0	3	0	0
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	0	0	0	0	0	0	0	0	0
8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs	0	0	0	0	0	0	0	0	0
	Outputs	0	0	0	0	0	0	0	0	0
	Macroeconomic	0	0	0	0	0	0	0	0	0
	Agricultural sector-wide	0	0	0	0	0	0	0	0	0
	Research, extension, information, and other public service	0	0	0	0	0	0	0	0	0
	Food security/vulnerable	0	0	0	0	0	0	0	0	0
	Climate change adaptation or natural resource management (NRM) (ag-related)	0	0	0	0	0	0	0	0	0
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	0	0	0	0	0	0	0	0	0
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	0	0	0	0	0	0	0	0	0
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0	0	0	0	0	0	0	0	0
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0	0	0	0	0	0	0	0	0
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0	0	0	0	0	0	0	0	0

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13–FY14

Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

Legume Innovation Lab Project : BUDGET SUMMARY FY 14

S01.A3 Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

	10/01/13 - 09/30/14											
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
Institution Name	MSU	MSU	UNL Nebraska	Ecuador INIAP	Uganda NaCCRI	Zambia ZARI	enter name here	enter name here	enter name here	enter name here	enter name here	
HC or U.S. Institution	US	HC	US	HC	HC	HC	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	
a. Personnel Cost												
Salaries	$40,584	$20,292	$8,424	$20,000	$18,000	$14,000						$121,300
Fringe Benefit	$5,128	$2,564	$3,876	$2,000		$2,000						$15,568
b. Travel	$10,000	$0	$9,000	$10,000	$14,000	$12,000						$55,000
c. Equipment ($5000 Plus)												$0
d. Supplies	$12,000	$0	$23,750	$20,000	$8,500	$16,000						$80,250
e. Training												
Degree												$0
Non-Degree	$0	$9,000	$4,000	$5,000	$8,000	$6,000						$32,000
f. Other	$30,000	$0	$40,950	$3,000	$11,500	$10,000						$95,450
Other [tuition]	$22,296	$11,148	$0	$0	$0	$0						$33,444
g. Total Direct Cost	**$120,008**	**$43,004**	**$90,000**	**$60,000**	**$60,000**	**$60,000**	**$0**	**$0**	**$0**	**$0**	**$0**	**$433,012**
h. Indirect Cost 51%	$49,833	$16,247	$0	$0	$0	$0						$66,080
i. Indirect Cost on Subcontracts (First $25000) 51%	$0	$0	$7,650	$12,750	$12,750	$12,750						$45,900
j. Total Indirect Cost	$49,833	$16,247	$7,650	$12,750	$12,750	$12,750	$0	$0	$0	$0	$0	$111,980
Total	**$169,841**	**$59,251**	**$97,650**	**$72,750**	**$72,750**	**$72,750**	**$0**	**$0**	**$0**	**$0**	**$0**	**$544,992**
Grand Total							$544,992					

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	$210,008.00	48.50%
Total direct cost budgeted for H.C institution(s)	$223,004.00	51.50%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
In-kind	$20,040.00		$13,056.00									$33,096.00
Cash	$10,000.00											$10,000.00
Total	$ 30,040.00	$ -	$ 13,056.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 43,096.00

Attribution to Capacity Building												
Percentage of effort	1.00%	1.00%	10.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	10.36%
Amount corresponding to effort	$1,200.08	$430.04	$9,000.00	$600.00	$600.00	$600.00	$0.00	$0.00	$0.00	$0.00	$0.00	$12,430.12

S01.A3 Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (BNF)

Milestones for FY 13-FY14, Improving Genetic Yield Potential of Andean Beans with . . .

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

Research, Training and Outreach Workplans

(April 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: S01.A3 Improving Genetic Yield Potential of Andean Beans with Increased Resistances to Drought and Major Foliar Diseases and Enhanced Biological Nitrogen Fixation (

	Provide abbreviated name of institutions in columns below. Start with the U.S. institution.																	
	MSU			**UNL**			**ZARI- Zambia**			**INIAP-Ecuador**			**NaCCRI-Uganda**			**Institution 6**		
Identify Milestones by Objectives	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**
	(Tick mark the time period for achieving identified milestones by institution)																	
Objective 1: 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 Andean bean germplasm for the Eastern Africa highlands (Zambia and Uganda), Ecuador and U.S.																		
1.1. Integrated Nursery of Elite Sources from Meso and Andean LIL breeding programs		x			x			x			x				x			
1.2. Evaluation of Integrated Nursery			x			x		x			x	x		x	x			
1.3. Identification of resistance sources	x		x	x		x			x		x	x		x	x			
1.4. Crossing and backcrossing resistance sources		x			x				x		x	x			x			
1.5. Evaluation of lines for BNF	x		x					x			x	x			x			
1.6. Population development for genetic studies		x			x				x		x	x			x			
1.8. Screening for cooking time		x			x				x									
1.9. Canning evaluation of lines		x										x			x			
1.10. Evaluation of elite lines for cooking time bioavailability		x			x				x						x			
1.11 Assembling a Legume Innovation Lab nurseries for drought tolerance (andean and mesoamerican). Coordinate with the				x														
1.12 Develop protocol across MA and A and disseminate and perhaps train local	x			x			x			x			x					
1.13 Seed multiplication		x						x			x			x				
1.14 Site identification. BNF (sandy soils and low organic matter content)		x						x			x			x				
1.15 Field testing			x			x			x			x			x			
1.16 Evaluation of cooking time methodology			x															

Objective 2: 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.																		
2.1. Anthracnose race characterization, screening		x						x	x	x	x	x		x	x			
2.2. Angular Leaf Spot characterization, screening								x	x	x	x	x		x	x			
2.3. Rust characterization, screening		x		x	x	x		x	x	x	x	x		x	x			
2.4. Common Bacterial Blight Screening		x		x	x	x		x	x		x	x		x	x			
2.5 Compile data base of past pathogen collections			x			x			x			x			x			
Objective 3: 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.																		
3.1. SNP marker development linked to major resistance genes			x															
3.2. SNP marker associated with BNF			x															
3.3. SNP markers associated with drought		x		x	x													
3.4. MAS for disease screening using SNP																		
3.5 Plant regional BNF and drought nurseries for genotyping			x	x					x			x			x			
3.6 Fingerprinting lines/populations with SNP markers		x																
3.7 Association mapping			x			x												

Objective 4: Focus on phenometric approaches to improving the efficiencies of breeding for abiotic stress tolerance, especially drought															
4.1 Assemble selected sets of physiologically contrasting genotypes from breeders	x														
4.2 Conduct initial phenometric measurements and evaluations of contrasting genotypes	x	x													
4.3 Identify differences among genotypes with contrasting responses to high light and high temperature stresses.			x												
4.4 Extend methodology to include drought stress			x												
Objective 5: Capacity Building															
5.1. Graduate Student training	x	x	x		x										
5.2. Short term training for colloborators and technician (SNP Markers applications)						x			x			x			x
5.3 Short term training of graduate students/collobarators on phenometrics and	x	x	x						x						x
5.4 Train PhD or Msc students								x			x			x	
5.5 On-country training (BNF). Collaborate with the MA Legume Innovation Lab. Decide							x		x			x			x
5.6 Short term training for technicians/project personnel in host countries on the use of different screening protocols (drought and diseases)								x			x			x	
Signature/Initials:	mes D. Kelly, Karen Cic			hes Steadman, Carlos U			Kennedy Muimui			Eduardo Peralta			Stanley Nkalubo		
Date:		5-Sep-13													

Development and Implementation of Robust Molecular Markers and Genetic Improvement of Common and Tepary Beans to Increase Grain Legume Production in Central America and Haiti (S01.A4)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
James Beaver and Consuelo Estevez de Jensen, University of Puerto Rico, Mayaguez, Puerto Rico, USA

Collaborating Host Country and U.S. PIs and Institutions
Timothy Porch, USDA/ARS/TARS, Mayaguez, Puerto Rico, USA
Phil Miklas, USDA/ARS, Prosser, Washington, USA
Juan Osorno and Phil McClean, North Dakota State University, USA
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

Project Problem Statement and Justification
During the past 30 years, most of the growth in bean production in Central America was due to an increase in the area of production in the lowlands (< 1000 m). Greater heat tolerance combined with resistance to BGYMV permitted increased bean production in El Salvador. Bean production in Guatemala and Nicaragua has expanded into more humid lowland regions whereas a significant portion of the beans in Haiti continues to be produced in the lowlands. Bean production in Africa could be expanded if lines with better lowland adaptation were developed. This Legume Innovation Laboratory project will address several of the biotic and abiotic constraints often encountered by bean producers in the tropical lowlands.

Andean bean breeding lines developed by Dr. Paul Kusolwa at Sokoine University of Agriculture have a unique combination of traits that confer a high level of resistance to bruchids. These breeding lines include the arcelin 2 seed protein from common beans, the null phaseolin trait from *P. coccineus* and the APA locus derived from *P. acutifolius*. The bruchid resistant breeding lines have been used as progenitors at the University of Puerto Rico to introgress this resistance into black, small red and white beans that have resistance to BCMV, BCMNV and BGYM. Regional performance trials will be conducted in Central America and the Caribbean to measure the durability of the resistance when exposed to different genera and ecotypes of bruchids.

BCMNV threatens bean production in warmer bean production regions of Africa. The recent arrival of BCMNV in the Caribbean made the selection for resistance to this virus a priority breeding objective in Haiti, the Dominican Republic and Puerto Rico. An INIFAP bean scientists mentioned at the 2013 Bean Improvement Cooperative that BCMNV is a serious disease in lowland bean production regions of southeastern Mexico. Collaborative research supported by the Bean/Cowpea and Pulse CRSP resulted in the development and release of black bean lines such as DPC-40, XRAV-40-4 and MEN-2201-64ML that combine resistance to BCMNV and BGYMV. Small red bean breeding lines with the same combination of resistances are currently being developed at Zamorano. These BGYMV and BCMNV resistant black and small red bean lines will be available in the event that BCMNV emerges as a threat to bean production in Central America. The availability of small red bean breeding lines with BCMNV resistance will permit the evaluation of the performance of this seed type in Tanzania where red beans are consumed. These field trials will provide an appraisal of the potential benefit of Middle American bean production in the lowlands of Eastern Africa. Compared with Andean beans, small red and black beans tend to have greater yield potential and heat tolerance. Middle American beans may also have greater resistance to pathogens in Africa, since these pathogens have co-evolved with Andean beans.

Increased resistance to common bacterial blight and web blight is needed for beans produced in warm and humid lowland regions such as the Petén in Guatemala. This combination of resistances may also permit increased production of beans in Central America during the first growing season when rainfall is more abundant and reliable.

The previous Dry Grain Pulse CRSP project (UPR-1) developed Middle American and Andean bean breeding lines having adaptation to the lowland tropics and different combinations of resistance to diseases (common bacterial blight, rust, angular leaf spot, web blight and root rot) and tolerance to edaphic constraints (low N soils, high temperature). During the next five years, the Legume Innovation Lab project will use these elite breeding lines as the base for the continued improvement of beans for our target countries. In a previous Pulse CRSP project, Dr. Phil Miklas developed Andean bean breeding lines with resistance to BCMNV and anthracnose that should be useful to both Legume Innovation Lab breeding projects.

Several improved black and small red bean germplasm lines and cultivars are expected to be released in Central America and the Caribbean during the next five years. This Legume Innovation Laboratory will continue, in collaboration with CIAT, to support bean research network activities in Central America and the Caribbean. Collaborative activities such as the regional performance nurseries will help to extend the impact of this project through the release of improved cultivars throughout the region. The project will use a similar approach in Tanzania to collaborate with the Ministry of Agriculture bean research program and CIAT.

During the next five years, the project plans to release in Haiti red mottled, yellow and white bean cultivars with enhanced levels of disease resistance. These seed types are produced in regions in Haiti where the CRSP projects had less impact. This effort is consistent with the FTF 2011-2015 multi-year strategy in Haiti to increase the production of staples such as beans to increase food security. Yellow, red mottled and white bean breeding lines having BCMNV resistance will also be tested in Tanzania.

The project will continue to screen germplasm to identify additional sources of resistance to diseases that limit bean production in Central America, the Caribbean and Eastern Africa. For example, more resistance to ashy stem blight, caused by *Macrophomina phaseolina,* is needed to improve adaptation to hot and dry environments whereas greater resistance to web blight, caused by *Rhizoctonia solani,* is required to increase yield and seed quality of beans produced in more humid environments. Project personnel have the expertise and experience needed to reliably phenotype the Andean and Middle American Diversity Panels for traits of economic importance. This should contribute to the identification of new sources of resistance.

There are regions and/or growing seasons in Central America, Haiti and Tanzania that are too hot and/or dry to produce common beans. The tepary bean (*P. acutifolius*) is a potential alternative grain legume for these stressful environments. In fact, farmers on the Pacific coast of Central America and some countries of Africa already produce tepary beans on a limited scale. In addition to heat and drought tolerance, tepary bean lines with high levels of resistance to common bacterial blight, bruchids and other important traits have been identified. Resistance to BCMV, BGYMV, larger seed size and improved agronomic traits, would increase the potential adoption of tepary beans. Interspecific crosses with common beans could be used to introgress these traits into tepary beans. This effort represents the first systematic attempt to genetically improve tepary beans.

Bean breeders were early adopters of marker-assisted selection to identify lines with desired combinations of traits. This has resulted in increased efficiency in the development of improved breeding lines. There are, however, molecular markers available for a limited number of traits. Others, such as the SAP-6 SCAR marker, are only effective in a specific gene pool. Therefore, there is a need to develop new or more robust markers, particularly for traits of economic importance to bean breeding programs in the tropics. Recent advances by the BeanCAP project, led by North Dakota State University, in sequencing the bean genome and the development of a SNP array will facilitate the mapping and development of molecular markers for traits of economic importance, while breeder-friendly indel markers are a broadly applicable technology. The availability of phenotypic data in appropriate populations is a major factor limiting the development of these markers. This Legume Innovation Lab will assist this effort through the development of the populations and information needed to identify improved markers for traits such as the *Ur-11* gene for rust resistance. Dr. Phil McClean at NDSU will lead the collaborative effort to develop improved molecular markers.

The TMAC and the Management Office of the Legume Innovation Lab pointed out the need for SUA to engage the Agricultural Research Institute (ARI) in Uyole to enhance bean breeding capacity for the highlands of southern Tanzania. The focus of bean breeding will be the improvement of yellow beans, Kablanketi and Calima types which are produced throughout southern Tanzania. Mbeya is a good screening site for many of the diseases that limit bean production and for the evaluation, testing and dissemination of improved varieties in southern Tanzania. SUA has the capacity to help the ARI in Uyole to screen bean breeding lines using marker-assisted selection for resistance to rust, anthracnose and angular leaf spot. Dr. Phil Miklas will serve as the lead U.S. Co-PI for Tanzania, given his previous experience collaborating with SUA bean researchers and his expertise with the utilization of molecular markers for bean improvement. He will also lead the effort to evaluate the performance of Durango race beans in eastern Africa. A meeting at Morogoro and Uyole will be convened in May or June of 2014 to discuss collaborative research and training activities in southern Tanzania for FY15-FY17. Participants will include Co-PIs from Tanzania and the U.S and representatives from the ARI and CIAT. The principal objective of the meeting will be the development of strategies to strengthen collaboration among bean research programs in southern Tanzania. This should enhance the capacity of SUA and ARI breeding programs to develop and deliver of technologies that will address the needs of bean growers in Tanzania.

Planned Project Activities for the Workplan Period

<u>Objective 1.</u> *Genetic improvement of common and tepary beans for Central America, Haiti and Tanzania*

<u>Objective 1a</u>
Genetic improvement of common beans for Central America, Haiti and southern Tanzania

Collaborators
James Beaver and Consuelo Estevez de Jensen–University of Puerto Rico, Mayaguez, PR, USA
Timothy Porch–USDA/ARS/TARS, Mayaguez, PR, USA
Phil Miklas–USDA/ARS, Prosser, WA, USA
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
Michael Kilango, Agricultural Research Institute, Tanzania

Approaches and Methods
Conventional plant breeding techniques and marker-assisted selection will be used by Legume Innovation Lab scientists to develop common bean cultivars and breeding lines with enhanced levels of disease resistance and greater tolerance to abiotic stresses. Plant breeders will focus on the most important biotic and abiotic constraints in lowland (< 1000 m) bean production regions in Central America and Haiti and both lowland and highland regions of southern Tanzania.

Bruchid resistant bean breeding lines developed by Dr. Kusolwa at Sokoine University of Agriculture will be used to introgress resistance to this pest into commercial seed types (black, small red, red mottled, light red kidney and yellow) produced in the target countries. A laboratory screening technique developed at the University of Puerto Rico will be used to evaluate the resistance of bean breeding lines. Molecular markers will also be used to identify lines having traits (null phaseolin, arcelin 2 and APA locus) associated with bruchid resistance. An additional breeding objective is to combine bruchid and virus (BCMV, BCMNV and BGYMV) resistance. Bruchid resistant Andean bean lines with BCMV and BCMNV ($I + bc\text{-}1^2$) resistance have already been developed. Considerable progress has also been made toward the development of black beans that combine bruchid and virus resistance. During FY14, a small group of lines selected in Tanzania and/or Puerto Rico for bruchid resistance will be tested in Central America and Haiti to evaluate the durability of resistance when exposed to different ecotypes of *Acanthoscelides obtectus* and other genera (*Zabrotes subfasciatus*) of bruchids. The project will attempt to identify a FTF collaborator to characterize the amino acid profile of bruchid resistant common beans.

Legume Innovation Lab plant breeders will assist bean research programs in Guatemala and Haiti to develop the capacity to produce populations and test breeding lines that will lead to the release of improved bean cultivars. This should contribute to the long-term sustainability of bean breeding activities in the region.

Zamorano will coordinate the regional testing of small red and black bean breeding lines. These trials will be conducted in collaboration with national bean research programs and CIAT. Promising lines will be tested throughout Central America and the Caribbean, including countries that are not participating in this Legume Innovation Lab project. Testing lines in different countries provides more information concerning the potential performance of the lines and expands the potential impact of the research supported by the Legume Innovation Lab. In addition to yield trials, field trials will be conducted to screen bean lines for resistance to different diseases such as angular leaf spot and web blight. Testing sites will be chosen that are expected to produce the most reliable results for screening for specific traits.

Small red, white and red mottled bean lines from Zamorano and the UPR having BCMNV resistance will be tested in southern Tanzania. Results from these field trials will provide valuable information concerning the potential value of Middle American beans in Eastern Africa.

The Middle American and Andean Diversity panels will be screened in Central America, the Caribbean and Tanzania for specific traits. For example, the Andean Diversity Panel will be screened in Haiti for reaction to powdery mildew and in Honduras for angular leaf spot. Performance of the Middle American Diversity Panel will be evaluated in low N environments in Central America, the Caribbean and southern Tanzania. The Middle American Diversity Panel will be screened in Puerto Rico for resistance to ashy stem blight. Durango race bean lines in the Middle American Diversity Panel will be evaluated for potential production in Tanzania. Durango beans will be bred for increased seed size in desired market classes and for resistance to the most important diseases including BCMNV, anthracnose angular leaf spot and ashy stem blight.

Although disease resistance is the primary focus of this Legume Innovation Lab project, the performance of bean breeding lines will be evaluated in low fertility soils. Honduras has an ideal site for the evaluation of lines for adaptation to low P soils whereas Puerto Rico has good locations for screening beans for performance in a low N soil and root rot resistance. Morogoro, in the eastern part of Tanzania, and Mbozi, in the southern part of Tanzania, are also good sites for screening for low N. These sites will be used to evaluate the performance of bean breeding lines derived from recurrent selection for increased BNF and/or selected for greater nitrogen use efficiency. These sites will be inoculated with efficient *Rhizobium* strains to allow indirect selection for enhanced biological nitrogen fixation.

<u>Specific research activities for objective 1a during FY14:</u>

Central America

1. Develop and test black and small red bean breeding lines for the lowlands that combine disease and pest resistance with greater tolerance to abiotic stress.
2. Coordinate the regional testing of small red and black bean breeding lines in the lowlands of Central America and Haiti.
3. Utilize recurrent selection to develop bean populations for better adaptation to low N soils and greater resistance to web blight.
4. Test improved tepary bean lines.

5. Initiate the development of bean breeding populations in Guatemala with the goal of releasing a locally-developed cultivar by the end of the five-year extension period.
6. Haiti
7. Test black and Andean bean breeding lines that combine disease and pest resistance with greater tolerance to abiotic stress.
8. Test improved tepary bean and photoperiod insensitive Lima bean lines.
9. Study the potential benefit of thicker pod walls in common bean to prevent seed germination during periods of wet weather during the harvest.
10. the development of bean breeding populations in Haiti with the goal of releasing a locally-produced cultivar by the end of the five-year extension period.
11. collaboration between the NSS and NGOs in Haiti for on-farm testing of improved bean breeding lines (black, white, yellow and red mottled)
12. Screen the Andean Diversity Panel (ADP) in Haiti for resistance to powdery mildew to identify new sources of resistance and to use association mapping to identify molecular markers for resistance.

Tanzania

1. Test the performance of elite small red, white, yellow and red mottled bean breeding lines from Central America and the Caribbean
2. Test the performance of improved tepary bean lines.
3. Evaluate Durango bean lines in the Middle American Diversity Panel for potential production in Tanzania.
4. Screen the Middle American Diversity Panel for performance in low N soils.

Puerto Rico (UPR and USDA/ARS/TARS)

1. Develop and test Andean and Middle American bean breeding lines that combine disease and pest resistance with greater tolerance to abiotic stress.
2. In collaboration with the MSU breeding project, screen *Zorro x Puebla 152* RIL population for BNF traits.
3. Screen the Middle American Diversity Panel for resistance to ashy stem blight and performance in low N soils.
4. Screen bean lines and populations derived from recurrent selection for root rot resistance and adaptation to low N.
5. Coordinate Andean bean line performance trials for the Caribbean and Tanzania.

Objective 1b: *Improve agronomic traits and disease resistance of climate resilient tepary bean.*

Collaborators

Timothy Porch, USDA/ARS/TARS, Mayaguez, PR, USA
James Beaver and Consuelo Estevez de Jensen, University of Puerto Rico, Mayaguez, PR, USA
Phil McClean- North Dakota State University, Fargo, ND USA
Juan Carlos Rosas, Escuela Agrícola Panamericana (Zamorano), Honduras
Julio Cesar Villatoro, Instituto de Ciencia y Tecnología Agrícolas (ICTA), Guatemala
Emmanuel Prophete, National Seed Service, Ministry of Agriculture, Haiti
Susan Nchimbi-Msolla, Sokoine University of Agriculture (SUA), Tanzania
Kirstin Bett, U. of Saskatchewan, Saskatoon, Canada

Mark Brick, Colorado State University, Ft. Collins, Colorado, USA

Approaches and Methods

Although tepary bean has high levels of abiotic stress tolerance, it is susceptible to viruses such as BGYMV, BCMV, and BCMNV. In order to expand the potential use of tepary bean in abiotic stress prone regions, a primary focus of this project will be to initiate the introgression of virus resistance from common bean into tepary bean. By project end (FY17) we expect to have tepary breeding lines with improved virus resistance that will be available for pyramiding of virus resistance loci in future efforts.

A tepary breeding program was initiated at USDA-ARS-TARS in 2008. Advanced breeding lines developed from these previous breeding efforts will be increased in FY13 and FY14 and then shared with the collaborators for testing in Tepary Adaptation Trials (TAT).
New tepary F_4 lines will be generated from crosses between promising large and round seeded genotypes from the CIAT collection and breeding lines selected for disease and abiotic stress tolerance. Using leveraged funds, these materials will be initially tested through a shuttle breeding program with M. Brick at Colorado State University. This effort will focus on seed size/shape, drought and heat tolerance, and CBB and bruchid resistance in PR; and on photoperiod insensitivity, broad adaptation, rust resistance, and yield in Colorado. Superior lines will then be tested in the host countries for potential future release.

In order to speed the breeding progress with tepary and to advance genetic analysis, common bean Indel markers will be tested in tepary to evaluate their potential use.
Additional sources of disease resistance will be evaluated using the CIAT tepary bean collection (about 250 accessions). These accessions will be evaluated for CBB and BCMV.

Breeding and introgression of BGYMV Res., *I* and *bc3* into tepary/common bean hybrids.

- Based on previous Pa x Pv crossing efforts, effective Pv and Pa parents (e.g. *Pv Beniquez* with all four virus genes) will be selected for hybridization during FY13–14.
- F_1 Pv x Pa hybrids will be completed during FY14 from crosses between selected parents above at ARS-TARS.
- Embryo rescue will be initiated from the BC_1F_1 generation material in FY15 through collaboration with the U. of Saskatchewan.
- Determine potential use of *P. vulgaris* Indels for tepary genetic analysis and mapping.
- A small subset representing Tepary genetic diversity will be assembled at USDA-ARS-TARS in FY13 and sent to NDSU.
- NDSU will evaluate a subset of the 3,000 Pv indels on the Pa germplasm to evaluate potential use.
- Characterize the CIAT tepary bean germplasm collection for BCMV and CBB resistance.
- The CIAT tepary bean germplasm collection (~250 lines) will be evaluated for CBB (FY13), adaptation (FY14) at USDA-ARS-TARS using leveraged ARS-FTF funds.
- The CIAT tepary bean germplasm collection (~250 lines) will be evaluated for response to NL3 at the UPRM (FY13) using leveraged ARS-FTF funds.

Multilocation testing of improved tepary bean breeding lines

- Collaborators in Central America, Haiti, and Tanzania will initiate testing of breeding lines in Tepary Adaptation Trials (TAT) to test wide adaptation as well as specific adaptation of lines to specific potential growing areas.

<u>Objective 2:</u> *Develop and implement robust molecular markers for disease resistance genes*

Collaborators
Phil McClean, North Dakota State University, Fargo, ND, USA
Karla Ponciano, ICTA, Guatemala City, Guatemala
Paul Kusolwa, Sokoine University of Agriculture, Morogoro, Tanzania
Phil Miklas, USDA/ARS, Prosser, WA, USA

Approaches and Methods
This project will leverage the results from the USDA Common Bean Agricultural Project and the USDA/DOE/JGI common bean sequencing project. The BeanCAP project developed a suite of ~3000 indel markers distributed across all common bean chromosomes. These markers are co-dominant and designed to be functional with a single experimental condition (PCR protocol).The power of these markers is that they are simple to implement and thus completely portable in all laboratories and are amenable to multiplexing with suites of markers. Multiplexing reduces the cost of genotyping an individual line. The release of the common bean whole genome assembled sequence allows for precise localization of each of these markers. The final key element that facilitates this project is the development, over the last fifteen years, of markers that are linked, from 0-5 cM, to important target disease genes. While useful, there has been some difficulty in the portability of these markers from one laboratory to another. They all have unique experimental conditions that preclude multiplexing, and five percent recombination reduces effectiveness due to recombination between marker and target gene.

<u>Identify genetic materials for marker evaluation</u>
Potential targets for improved marker development include:
- Bean golden yellow mosaic virus resistance genes and QTL (*bgm*, SW12, *Bgp*)
- Bruchid resistance genes (*Arc2*, *Arl3*, *PHA* and *aAI3*)
- BCMV and BCMNV (*I, bc-3, bc-1*^{2})
- Bean rust (*Ur-4, Ur-5, Ur-11*).

For each of these targets, we will adopt the same procedure. First, we will search the published literature and communicate personally with breeders, geneticists, and pathologists in both Legume innovation Lab projects to identify genetic materials with contrasting phenotypes (resistance, susceptibility) for the specific disease. These could be genetic populations or a collection of lines with known phenotype that can then be used for the identification of closely linked indel markers.

Development of Indel markers

- DNA will be isolated from genetic populations or collections of lines with known phenotypes.
- The physical locations of target genes or markers will be identified using sequence information and the common bean genome sequence. If the sequence information is poor or unavailable, the specific marker will be cloned and sequenced.
- Indel marker selection: Once the location of the marker is determined, it will then be compared to the indel database to discover 30 indel markers that straddle the physical location of the marker. Those indel markers will be used in PCR amplification to determine which one acts as a definitive marker that is unambiguous in its predictive power. If several markers have equal predictive power, then the one that will best work as a multiplexing marker will be selected. Legume Innovation Lab bean breeding programs in Guatemala, Honduras, Ecuador, Tanzania and Uganda have the facilities and technical expertise needed to immediately adopt the use of indels for marker-assisted selection.

Objective 3: *Institutional capacity building*

Collaborators

James Beaver and Consuelo Estevez de Jensen, University of Puerto Rico, Mayaguez, PR, USA
Timothy Porch, USDA/ARS/TARS, Mayaguez, PR, USA
Phil Miklas, USDA/ARS, Prosser, WA, USA
Juan Osorno and Phil McClean–North Dakota State University (NDSU), Fargo, ND, USA
Juan Carlos Rosas–Escuela Agrícola Panamericana (Zamorano), Honduras
Julio Cesar Villatoro, Instituto de Ciencia y Tecnología Agrícolas (ICTA), Guatemala
Emmanuel Prophete– National Seed Service, Ministry of Agriculture, Haiti
Paul Kusolwa and Susan Nchimbi-Msolla–Sokoine University of Agriculture (SUA), Tanzania
Michael Kilango, Agricultural Research Institute, Tanzania

Approaches and Methods

Formal and informal training activities will be conducted to enhance the capacity of host country bean research programs to develop and release superior-performing bean cultivars that will increase production or reduce losses in the target countries. At the end of this project, these bean research programs should have the capacity to utilize the newly-developed suite of indel markers for marker-assisted selection. The Ph.D. and M.S. degree students will be provided a broad range of training in conventional and molecular plant breeding techniques so that they can assume roles of leadership in bean research programs in the target countries. Informal training of technicians should improve the reliability and quality of bean research conducted in host countries.

Informal training

- In-service training will be provided at NDSU for Legume Innovation Laboratory scientists to review recent advances in sequencing the bean genome and the utilization of SNP arrays to develop indel markers for traits of economic importance.

- A workshop will be held at the first meeting of Legume Innovation Lab researchers to discuss recent advances in the use of molecular techniques for bean and cowpea improvement.

- Workshops will be held in Honduras and Tanzania to train technical personnel concerning bean research techniques with the goal of improving the quality of field research. Topics will include the development and management of field trials, breeding and selection methods, field evaluation techniques, research with *Rhizobium*, participatory plant breeding and agro-ecological techniques. The workshop in Tanzania will include participants from both SUA and the ARI. U.S. PIs will take advantage of their trip to Tanzania in 2014 to offer presentations to researchers and technical staff on topics related to their research.

    - A significant amount of information concerning bean research techniques is already available on the BIC web site http://bic.css.msu.edu/ResearchTechniques.cfm. This Legume Innovation Lab project will collaborate with the BIC in developing modules for the BIC web site that will describe research techniques for additional traits such as bruchid resistance.

Formal training

- Undergraduate students at Zamorano and Sokoine University will be provided opportunities to participate in bean research activities related to Legume Innovation Lab project objectives.
- M.S. degree training will be completed at the UPR of Ana Vargas (Nicaragua), Angela Miranda (Guatemala) and Diego Rodriguez (Ecuador).
- Ph.D. degree training at NDSU of two bean researchers from Central America, the Caribbean or Africa. Both students will be trained in the use of conventional and molecular techniques.

Contribution of Project to USAID Feed the Future Performance Indicators

- Seed production of improved bean varieties developed with support from the Legume Innovation Lab can provide an indirect estimate of the number of hectares planted in target countries (performance indicator 4.5.2 (2).
- Ph.D., M.S. and B.S. degree training in the U.S. and Host Countries will contribute to performance indicator 4.5.2(6).-In-service training and workshops will contribute to performance indicator 4.5.2(7).
- -he development of indel markers can be documented as a Phase I performance indicator 4.5.2(39).
- Performance of breeding lines in regional trials and other field trials can be recorded as a Phase II performance indicator 4.5.2(39).
- Release of improved bean cultivars can be recorded as a Phase III performance indicator 4.5.2(39).

Outputs

- Release and dissemination in the lowlands of Central America and the Caribbean of black and small red bean cultivars with BGYMV & BCMV resistance and greater tolerance to low soil fertility.

- Release and dissemination in the lowlands of Central America and the Caribbean black, white and red mottled bean breeding lines with resistance to bruchids, BGYMV, BCMV and BCMNV.
- Release and dissemination of lowland black and white bean breeding lines with resistance to BGYMV, BCMV, BCMNV and rust.
- Testing and possible release in Haiti and Tanzania of yellow and red mottled bean lines with resistance to BGYMV, BCMNV and BCMV.
- New bioinformatic-based approach to enabling marker development.
- Indel markers for traits of economic importance that will facilitate the selection of bean lines with the desired combination of traits.
- Technical personnel in Central America, the Caribbean and Tanzania with greater capacity to conduct field trials and to produce reliable and repeatable results.
- Graduate degree training of students from Central America, the Caribbean and Eastern Africa.

Engagement of USAID Field Mission(s)

Host country scientists will be responsible of informing local USAID Missions about progress of the Legume Innovation Laboratory project toward research and training objectives. Opportunities will be sought to obtain USAID Mission support to expand activities in host countries. Local USAID Missions will be contacted when U.S. scientists visit host countries.

Partnering and Networking Activities

Dr. Phil Miklas serves as the President of the Bean Improvement Cooperative. Many Grain Legume Innovation Lab scientists publish research achievements in the Annual Report and make presentations or present posters at the biennial meeting.

Several Legume Innovation Laboratory scientists participate in Regional Hatch Project W-2150 which is a multi-disciplinary network of U.S. bean researchers.

Researchers in Central America and the Caribbean often make scientific presentations at the annual meeting of the PCCMCA. The meeting provides an opportunity for the Central American/Caribbean research network which includes national programs, CIAT and the Legume Innovation Laboratory scientists to meet to exchange results from research and plan activities for the upcoming year

Dr. Miklas and Dr. Porch receive USDA-ARS Feed the Future funds which complement Legume Innovation Laboratory research and training activities in Tanzania. Dr. Miklas, Dr. Porch, Dr. Rosas, Dr. Beebe and Dr. Beaver will participate in the Penn State University project led by Dr. Jonathan Lynch dealing with abiotic stress. An online group has been established in Google+ to discuss collaborative research and regional nurseries. Legume Innovation Lab project personnel will strive to coordinate activities so that regional field trials and travel plans complement the goals of both projects. It would be useful for both projects to utilize the same database for the collection and management of data from field trials.

Leveraging of Legume Innovation Laboratory Resources

Project scientists will continue close collaboration with the other Legume Innovation Laboratory and FTF projects focused on genetic improvement of beans. Promising breeding lines are frequently exchanged among U.S. and Host Country scientists. For example, we recently provided collaborators in Ecuador with a source of bruchid resistance. The exchange of breeding lines developed by the Legume Innovation Lab can also benefit U.S. bean breeding programs. Interspecific lines originally developed for web blight resistance were found to have the high levels of resistance to white mold (McCoy et al. 2012. BIC 55:153-154). In Puerto Rico, the project currently collaborates with the Michigan State University in the evaluation of a bean population for biological nitrogen fixation in a low N soil.

Dr. Porch has received FTF funds from the USDA which are being used to support a graduate student from Nicaragua (Ana Vargas). He is coordinating collaboration between the USDA/ARS and Legume Innovation Lab in the evaluation of the Andean Bean Diversity Panel for powdery mildew and root rot resistance, low fertility response, and biological nitrogen fixation efficiency.

The McKnight Foundation supports work in Tanzania on the development of bruchid resistance in farmer-preferred varieties and the integration of botanical and physical methods to control bruchids. Bean lines developed from this project will be useful to the Legume Innovation Lab project for bean improvement in collaborating countries. Marker-assisted selection will be used to develop bean lines with bruchid resistant genes.

Researchers in Tanzania participate in a Kirkhouse Trust project aimed at developing bean varieties with multiple disease resistance using marker-assisted selection (MAS). Bean lines with multiple disease resistance developed in this project could be used for further genetic improvement by this Legume Innovation Lab project.

Tanzania is part of the Southern Africa Bean Research Network (SABREN) and Eastern Africa Bean Research Network (ECABRN). Participation in these networks allows testing of promising bean breeding lines developed by this Legume Innovation Lab project in the regional nurseries. This should result in wider adoption of varieties developed by the project, thus greater impact. On the other hand promising breeding lines from other countries or CIAT in these regional nurseries can be used as parents by the Legume Innovation Lab project.

Dr. Rosas continues to collaborate with Dr. Lynch in the selection of bean lines having root traits that should improve performance in low P soils. Several scientists in this Legume Innovation Lab project will participate in a USAID-funded project led by Dr. Jonathan Lynch that seeks to use marker-assisted selection to develop bean lines with greater tolerance to drought and heat.

Legume Innovation Lab breeders and pathologists (Kelly, Steadman, Urrea, Osorno, Beaver, Estevez and Porch) have an opportunity to meet at least once a year in Puerto Rico. This facilitates communication between the Legume Innovation Lab bean breeding projects.

The Bean Technology Dissemination associate award led by Michigan State University allowed the Pulse CRSP and Legume Innovation Lab projects to produce and distribute seed of improved black and small red bean cultivars and *Rhizobium* inoculants to thousands of farmers in Central America and the Caribbean.

Timeline for Achievement of Milestones of Technical Progress
Please refer to the document describing milestones

Training/Capacity Building Workplan for FY 2013–2014

<u>Degree Training</u>
First and Other Given Names: Ana Gabriela
Last Name: Vargas
Citizenship: Nicaragua
Gender: F
Training Institution: University of Puerto Rico
Supervising CRSP PI: Tim Porch and James Beaver
Degree Program for training: M.S.
Program Areas or Discipline: Plant breeding
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID?- No
Host Country Institution to Benefit from Training: None
Thesis Title/Research Area: To be defined
Start Date: Jan. 2013
Projected Completion Date: May 2015
Training status (Active, completed, pending, discontinued or delayed): Active
Type of CRSP Support (full, partial or indirect) for training activity: Partial

First and Other Given Names: Angela Nadeshda Nicte
Last Name: Miranda Mijangos
Citizenship: Guatemala
Gender: F
Training Institution: University of Puerto Rico
Supervising CRSP PI: James Beaver and Tim Porch
Degree Program for training: M.S.
Program Areas or Discipline: Plant breeding
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Host Country Institution to Benefit from Training: ICTA
Thesis Title/Research Area: To be defined
Start Date: Jan. 2014
Projected Completion Date: May 2016
Training status (Active, completed, pending, discontinued or delayed): Pending
Type of CRSP Support (full, partial or indirect) for training activity: Full

First and Other Given Names: Diego
Last Name: Rodriguez
Citizenship: Ecuador
Gender: M
Training Institution: University of Puerto Rico

Supervising CRSP PI: Jim Beaver and Phil Miklas
Degree Program for training: M.S.
Program Areas or Discipline: Plant breeding
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Host Country Institution to Benefit from Training: INIAP
Thesis Title/Research Area: To be defined
Start Date: August2013
Projected Completion Date: December 2015
Training status (Active, completed, pending, discontinued or delayed): Pending
Type of CRSP Support (full, partial or indirect) for training activity: Partial

First and Other Given Names: To be determined (TBD)
Last Name: TBD
Citizenship: TBD
Gender: TBD
Training Institution: North Dakota State University
Supervising CRSP PI: Phil McClean and Juan Osorno
Degree Program for training: Ph.D.
Program Areas or Discipline: Plant breeding and genetics
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: TBD
Thesis Title/Research Area: TBD
Start Date: TBD
Projected Completion Date: TBD
Training status (Active, completed, pending, discontinued or delayed): Pending
Type of CRSP Support (full, partial or indirect) for training activity: Full

First and Other Given Names: To be determined (TBD)
Last Name: TBD
Citizenship: TBD
Gender: TBD
Training Institution: North Dakota State University
Supervising CRSP PI: Juan Osorno and Phil McClean
Degree Program for training: Ph.D.
Program Areas or Discipline: Plant breeding and genetics
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: TBD
Thesis Title/Research Area: TBD
Start Date: TBD
Projected Completion Date: TBD
Training status (Active, completed, pending, discontinued or delayed): Pending
Type of CRSP Support (full, partial or indirect) for training activity: Full

First and Other Given Names: TBD
Last Name: TBD
Citizenship: TBD

Gender: F
Training Institution: Zamorano
Supervising CRSP PI: J.C. Rosas
Degree Program for training: B.Sc.
Program Areas or Discipline: Plant breeding
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID?
Host Country Institution to Benefit from Training: TBD
Thesis Title/Research Area: Improvement of beans for tolerance to low N soils
Start Date: Jan. 2014
Projected Completion Date: Dec. 2014
Training status (Active, completed, pending, discontinued or delayed): Pending
Type of CRSP Support (full, partial or indirect) for training activity: Partial

Short-term Training
Type of training: In-service training
Description of training activity: In-service training will be provided at NDSU for Legume Innovation Lab scientists to review recent advances in sequencing the bean genome and the utilization of a SNP arrays to develop indel markers for traits of economic importance.
Location: NDSU
Duration: Two weeks
When will it occur? 2014
Participants/Beneficiaries of Training Activity: two
Anticipated numbers of Beneficiaries (male and female): 1M, 1F
PI/Collaborator responsible for this training activity: Phil McClean
List other funding sources that will be sought (if any): None
Training justification: This training is needed to permit host country scientists to take advantage of the recent advances in the development and use of molecular markers for bean breeding programs.

Type of training: Workshop
Description of training activity: A workshop will be held at the first global meeting of Legume Innovation Lab researchers to discuss recent advances in the use of molecular techniques for bean and cowpea improvement.
Location: TBD
Duration: TBD
When will it occur?2014
Participants/Beneficiaries of Training Activity: Legume Innovation Laboratory scientists
Anticipated numbers of Beneficiaries (male and female): TBD
PI/Collaborator responsible for this training activity: Phil McClean
List other funding sources that will be sought (if any): None
Training justification: This training will benefit Legume Innovation Lab scientists to become familiar with recent advances in the development and use of molecular markers for bean and cowpea breeding programs.

Type of training: Workshops
Description of training activity: Workshops will be held in Honduras and Tanzania to train technical personnel concerning bean research techniques with the goal of improving the quality of field research. Topics will include the conduct of field trials, breeding and selection methods, field evaluation techniques, research with *Rhizobium*, participatory plant breeding and agro-ecological techniques.

Location: Tanzania and Honduras
Duration: One week
When will it occur? 2014
Participants/Beneficiaries of Training Activity: Technicians working for bean research programs in Central America, Haiti and Tanzania
Anticipated numbers of Beneficiaries (male and female): 30
PI/Collaborator responsible for this training activity: Juan Carlos Rosas and Consuelo Estevez
List other funding sources that will be sought (if any): None
Training justification: Trainees will improve their skills in conducting field and laboratory research. This should improve the quality and reliability of research conducted in host countries.

Type of training: In- service
Description of training activity: Techniques for screening lines for resistance to BCNMV.
Location: UPR
Duration: three months
When will it occur: Jan.-April, 2014
Participants/Beneficiaries of Training Activity: Senior student from Zamorano
Anticipated numbers of Beneficiaries (male and female): 1 F
PI/Collaborator responsible for this training activity: J. Beaver
List other funding sources that will be sought (if any)
Training justification: Screening advanced breeding lines with strain NL3 and implementation of bc3 marker at Zamorano program.

Equipment (costing >$5,000)
None during FY-14

Performance Indicators for FY 13-FY14
Development and Implementation of Robust Molecular Markers and Genetic Improvement of Common and Tepary Beans to Increase Grain Legume Production in Central America and Haiti (S01.A4)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 13 (Second Semester only), FY 14, and FY 15

Project Name:

Institution 1 Name (one sheet per institition):

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	2	0	0	4	0	0	4	0	0
	Number of women	0			1			1		
	Number of men	2			3			3		
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	0	0	0	17	0	0	17	0	0
	Number of women	0			10			10		
	Number of men	0			7			7		
	Numbers by Type of individual									
	Producers	0								
	People in government	0			17			17		
	People in private sector firms	0								
	People in civil society	0								
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New									
	Continuing									
	Gendered Household Type									
	Adult Female no Adult Male (FNM)									
	Adult Male no Adult Female (MNF)									
	Male and Female Adults (M&F)									
	Child No Adults (CNA)									
4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization									
	Private enterprises (for profit)									
	Producers organizations									
	Water users associations									
	Women's groups									
	Trade and business associations									
	Community-based organizations (CBOs)									
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New									
	Continuing									

5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	0	0	0	0	0	0	0	0	0
	Agricultural production									
	Agricultural post harvest transformation									
	Nutrition									
	Multi-focus									
	Other									
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	0	0	0	0	0	0	0	0	0
	crop genetics									
	animal genetics									
	pest management									
	disease management									
	soil-related									
	irrigation									
	water management									
	post-harvest handling and storage									
	processing									
	climate mitigation or adaptation									
	fishing gear/technique									
	other									
	total w/one or more improved technology									
	New/Continuing hectares									
	New									
	Continuing									
	Sex of person managing hectare									
	Male									
	Female									
	Association-applied									
7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	0	2	0	29	0	0	29	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance		2		14			14		
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance		0		11			11		
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance		0		4			4		

8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs									
	Outputs									
	Macroeconomic									
	Agricultural sector-wide									
	Research, extension, information, and other public service									
	Food security/vulnerable									
	Climate change adaptation or natural resource management (NRM) (ag-related)									
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed									
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation									
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree									
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved									
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun									

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13-FY14

Development and Implementation of Robust Molecular Markers and Genetic Improvement of Common and Tepary Beans to Increase Grain Legume Production in Central America and Haiti (S01.A4)

Legume Innovation Lab Project : BUDGET SUMMARY

S01.A4 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.

	4/1/13 - 09/30/17					
	FY 13	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
a. Personnel Cost						
Salaries	$0.00	$129,761.00	$127,059.00	$127,237.00	$127,420.00	$511,477.00
Fringe Benefit	$0.00	$24,952.00	$24,141.00	$24,194.00	$24,249.00	$97,536.00
b. Travel	$26,000.00	$43,000.00	$45,200.00	$45,000.00	$45,000.00	$204,200.00
c. Equipment ($5000 Plus)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Supplies	$4,338.00	$56,738.00	$52,150.00	$51,150.00	$51,150.00	$215,526.00
e. Training						
Degree	$0.00	$89,989.00	$93,617.00	$72,275.00	$60,969.00	$316,850.00
Non-Degree	$0.00	$6,000.00	$13,000.00	$6,000.00	$6,000.00	$31,000.00
f. Other	$0.00	$5,500.00	$6,400.00	$5,500.00	$5,500.00	$22,900.00
g. Total Direct Cost	**$30,338.00**	**$355,940.00**	**$361,567.00**	**$331,356.00**	**$320,288.00**	**$1,399,489.00**
h. Indirect Cost	$7,585.00	$52,460.00	$51,265.00	$50,469.00	$50,576.00	$212,355.00
i. Indirect Cost on Subcontracts (First $25000)	$0.00	$6,250.00	$0.00	$0.00	$0.00	$6,250.00
j. Total Indirect Cost	$7,585.00	$58,710.00	$51,265.00	$50,469.00	$50,576.00	$218,605.00
Total	**$37,923.00**	**$414,650.00**	**$412,832.00**	**$381,825.00**	**$370,864.00**	**$1,618,094.00**
Grand Total	**$1,618,094.00**					

Cost Share	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
In-kind	$10,269.00	$80,539.00	$80,539.00	$80,539.00	$80,539.00	$332,425.00
Cash	$0.00	$1.00	$1.00	$1.00	$1.00	$4.00
Total	$ 10,269.00	$ 80,540.00	$ 80,540.00	$ 80,540.00	$ 80,540.00	$ 332,429.00

Attribution to Capacity Building						
Percentage of effort	0.00%	26.97%	29.49%	23.62%	20.91%	24.86%
Amount corresponding to effort	$0.30	$95,989.00	$106,617.00	$78,275.00	$66,969.00	$347,850.30

Milestones for FY 13-FY14, Development and Implementation of Robust Molecular Markers and Genetic . . .

Research, Training and Outreach Workplans
(April 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: S01.A4 Development and implementation of robust molecular markers and genetic improvement of common and tepary beans to increase grain legume production in Central America and Haiti.

	Provide abbreviated name of institutions in columns below											
	UPR			**EAP**			**NSS-Haiti**			**USDA-ARS-TARS**		
Identify Milestones by Objectives	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14
	(Tick mark the time period for achieving identified milestones by institution)											

Objective 1: Genetic improvement of common and tepary beans for Central America and Haiti.

1.1 Develop Andean and Middle American lines for the lowlands that combine disease/pest resistance with greater tolerance to abiotic stress.	x	x	X	x	x	x				x	x	x
1.2 Testing of Andean and Middle American bean breeding lines in the lowlands of Central America and Haiti.							x	x	x			
1.3 Initiate recurrent selection to develop bean populations for better adaptation to low N soils and greater resistance to web blight				x	x	x						
1.4 Initiate the development of bean breeding populations in Guatemala and Haiti with the goal of releasing a locally-produced cultivar by the end of the five-year extension period							x	x	x			
1.5 Screen the Andean Diversity Panel (ADP) in Haiti for resistance to powdery mildew to identify new sources of resistance							x	x	x			

1.6 Screen the Middle American Diversity Panel and breeding lines for performance in low N soils.	x	x	X									
1.7 Screen in the field and greenhouse the Middle American Diversity Panel for resistance to ashy stem blight	x	x	X							x	x	
1.8 Initiate a tepary bean breeding program to introgress virus resistance and improved seed and agronomic traits										x	x	x
1.9 Characterize the CIAT tepary bean germplasm collection for disease resistance										x	x	
1.10 Determine potential use of *P. vulgaris* indels for tepary genetic analysis and mapping											x	x

Objective 2: Develop and implement robust molecular markers for disease and resistance genes

2.1 Identify and screen lines and populations having divergent phenotypes of target traits											x	x
2.2 Isolate DNA												
2.3 Identify physical locations of existing genes and QTL of target traits												
2.4 Identify indels in the physical locations of genes and QTL of target traits												
2.5 Screen lines with potential indel markers												
2.6 Confirm the utility of the markers												

Objective 3: Institutional capacity building

3.1 Initiate M.S. degree training	x	x	X									
3.2 Initiate Ph.D. degree training												
3.3 In-service training at NDSU												
3.4 Conduct workshop at global meeting for Legume Innovation Lab PI's												
3.5 Conduct workshop for technicians at Zamorano						x						

Name of the PI responsible for reporting on milestones	James Beaver	Juan Carlos Rosas	Emmanuel Prophete	Timothy Porch

Research, Training and Outreach Workplans
(April 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: S01.A4 Development and implementation of robust molecular markers and genetic improvement of common and tepary beans to increase grain legume production in Central America and Haiti.

	Provide abbreviated name of institutions in columns below											
	NDSU			ICTA			USDA-ARS-Prosser					
Identify Milestones by Objectives	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14
	(Tick mark the time period for achieving identified milestones by institution)											
Objective 1: Genetic improvement of common and tepary beans for Central America and Haiti.												
1.1 Develop Andean and Middle American lines for the lowlands that combine disease/pest resistance with greater tolerance to abiotic stress.												
1.2 Testing of Andean and Middle American bean breeding lines in the lowlands of Central America and Haiti.				x	x	x						
1.3 Initiate recurrent selection to develop bean populations for better adaptation to low N soils and greater resistance to web blight												
1.4 Initiate the development of bean breeding populations in Guatemala and Haiti with the goal of releasing a locally-produced cultivar by the end of the five-year extension period				x	x	x						
1.5 Screen the Andean Diversity Panel (ADP) in Haiti for resistance to powdery mildew to identify new sources of resistance												
1.6 Screen the Middle American Diversity Panel and breeding lines for performance in low N soils.								x	x			
1.7 Screen the Middle American Diversity Panel for resistance to ashy stem blight												

1.8 Initiate a tepary bean breeding program to introgress virus resistance and improved seed and agronomic traits												
1.9 Characterize the CIAT tepary bean germplasm collection for disease resistance												
1.10 Determine potential use of *P. vulgaris* Indels for tepary genetic analysis and mapping												

Objective 2: Develop and implement robust molecular markers for disease and resistance genes

2.1 Identify and screen lines and populations having divergent phenotypes of target traits	x	x	x	x	x	x	x	x	x			
2.2 Isolate DNA		x	x		x	x		x	x			
2.3 Identify physical locations of existing genes and QTL of target traits		x	x			x			x			
2.4 Identify indels in the physical locations of genes and QTL of target traits												
2.5 Screen lines with potential indel markers												
2.6 Confirm the utility of the markers												

Objective 3: Institutional capacity building

3.1 Initiate M.S. degree training												
3.2 Initiate Ph.D. degree training			x									
3.3 In-service training at NDSU			x									
3.4 Conduct workshop at global meeting for Legume Innovation Lab PI's			x									
3.5 Conduct workshop for technicians at Zamorano												

Name of the PI responsible for reporting on milestones				
Signature/Initials:	Phil McClean and Juan Osorno	Julio Cesar Villatoro	Phil Miklas	

Date ______________________________

Genetic Improvement of Cowpea to Overcome Biotic Stress and Drought Constraints to Grain Productivity (SO1.A5)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
Philip A. Roberts, University of California, Riverside, CA 92521

Collaborating Host Country and U.S. PIs and Institutions
Issa Drabo & Jean-Baptiste Tignegre, Institut de l'Environment 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, CA

Project Problem Statement and Justification
The primary project focus is to 1) discover insect tolerance and resistance QTL for cowpea breeding; 2) increase African and US cowpea productivity by improved varieties with resistance to insect stresses, drought tolerance or disease resistance; 3) expand farmer marketing opportunities with improved cowpea varieties with desirable grain characteristics; and 4) provide training and capacity building in modern cowpea breeding. In addressing these primary constraints, the objectives are well aligned with Feed The Future research strategic priorities of 1) crop resistance to heat, drought, salinity and flood; 2) West African Sudano–Sahelian systems with emphasis on insect-resistant cowpea; and 3) grain legume productivity. Our plan includes the FTF focus countries Ghana and Senegal, and also Burkina Faso, which offers regional importance from an agro-ecological perspective for cowpea yield gain in the Sudano–Sahel region. Strategically, these countries represent the primary agro-ecologies underpinning cowpea production in this region.

We will employ genomics and modern breeding methods to improve cowpea for yield limiting constraints. By leveraging genomic resources developed under complementary cowpea genomics and modern breeding work funded by the CGIAR Generation Challenge Program, we will apply comprehensive modern breeding tools and methods for genetic improvement of cowpea emphasizing insect tolerance and resistance. Insect pests are seen as a major regional constraint to cowpea productivity in West Africa. The project team determined in the project planning meeting that significant gain can be made by targeting the major insect threats that occur at early (aphids), mid-flowering and pod-set (flower thrips), and later pod-filling (pod-sucking bugs) stages of the cowpea season. Although discovery work through phenotyping, genetic mapping and QTL identification needs to be done in most cases for these insect pests, some progress on resistance and tolerance donors and initial QTL identity provide good starting points in the project. High throughput SNP genotyping platforms, high density consensus cowpea genetic maps, plus numerous discovered QTL for important biotic stress resistance and abiotic drought tolerance traits are now available through our work. We are completely familiar with these technological advancements and have initial experience in their application to modern cowpea breeding. We have also been working closely with the CGIAR-GCP Integrated Breeding Platform program development using our cowpea data as a test user case, and will bring these technological advances into the project work. The project breeding programs have a range of early generation populations carrying various target traits, providing valuable starting points for breeding advancement.

Low productivity of agriculture is central to rural and urban poverty in Africa. On-farm cowpea yields in West Africa average 240 kg/ha, even though potential yields are often five to ten times greater. Most of the loss in yield potential is due to drought, poor soil fertility, and insect pests. Cowpea varieties with increased productivity (yield per unit area) without the need for purchased inputs especially benefit poor farmers, many being women who lack access to the most productive lands. By targeting insect tolerance and combining with drought tolerance, we have the opportunity to increase cowpea productivity. Productivity is key to increasing rural incomes and new resources can then be invested in other activities that help boost total family income. Productivity increases also help reduce prices to urban consumers. Sustainable increases in cowpea productivity in Africa and the US can be achieved through development of varieties with resistance to insects, nematodes and pathogens, drought tolerance, and the ability to thrive under of low soil fertility.

To increase marketing options, new cowpea varieties must have features desired by consumers; grain appearance, cooking and processing characteristics are especially important. Large white grains with rough seed-coat are good for direct dry-milling, and can be marketed over a wide area, buffering supply and prices in the region. Regionally adapted cowpea varieties with large white grain and resistance to pests would increase the marketing opportunities of cowpea farmers and traders in both West Africa and the U.S. Considerable demand exists for large rough brown grain types, especially in the large urban centers and command a premium price. However standard varieties like *Ife Brown* are susceptible to pests and diseases and require improvement.

Planned Project Activities for the Workplan Period (April 1, 2013–September 30, 2014)

<u>Objective 1.</u> *Discover QTL for insect resistance and apply in molecular breeding for target regions in West Africa and the U.S.*

Collaborators
Dr. Bao Lam Huynh, UC Riverside, USA
Dr. Clementine Dabire, INERA, Burkina Faso
Dr. Isgouhi Kaloshian, UC Riverside, USA
Dr. Barry Pittendrigh, U Illinois, USA
Dr. Manu Tamo, IITA, Benin
Dr. Christian Fatokun, IITA, Nigeria
Dr. Ousmane Boukar, IITA, Nigeria
Dr. Ibrahima Sarr, ISRA, Senegal
Mr. Joseph Batieno, INERA, Burkina Faso

Approaches and Methods

Overall approach to subobjectives

We have developed the necessary tools to exploit molecular breeding for cowpea. We have also worked with the CGIAR-GCP to develop a publicly available integrated breeding platform, essentially a pipeline for conducting marker-based selection from initial crossing to new variety release. Requisite tools developed include genic SNP markers, high density SNP-based genetic maps including consensus maps using African cowpea germplasm for sub-Saharan Africa relevant breeding use, a high-throughput SNP genotyping platform for cowpea, with conversion to a format provided through an outsource genotyping service, QTL for many major biotic and abiotic stress resistance and tolerance traits (drought, heat, fungal, bacterial and viral diseases, some insects, nematodes, Striga), and accompanying software programs. These tools, documented in the Technical Application, enable selection of multiple traits simultaneously across the genome (rather than single marker-trait selection). We will apply these technologies to existing and new breeding populations, for both QTL discovery and breeding.

Breeding targets will be to develop and release varieties that have preferred large white grain type for both domestic and export markets, and rough brown types primarily for domestic markets. The primary traits for grain yield enhancement include QTL for tolerance or resistance to three target insect pests. We have already identified a series of QTL controlling biotic and abiotic stresses. We will select parent combinations and generate breeding populations from their crosses which will enable selection for progeny carrying combinations of the insect tolerance with the other traits (specifically drought tolerance, nematode, Striga and Macrophomina resistance and also some virus resistance). In California, QTL for resistance to Fusarium wilt (*Fot3-1, Fot4-1, Fot4-2*) and root-knot nematodes (*Rk, Rk2*, *Rkn*) will be bred in backgrounds with Lygus bug tolerance, targeting the primary biotic stress constraints to yield.
Three sub-objectives focus on aphid resistance (Obj. 1.1), flower thrips resistance (Obj. 1.2), and pod-sucking bug resistance (Obj. 1.3). Each of these foci has the same goal, to discover and validate QTL underlying the target insect tolerance/resistance traits, then to apply the QTL knowledge to breeding population development and advancement, leading to enhanced yield performance cowpea varieties.

Genotyping approach

We will apply the KASP SNP platform that we developed with the GCP IBP and LGC KBioscience for SNP genotyping both in the QTL discovery phase and for breeding. The platform has 1022 mapped SNPs providing excellent coverage across the cowpea genome. For cost efficiency, on a cost per data-point basis we can choose the number of SNPs to be tested on the number of genotypes needed for each QTL discovery population or breeding decision. We will genotype all parent and control genotypes with the full set of SNPs. Then we will select the polymorphic SNPs for a desired pair of parents and genotype the progenies (individuals or bulked families) with the polymorphic subset of SNPs. This approach can be used for genotyping RIL populations or F2:3 families for QTL mapping purposes, or for backcross populations to select the appropriate individuals (BC1F1 or BC2F1, etc.) carrying positive alleles for making the next backcross. We will employ this genotyping approach in the workplan period. The NARS breeders will grow plants in the host country, where take leaf punches at the young plant stage, place in 96-well plates, dehydrate with silica gel and then express ship to LGC KBioscience in the UK or USA. The data will be returned within a four-week turnaround, analyzed and jointly interpreted for a breeding decision (which plants to use for crossing or to advance) for the QTL discovery or breeding advancement. Iterative rounds of genotyping and periodic phenotyping to validate will be used to foreground select the desired complement of positive QTL. Because of the high density of markers and our ability to choose the cM distance and specifically QTL flanking markers for the population-specific SNP marker subsets (using our in-house “SNP selector” program available at Breedit.org), efficient genetic gain by pyramiding the target traits can be made.

Phenotyping and data handling approach

Phenotyping will be conducted under field, greenhouse and lab conditions (insect screens) will be done at NARS locations using standard test protocols. Phenotypic data analyses will be by standard ANOVA. When drought tolerance is being selected, performance testing under water-limited conditions will be done at NARS field sites. Sites and protocols will be determined by the target insect pest (see below). We will use the CGIAR GCP Integrated Breeding Platform (IBP) tools for data recording, processing and archiving. The variables will include geographical coordinates and dates of each trial, soil and weather data, persons conducting experiments, trait dictionary language and other parameters set up in the IBP Field Book (tool for software tablets). This data capture format allows for export into the ICI mapping and Optimas programs for QTL analyses and molecular score selection indices. These tools are now familiar to the project team members in Burkina Faso, Senegal and UC-Riverside from their use in the TL1 project, and we will train the Ghana NARS team members in their use and application.

1.1 Aphid resistance. We will test the genetic relatedness of five sources of cowpea aphid (*Aphis craccivora*) resistance. Field observations in Africa and California indicate differential effects of resistance sources on aphid populations from different cowpea production areas. Cowpea lines IT97K-556-6, KvX295-2-124-99, an IITA wild donor line, UCR01-11-52/SARC1-57-2, and 58-77 representing a set of resistance donor genotypes plus known susceptible control lines will be seed-multiplied by spring 2014. Uniform screens in field locations across all project NARS (Burkina, Ghana, Senegal) and California will be conducted in 2014 in protected and non-protected split plots, with four-fold replication, using standard resistance assessment scales across all test sites. The uniform test design and coordination planning for the aphid resistance assessment will be developed by the project team during 2013. Additional germplasm lines will be included in the screening sites to search for more sources of resistance. The resistance donors and susceptible controls will be SNP genotyped on the KASP platform, coordinated by UCR. We will engage with Dr. B. Pittendrigh and M. Tamo (Project SO1.B1) in the characterization (molecular fingerprinting) of the aphid isolates representing the different aphid populations at each location. This will be especially valuable if, as expected, aphid biotypes are delineated on the cowpea resistance sources. Samples of aphids will be collected and stored for DNA extraction, with a view to developing a DNA sequence based fingerprint to distinguish the isolates. We will also be advised by Dr. Kaloshian at UCR who has been working on the complete aphid genome sequence.

New segregating populations and some existing ones between aphid resistant and susceptible parents will be used to phenotype screen for QTL discovery. Depending on the source, we are at different stages of QTL mapping. We are finishing a QTL discovery effort for aphid resistance in

IT97K-556-6 for which one major and one minor QTL have been identified but which require further phenotypic validation. This validation test will be conducted in California during the summer 2013, using a four-fold replicated RCBD setup, with aphid damage scores being recorded one month after planting and again at post-flowering stage. In the wild donor IITA line a RIL population has been developed for mapping QTL but will require phenotyping and genotyping. This work is being planned in collaboration with Dr. Fatokun at IITA, Nigeria under the TL1 project, but the results will directly impact the LIL breeding decisions. The QTL will be included in foreground selection in the breeding populations, with a plan to target effective resistance sources within a given NARS region (i.e., match effective resistance with preferred and adapted cowpea types the relevant production area.

Crosses of the aphid resistant line UCR01-11-52/SARC1-57-2 with drought tolerance donors will be made in Ghana followed by the first backcross, and the BC1F1 will be SNP genotyped to select individuals for the second backcross.

1.2 Flower thrips resistance. In recent work on QTL discovery, we identified and SNP-mapped loci (*Cft-1* and *Cft-2*) for flower thrips (*Megalurothrips sjostedti*) tolerance donated by Sanzi in the cross Sanzi x Vita 7, and these loci are promising for introduction and selection in breeding progenies but require better definition through phenotyping. Additional sources of thrips tolerance are 58-77 (biparental RIL population from 58-77 x Yacine is available) and Tvx3236. In Senegal and Ghana both RIL populations will be field-phenotyped for tolerance to flower Thrips using the Jackai and Singh (1988) tolerance scale, at sites in Bambey, Njouro and Tamale during the workplan period. Additional germplasm lines will be included in the screening sites to search for more sources of resistance. Screens will be designed as a four-replication RCBD and include the parents, and run by entomologists Ibrahima Sarr (Senegal) and Francis Kusi (Ghana). In Senegal the different tolerance sources in Sanzi, 58-77 and Tvx3236 will be intercrossed in all combinations by Dr. Cisse. In Ghana, three Sanzi-derived F3 populations segregating for seed color (including white) and flower thrips resistance are available for QTL discovery and breeding. One parent is IT97K-499-35, now the popular Ghana variety *Songotra*, a high yielding black-eye resistant to Striga but thrips sensitive which can be improved for thrips tolerance via the F3 population. The SARI team will phenotype the three F3 populations for thrips tolerance in the workplan main season using the previously described experimental protocols. The parents of these populations will be SNP-genotyped by UCR to set up marker-based progeny selections.

1.3 Pod-sucking bug resistance. The Heteropteran Coreid pod-sucking bugs (*Clavigralla tomentosicollis* complex) are a major yield suppressor in Burkina Faso, Ghana and neighboring countries. We have not yet identified genes or QTL for resistance to pod-sucking bugs but resistant cowpea accessions are available. We plan to use biparental resistant x susceptible segregating populations to map QTL and initiate their selection as a new breeding target. This work will be a focus of effort in Burkina Faso. A primary tolerance source is IT86D-716 (used in Burkina Faso); pods (maternal, F3) on F3 plants will be genotyped and phenotyped to identify the underlying QTL, using standard screens of young pods in petri dishes to score bug viability and fecundity. We will also include other potential tolerance donor lines in the initial phenotyping screens, including those in the pedigree of resistance donor IT86D-716, to broaden the knowledge base and potentially identify additional sources of tolerance. Two existing F2 populations generated from resistance donor IT86D-716 with parents Kvx771-10 and IT98K-

205-8 will enable combining Striga resistance with pod-sucking bug tolerance. UCR will have the parents genotyped through KBioscience and the F2 and F3 populations will be phenotyped for pod bug resistance in Burkina Faso, in collaboration with Dr. Dabire. The F2 will be advanced to F3 early in the workplan period to provide screening resources. UCR will have the F2 and F3 populations genotyped using leaf samples collected from phenotyped plants in Burkina Faso. We will genotype single F2 plants and F3 family bulks consisting of a minimum of 12 individual plants. The phenotype and genotype data from the F2 and F3 generations will be used for QTL discovery with the ICI Mapping program, which will be conducted at UCR.
For the three insect groups (aphids, thrips, pod bugs), we will collaborate with Dr. Pittendrigh and Dr. Tamo (Project SO1.B1) to utilize our project trial sites to collect insect samples for use in molecular characterization of the insect populations.
Objective 2. *Complete release and validation of advanced cowpea lines developed under the Pulse CRSP in Burkina Faso, Senegal, and U.S.*

Collaborators
Dr. Bao Lam Huynh, UC Riverside, USA
Dr. G. McClaren, CGIAR GCP IBP
Dr. Ousmane Boukar, IITA, Nigeria
Dr. TJ Higgins, CSIRO, Canberra, Australia
Dr. Samba Thiaw, ISRA, Senegal
Dr. Mywish Maredia, Michigan State U., USA

Approaches and Methods
2.1. A first component of this objective is to use our genotyping capability to tag the BT gene insertion for Maruca resistance with our SNP marker panel, in order to track the gene in segregating progeny in breeding populations in Burkina Faso and Ghana. We will use the insert flanking sequence information to identify the insert region and its genomic location in the genetic map. The accuracy of marking the gene with higher density flanking markers or a perfect (gene) marker scored as presence absence will be done in conjunction with the new SNP development for increased capacity in the proposed 20,000-SNP panel under other USAID funding. However, for the current work, we will use a Bt-segregating cowpea population (to be chosen in 2013) which will be field-phenotyped in Burkina Faso and genotyped with our current SNP platform of 1022 mapped SNPs. PCR will be conducted to test for gene expression. These data will be used in ICI mapping to confirm the location of nearby markers to the Bt insert on the genetic map. The phenotyping trial will be done in four-fold replicated design in a Maruca hot-spot location in the central Burkina Faso cowpea production area (Kamboinse). Maruca damage to pods and grain yield estimates will be used to index resistance and susceptibility to pod borer damage. The Burkina Faso team has good experience with making these evaluations. The genotyping will mostly follow the same protocol as outlined under the Objective 1 work. We will use leaf samples from young field grown plants in the phenotyping plots for DNA extraction in Burkina Faso. Following shipping to KBioscience, the DNA samples will be SNP assayed and the genotype data sent to UCR for quality checking. The combined phenotype and genotype data will be analyzed for trait mapping using the ICI mapping software for QTL discovery. This should validate SNP markers flanking the Bt-insert locus, thereby enabling genotyping in the future generations to select for the Bt-insert without the need to phenotype at each generation.

Depending on the quality of the phenotyping data (insect pressure sometimes variable), a second season of phenotyping may be required in main season 2015.

2.2. We plan to capitalize on the previous Pulse CRSP breeding effort by completing the release requirements of several advanced breeding lines that are in the final stages of performance testing in Burkina Faso, Senegal and California. Specifically, in Senegal there are three large white grain type cowpeas (at least 25 g /100 grains) developed by Dr. Cisse which are in the pre-release phase that could all be released as varieties. These will be grown together with the recently released white seeded CRSP variety in 20 on-farm demonstration trials in main season FY13. Combined with performance data from 2011 and 2012, this should complete the performance data required for the formal release. The demonstration trials will be conducted in the northern cowpea zone (Louga, Mekhe, Thilmakha), with plot size sufficiently large (400 to 500 m^2) to allow mechanical planting. Yield, diseases and insects incidence will be recorded. The performance data will be used to submit the release request documentation during early 2014, with release approval expected by the end of this workplan period. Breeder Seed will be increased during 2014 to supply the Foundation Seed development.

In Burkina Faso, 20 pre-release CRSP advanced lines developed by Dr. Drabo require final rounds of on-farm performance testing. Multi-location tests are needed to support the final selections for release. These trials will be completed during the 2013-2014 seasons located at Saria, Pobe, and Kamboinse in Burkina Faso. The lines will be tested for yield and grain quality, plus any disease susceptibility in trials using four-row plots, five meters long and 4 reps arranged in a RCBD. Release of the best performing lines is anticipated for the project year 2015.

In California, we will field test advanced blackeye, all-white, and dry-green blackeye breeding lines for release potential. These represent CRSP developed lines and they require at least one to two years of field performance testing. The lines carry a combination of lygus bug tolerance, and root-knot nematode and Fusarium wilt resistance. For two advanced blackeyes, we will conduct on-farm large strip trails in Tulare Co. to assess commercial yield performance. The other lines will be tested at the Kearney and UCR field stations in four-row 4-fold replicated RCBD trials with the center two rows machine harvested. Yield weights, 100-seed weights and lygus damage to seed will be assayed. All yield and performance data will be analyzed by standard ANOVA.

The Senegal and Burkina Faso sites releases will represent tangible project outputs, and offer the opportunity for tracking along the impact pathway as new releases which will be entering the seed multiplication and distribution process in each country. Opportunities exist to initiate baseline data for the releases through the impact analyses under the LIL project led by Dr. M. Maredia.

<u>Objective 3:</u> *Increase capacity of NARS in Burkina Faso, Ghana and Senegal to serve the cowpea sector*

Collaborators

Dr. Bao Lam Huynh, UC Riverside
Dr. G. McClaren, CGIAR GCP IBP
Dr. Ousmane Boukar, IITA, Nigeria

Approaches and Methods

<u>Short-term Training:</u>

Molecular breeding for young trainee breeders and NARS scientists will be conducted. Continuous short-term training will occur through iterative data analysis and interpretation cycles using the phenotyping and genotyping data generated by each of the three Host Country partner teams (about 12 participants). To provide periodic intensive training, we will convene a training workshop in each project year, using training modules developed by the UC-R team, plus those developed by the CGIAR GCP Integrated Breeding Platform program (IBP) which is using our tropical legumes project cowpea breeding population data for the training modules development. We will plan a training workshop in conjunction with the Legume Innovation Lab Global planning meeting to be held in May 2014, and(or) earlier at UCR in conjunction with a possible GCP-TL1 training workshop. Where feasible, we will coordinate the cowpea modern breeding short-term training with the bean breeders in the Legume Innovation Lab Andean and Middle American bean breeding projects. The molecular breeding approach is complex and requires a combination of hands-on experience with self-generated data sets, augmented with periodic intensive training workshops to improve knowledge, skills and problem –solving. The technologies underlying the genotyping capability are in a state of frequent enhancement and upgrade, requiring periodic training input. Thus both young breeder trainees new to the programs and experienced breeders from the HC NARS are in need of this training. Training materials and protocols will also be used by the NARS breeders to train the technical staff in the NARS programs after NARS breeders have been trained further on the standardized electronic field book, leaf assay, and field phenotyping protocols.

<u>Degree Training:</u>

We plan to conduct degree training for two graduate students in the workplan period:

1. Arsenio Ndeve, Mozambique, male student in PhD Plant pathology program at UC Riverside, working in pathology, genetics and breeding of SE African cowpea germplasm
2. Sassoum Lo, Senegal, female student in MS Plant genetics program at UC Riverside, working in cowpea genomics and breeding

Contribution of Project to USAID Feed the Future Performance Indicators

Please see the attached completed Performance Indicators–Targets form for FY 2013, 2014 and 2015.

Outputs

Under Objective 1.1 — Aphid resistance

A differential cowpea panel of aphid resistance sources and control lines seed-multiplied for multi-location field screening (Project team).

A uniform test protocol designed for aphid biotype screening (Project team).

Set of F1s made from aphid resistant x drought tolerant line crosses (Ghana).

A set of first BC1 progenies will be made from the aphid x drought F1s (Ghana).

Genotyping data generated for aphid resistant parents and BC1F1s (UCR).

Under Objective 1.2 — Thrips resistance

Two RIL populations will be phenotyped for QTL refinement in Senegal and Ghana.

F1s will be generated from thrips resistance sources intercrosses (Senegal).
Data from phenotyping three F3 populations with Sanzi donor parent (Ghana).
Data generated from genotyping parents of three F3 with Sanzi donor (UCR).

Under Objective 1.3–Pod bug resistance
Data generated from genotyping parents, F2 and F3 populations derived from resistance donor IT86D-716 (UCR).
Two F3 populations developed from existing F2 for pod bug resistance (BF).
Data from phenotyping two F3 populations with IT86D-716 donor parent (BF).
Initial QTL from IT86D-716 discovered by ICI Mapping (UCR and BF).

Under Objective 2.1–SNP markers for Bt tracking
Genotype data produced from one Bt-transgene segregating population (UCR).
Phenotype data produced from one Bt-transgene segregating population (BF).

Under Objective 2.2–Variety releases
Release of three large white-seeded CRSP varieties in Senegal.
20 pre-release CRSP lines evaluated in on-farm trials (BF).
Data from one advanced yield trial of new lines (BF and Senegal).

Engagement of USAID Field Mission(s)
During the main cowpea season July-September in 2014, the UC-R PI and Co-PI will make field visits to the three HCs to review and coordinate field based phenotyping activities. During these HC trips, we will arrange to visit the Senegal and the Ghana country missions and also the West Africa regional mission in Accra. The mission visits will be made together with the respective Host Country PI and Co-PI plus senior NARS administrators where feasible, and will be used to inform the mission staff of our LIL cowpea modern breeding project goals and activities in each country and in the region. In Burkina Faso, we will connect with the mission representation from Niger to inform them of our activities, and as we have done in the past, with US Consulate leaders in Ougadougou. The UC-R team will also assist the NARS PIs in developing project activity briefs for them to share directly with the US Mission staff to keep them informed and to solicit possible Mission buy-ins.

Partnering and Networking Activities
We will work closely with other national and international cowpea breeders, including Drs. Ousmane Boukar and Christian Fatokun, Senior Scientists and Cowpea Breeders at IITA, Dr. Mohammed Ishiyaku of the IAR in Nigeria, and Dr. **Rogerio Chiulele, Eduardo Mondlane University, Maputo,** in Mozambique. We will continue to work with national extension services, World Vision International, World Bank and other NGOs to extend new cowpea technologies. Specifically in the Host Countries for this project, we will network with NGOs and farmers' cooperatives in Burkina Faso, Senegal, and Ghana. Although we do not have a formal seed systems objective in the project, the new cowpea varieties developed by the project will be fed into the NARS coordinated seed systems structure in each country. New varieties will be assured of entry and promotion in the seed systems. Exciting events are occurring to aid in this realization for seed multiplication and distribution to farmers. In Senegal, HC PI N. Cisse is working with World Bank on its new $80M commitment to the cowpea seed system, while

CORAF and AGRA with Foundation support are working to advance the seed systems in Burkina Faso, Ghana and neighboring countries. HC PIs I. Drabo and I. Atokple are involved in these efforts and can promote the introduction of the new CRSP and LIL cowpea varieties. This will be especially important in the Objective 2 activities through which CRSP variety releases are planned for 2014 in Senegal and 2015 in Burkina Faso.

Leveraging of CRSP Resources
Other resources leveraged from current and future funded complementary cowpea research projects include the following:

California Dry Bean Advisory Board and its Blackeye Varietal Council (funds currently and typically set at $20,000 per year) funded for cowpea breeding in California. This is a continuing, long term research arrangement in support of the UC Riverside cowpea breeding program.

The CGIAR Generation Challenge Program (GCP) Tropical Legumes I Project Phase 2 extension was funded for four years (May 2010-April 2014). The cowpea component of this project is led by UC Riverside (Roberts, and Close) and includes collaborative funded cowpea breeding and research with the cowpea breeding programs in Burkina Faso (with PI I. Drabo), Mozambique (PI R. Chiulele) and Senegal (PI N. Cisse), and IITA (PI, O. Boukar). This project funded at $2.729M is applying cowpea genomic resources based on SNP genotyping for cowpea marker-assisted breeding. Use of the high throughput marker platform for major traits including insect pest, nematode and disease resistance, and drought and heat tolerance are being targeted in African breeding populations. This project provides an excellent leveraging for CRSP activities described here to be used for cowpea modern breeding. The project also links us to the GCP-Integrated Breeding Platform project which is developing a breeder's workflow system, which we will bring into the LIL project activities for data collection, analysis, interpretation and curation.

The project team plus Dr. O Boukar, IITA, Nigeria, have a proposal pending to the USAID Climate Resilient legumes program. We are optimistic of funding approval, with a final decision likely by September 2013. This project would enable development of new cowpea genomic resources, particularly a 20,000-SNP Infinium genotyping platform, which would be developed by late 2014. We will plan to leverage this advancement by applying it to our LIL project genotyping needs, thereby enhancing the quality and efficiency of the genotyping component.

The LIL funds proposed herein will also be leveraged with opportunity funds within the Host Countries via NGOs and national sources through presentation of the LIL effort and the associated opportunities for participatory funding.

The Kirkhouse Trust is supporting a project under Dr. Cisse at ISRA on molecular breeding for Striga resistance for three years (July 2012–June 2015) for $ 90,000.

VI Timeline for Achievement of Milestones of Technical Progress

Please see completed *Milestones for Technical Progress form for the workplan period.*

Training/Capacity Building Workplan for FY 2013–2014

Degree Training

First and Other Given Names: Sassoum
Last Name: Lo
Citizenship: Senegal
Gender: Female
Training Institution: UC Riverside
Supervising CRSP PI: Roberts and Close, UC-R
Degree Program for training: MS/PhD
Program Areas or Discipline: Cowpea genomics and breeding
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID: Yes
Host Country Institution to Benefit from Training: Senegal
Thesis Title/Research Area: Cowpea molecular breeding
Start Date: 01/2014
Projected Completion Date: 12/2015
Training status: Pending
Type of CRSP Support: partial

First and Other Given Names: Arsenio
Last Name: Ndeve
Citizenship: Mozambique
Gender: Male
Training Institution: UC Riverside
Supervising CRSP PI Roberts and Close, UC-R
Degree Program for training: PhD
Program Areas or Discipline: Plant Pathology, genetics and breeding
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID: Yes
Host Country Institution to Benefit from Training: Mozambique
Thesis Title/Research Area: Genomewide selection for disease and drought tolerance in SE African cowpeas
Start Date: 01/2012
Projected Completion Date: 06/2016
Training status: Active
Type of CRSP Support: partial

Short-term Training

Type of training: Molecular breeding for young trainee breeders and NARS scientists
Description of training activity: As described under capacity building Objective 3, continuous short-term training will occur through iterative data analysis and interpretation cycles using the phenotyping and genotyping data generated by each Host Country partner team. To provide periodic intensive training, we will convene a training workshop in each project year, using training modules developed by the UC-R team, or developed by the CGIAR GCP Integrated Breeding Platform program (IBP) which is using our tropical legumes project cowpea breeding population data for the training modules. We will plan the first of these training workshops to coincide with the Legume Innovation Lab Global planning meeting to be held in May 2014.

Location: TBD, linked to LIL Global meeting
Duration three days
When will it occur? May 2014
Participants/Beneficiaries of Training Activity
Anticipated numbers of Beneficiaries (male and female): 12 (eight male, four female)
PI/Collaborator responsible for this training activity: Dr. Bao Lam Huynh, UC-R
List other funding sources that will be sought (if any): Training funds through CGIAR-GCP Tropical Legumes I project and possibly USAID Climate Resilient Legumes project (if funded).
Training justification: The molecular breeding approach is complex and requires a combination of hands-on experience with self-generated data sets, augmented with periodic intensive training workshops to improve knowledge, skills and problem –solving. The technologies underlying the genotyping capability are in a state of frequent enhancement and upgrade, requiring periodic training input. Thus both young breeder trainees new to the programs and experienced breeders from the HC NARS are in need of this training.

Equipment (costing >$5,000)
None requested during this period

Performance Indicators for FY 13-FY14
Genetic Improvement of Cowpea to Overcome Biotic Stress and Drought Constraints to Grain Productivity

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 13 (Second Semester only), FY 14, and FY 15

Project Name: Genetic improvement of cowpea to overcome biotic stress and drought constraints to grain produ

Institution 1 Name: UC Riverside

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	3	0	0	3	0	0	3	0	0
	Number of women	1			1			1		
	Number of men	2			2			2		
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	0	0	0	10	0	0	10	0	0
	Number of women	0			3		0	3		
	Number of men	0			7		0	7		
	Numbers by Type of individual									
	Producers	0					0			
	People in government	0					0			
	People in private sector firms	0					0			
	People in civil society	0			10		0	10		
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0					0			
	Continuing	0					0			
	Gendered Household Type									
	Adult Female no Adult Male (FNM)	0					0			
	Adult Male no Adult Female (MNF)	0					0			
	Male and Female Adults (M&F)	0					0			
	Child No Adults (CNA)	0					0			
4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization									
	Private enterprises (for profit)	0					0			
	Producers organizations	0					0			
	Water users associations	0					0			
	Women's groups	0					0			
	Trade and business associations	0					0			
	Community-based organizations (CBOs)	0					0			
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0					0			
	Continuing	0					0			

5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	0	0	0	0	0	0	0	0	0
	Agricultural production	0					0			
	Agricultural post harvest transformation	0					0			
	Nutrition	0					0			
	Multi-focus	0					0			
	Other	0					0			
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	0	0	0	0	0	0	0	0	0
	crop genetics	0					0			
	animal genetics	0					0			
	pest management	0					0			
	disease management	0					0			
	soil-related	0					0			
	irrigation	0					0			
	water management	0					0			
	post-harvest handling and storage	0					0			
	processing	0					0			
	climate mitigation or adaptation	0					0			
	fishing gear/technique	0					0			
	other	0					0			
	total w/one or more improved technology	0					0			
	New/Continuing hectares									
	New	0								
	Continuing	0								
	Sex of person managing hectare									
	Male	0								
	Female	0								
	Association-applied	0								
7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	2	0	0	0	0	0	0	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	1								
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	1								
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	0								

8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs	0								
	Outputs	0								
	Macroeconomic	0								
	Agricultural sector-wide	0								
	Research, extension, information, and other public service	0								
	Food security/vulnerable	0								
	Climate change adaptation or natural resource management (NRM) (ag-related)	0								
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	0								
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	0								
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0								
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0								
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0								

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13-FY14

Genetic Improvement of Cowpea to Overcome Biotic Stress and Drought Constraints to Grain Productivity

	4/30/13 - 09/30/14											
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
Institution Name	UC Riverside	UC for HC	Burkina Faso INERA	Senegal ISRA	Ghana	UC for HC	enter name here	enter name here	enter name here	enter name here	enter name here	
HC or U.S. Institution	US	HC	HC	HC	HC	HC	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	
a. Personnel Cost												
Salaries	$83,901.00	$0.00	$25,000.00	$25,000.00	$25,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$158,901.00
Fringe Benefit	$37,999.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$37,999.00
b. Travel	$5,819.00	$0.00	$5,000.00	$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,819.00
c. Equipment ($5000 Plus)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Supplies	$10,000.00	$0.00	$20,000.00	$20,000.00	$20,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$70,000.00
e. Training												
Degree	$0.00	$27,670.08	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$27,670.08
Non-Degree	$0.00	$5,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5,000.00
f. Other	$12,000.00	$0.00	$0.00	$0.00	$0.00	$39,683.00	$0.00	$0.00	$0.00	$0.00	$0.00	$51,683.00
g. Total Direct Cost	**$149,719.00**	**$32,670.08**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$39,683.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$372,072.08**
h. Indirect Cost	$77,853.00	$0.00	$0.00	$0.00	$0.00	$10,317.00	$0.00	$0.00	$0.00	$0.00	$0.00	$88,170.00
i. Indirect Cost on Subcontracts (First $25000)	$6,500.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6,500.00
j. Total Indirect Cost	$84,353.00	$0.00	$0.00	$0.00	$0.00	$10,317.00	$0.00	$0.00	$0.00	$0.00	$0.00	$94,670.00
Total	**$234,072.00**	**$32,670.08**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$50,000.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$466,742.08**
Grand Total	$466,742.08											

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	**$149,719.00**	**49.95%**
Total direct cost budgeted for H.C institution(s)	**$150,000.00**	**50.05%**

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
In-kind	$35,110.80		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$35,110.80
Cash	$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$ 35,110.80	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 35,110.80

Attribution to Capacity Building												
Percentage of effort	23.00%	100.00%	35.00%	35.00%	35.00%	30.00%	0.00%	0.00%	0.00%	0.00%	0.00%	87.84%
Amount corresponding to effort	$34,435.37	$32,670.08	$17,500.00	$17,500.00	$17,500.00	$11,904.90	$0.00	$0.00	$0.00	$0.00	$0.00	$131,510.35

Milestones for FY 13-FY14

Genetic Improvement of Cowpea to Overcome Biotic Stress and Drought Constraints to Grain Productivity (SO1.A5)

	(Tick mark the time period for achieving identified milestones by institution)											
Objective 1.1: Breeding & Trait Discovery - Aphid Resistance												
1.1.1 differential set seed increase		x			x			x			x	
1.1.2 uniform test design	x			x			x			x		
1.1.3 insect samples collected			x			x			x			x
1.1.4 1st differential set test conducted			x			x			x			x
1.1.5 aphid x drought crosses made											x	
1.1.6 first BC of aphid x drought											x	
1.1.7 genotype aphid resistant parents			x									
1.1.8 genotype aphid x drought BC1F1s			x									
Objective1.2: Breeding & Trait Discovery - Flower Thrips Resistance												
1.2.1 phenotype 2 RILs for QTL refinement								x	x			x
1.2.2 intercross thrips tolerant sources							x					
1.2.3 insect samples collected									x			x
1.2.4 phenotype 3 F3 populations from Sanzi donor												x
1.2.5 genotype parents of 3 F3 populations			x									

Objective 1.3: Breeding & Trait Discovery - Pod-Sucking Bug Resistance												
1.3.1 genotype parents of 2 populations			x									
1.3.2 phenotype 2 populations from IT86D-716 donor						x						
1.3.3 insect samples collected						x						
1.3.4 advance F2 to F3 from 1.3.2						x						
1.3.5 genotype F2 and F3 from 1.3.3			x									
1.3.6 QTL discovery through ICI mapping			x			x						
Objective 2.1: Breeding & Trait Discovery - SNP Markers for Bt transgene tracking												
1.4.1 genotype a Bt segregating population		x			x							
1.4.2 phenotype a Bt segregating population		x			x							
Objective 2.2: Breeding & Trait Discovery -Variety release including additional traits												
1.5.1 Release 3 large-seeded white varieties									x			
1.5.2 On-farm evaluation of 20 pre-release CRSP varieties				x		x						
1.5.3 Advanced yield trial of new breeding lines			x			x			x			
Name of the PI responsible for reporting on milestones	P. Roberts			I. Drabo			N. Cisse			I. Atokple		
Signature/Initials:												
Date:												

IPM-omics: Scalable and Sustainable Biological Solutions for Pest Management of Insect Pests of Cowpea in Africa (SO1.B1)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University

Dr. Barry Pittendrigh, University of Illinois at Urbana–Champaign (UIUC)

Collaborating Host Country and U.S. PIs and Institutions

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

Project Problem Statement and Justification

Insect pests of cowpeas dramatically reduce yields for cowpea farmers in West Africa, many of who live on less than $2 per day. Arguably, the greatest biotic constraints on cowpea (*Vigna uguiculata* [L.] Walp.) production are insect pests. The major pests of cowpea in the field in northern Nigeria, Niger, and Burkina Faso include (i) the legume pod borer, *Maruca vitrata* Fabricius; (ii-iii) the coreid pod-bugs, *Clavigralla tomentosicollis* Stal and *Anoplocnemis curvipes* (F.); (iv) the groundnut aphid, *Aphis craccivora* Koch; and, (v-vi) thrips, *Megalurothrips sjostedti* Trybom. Foundational work has been initiated to understand these insect pests in the areas where we propose to work to develop and deploy solutions. This foundational work, has positioned us well to have a better understanding of pest biology and population structure (due to molecular tools)–which will help direct current and future pest control strategies. Up until our last phase of this project, there were few alternatives to pesticide sprays for many of these pest species. Our program, over the past several years, has developed multiple promising integrated pest management (IPM) solutions for the pests of cowpeas. Additionally, for *M. vitrata*, there exists a potential biotechnology-based pest control solution. Transgenic cowpea expressing the *Bt*-protein Cry1Ab, effective against *M. vitrata* already exists, but has not been released, and may be a component of IPM in the next phase of this project. However, before transgenic Bt-cowpea can be released there will be a need for an insect resistance management (IRM) plan and our program has already set the stage for just such a plan (Onstad et al., 2012). Bt-cowpea, even if/when it becomes available to farmers, will only control one of many pests that attack cowpea. Thus, for more immediately tangible control strategies, we have other pest control solutions at hand for *M. vitrata*. Additionally, host plant resistant traits are being brought forward by Dr. Phillip Roberts at California at Riverside (UC-R), some of which is being done in collaboration with our collaborators at INERA and IITA. We will continue our work with the aforementioned investigators, to bring forward such host plant resistance traits. However, over the past phase of this project we have developed multiple IPM pest control options for cowpea systems, many of which will require the next phase of research to bring them forward to larger-scale release and testing of impact.

Although biocontrol agents, transgenic plants, and traditional plant breeding for insect resistant varieties are all potentially effective methods for controlling pests of cowpeas, a continued refinement of our understanding of pest populations is needed in order to integrate these, and other, pest control options into an overall integrative pest management (IPM) plan to maximize cowpea production in the field. IPM refers to a pest control strategy where a variety of complementary approaches are used to minimize the negative effects of pests on a given crop or cropping system. As we develop, refine and deploy IPM strategies, we must understand the important life-history parameters of these pest insects in relationship to their environment. In the past phase of CRSP we developed a more in depth understanding of *M. vitrata* populations and have recently determined that *M. vitrata* living on cowpea have a great diversity of alternative host plants and common populations–this insight (due to the use of genomics tools) is extremely important as it means all alternative host plants, for *M. vitrata*, can likely act as a refuge for Bt-cowpea and when releasing biocontrol agents onto alternative host plants, programs can choose the host plants that are most useful and cost effective. We term the use of genomics tools to help direct IPM strategies as IPM-omics. The IITA group has demonstrated that the release of biocontrol agents, for *M. vitrata* control, on different alternative host plants can be done with varying levels of cost-effectiveness. Thus, as we move forward over the next four years we will determine the population genetic structure of the other pests of cowpea. We have developed molecular tools to accomplish such a task (Agunbiade et al., accepted). We will also investigate the presence of these insects on cowpea and the population structure of these species, as well, if they prove to be pests causing significant economic losses.

Over the upcoming year we will research, develop, implement and determine the impacts of an IPM-omics program for cowpea in West Africa. We will research and develop scalable solutions, with the potential for larger-scale impact with donor community buy-in.

Planned Project Activities for the Workplan Period (April 1, 2013–September 30, 2014)
Our objectives all emerge from the following vision, with three critical major objectives, supported and intertwined with the fourth objective of capacity building.
First, we define IPM-omics in the following equation:

IPM-omics = define the pest problems + appropriate solutions + scaling of solutions

In order to define *IPM-omics* we will (1) define "IPM," "omics," and how these dovetail together, and (2) the operational approaches we will take over the next four years towards our goals. **IPM** was first defined in 1967 by Smith and Van Dan Bosch as a concurrent application of multiple control measures to reduce damage caused by insects to crop plants. In practical terms, this involves understanding pest systems in detail to define when and where they are a problem, defining ecologically and economically viable solutions, suppression of pest populations below an economic threshold level for increased yields and sustainable solutions. **Omics** is a term used in molecular biology to describe biological processes in large scale or high throughput. We use it to describe large-scale approaches now available to us in IPM. Thus, we define **IPM-omics** as the use of scalable technologies to understand, develop and deliver pest control solutions. IPM-omics is both a paradigm shift in how we need to think about best control in the present and in the future based on the use of cutting edge technologies available to us right now.

In our IPM-omics equation we must first ***define the pest problems***. First, we must ask what are the paradigms and technologies that are in our toolbox and how can we use them? At the current moment we have the follows tools to work with: (1) scouting, field experiments, light traps; (2) genomic markers to define pest and biocontrol agent populations—movement patterns and sources of the outbreaks; (3) computational modeling; and, (4) GIS systems—understanding pests in the background of their ecology and life history. These aforementioned combined tools will be focused on a regional understanding of pest problems on cowpea across West Africa. In our IPM-omics equation the second step is ***appropriate solutions***. We have developed a Biocontrol/Biopesticide pipeline in order to develop a series of environmentally and economically appropriate pest control solutions. This is not a pipeline of magic bullets, but instead a diversity of technologies to provide farmers with a variety of solutions to suppress pest populations.

The final step in the IPM-omics equation will be the ***scaling of solutions***. When solutions have been developed we need mechanisms to effectively deploy them in a cost effective and sustainable manner. Discovering and testing such scaling pathways will be critical to determine which approaches will be most successful for scaling. Solutions, for scaling, fall into three categories: (1) direct release into the environment and natural establishment; (2) educational solutions; and (3) private sector and NGO involvement. **Direct release into the environment and natural establishment** has and will involve the release of bio-control agents that ultimately become endemic in the environment and suppress the insect populations. The most effective places to deploy these biocontrol agents is directly influenced by the knowledge we gain from our studies of "Defining the pest problems" and such agents come directly from our bio-control pipeline. **Educational solutions** are and will be pest control strategies that will require primarily educational interventions. Our past program has taken two educational approaches: (1) farmer field flora (FFF) (labor intensive, but scalable through partner organizations) and (2) cell phone animations (potentially highly scalable) voice overlaid in many West African languages and can be distributed by a variety of electronic mechanisms. We will study models of deployment and scaling of solutions through these approaches. Two major questions arise around these. First, for the cell phone approaches we need to determine (experimentally) what people learn, what they retain, and what are their changes in behavior and what are the benefits for the farmers and their communities. Additionally, we need to test experimentally the most efficient pathways for deployment of such educational content. How do we make it accessible and who will use it with the greatest impact, something that we are well positioned to test experimentally. Second, for FFF how can we make this approach scalable through educational programs and technology packages for NGOs and other extensions groups, and can we demonstrate that these groups have had positive impacts in their target communities (e.g., increased production or reduced labor/input costs). Finally, solutions requiring **private sector involvement** (e.g., where a product needs to be produced and distributed) will be explored and implemented through co-operatives and other business models that empower women and unemployed youth. Finally, we will refine our online interfaces and create Apps that allow for the use of our solutions well beyond our own team—thereby allowing for greater impact. However, it is important to note that we are currently interacting with the Bill and Melinda Gates Foundation on a planning grant that, if funded, would involve an interactive IPM-omics system for identifying pest insect populations, making of management decisions and pushing back of solutions to farmers. If funded, this separate online system would complement our work in this project, however, it would be separate and beyond the scope of what we proposed to do in this project.

However, it is important to note that multiple aspects of the IPM-omics equation are researchable questions that we expect will allow us to develop efficient pathways from IPM innovations to scaling of these solutions. We will also test the impact of IPM approaches on farmer incomes, through studies with Dr. Mywish Maredia at MSU. As part of the development of our scaling pathways, we will work with multiple local and transnational programs such as AATF and CORAF.

We will continue our ongoing work in Burkina Faso, Niger, and Benin, however, we will also be adding the Feed the Future country Ghana to our program, as they have ongoing expertise in cowpea IPM and ongoing interactions with IITA on the development and deployment of IPM solutions. In the past phase of the CRSP we also worked with the FTF country Mali, but we were unable to continue these efforts due to the political situation in that country. If circumstances change in the next four years, we would hope to bring back the NARS program from Mali (IER) into our program.

Objective 1. *Define the pest problems*
First, we must ask what are the paradigms and technologies that are in our toolbox and how can we use them? At the current moment we have the following tools to work with: (1) scouting, field experiments, light traps; (2) genomic markers to define pest and biocontrol agent populations—movement patterns and sources of the outbreaks; (3) computational modeling; and, (4) GIS systems—understanding pests in the background of their ecology and life history. We expect to work on Steps 1 and 2 in our impact pathway for "1–defining pest problems." In terms of Program Logic we will work on Step 4.1. Collection of pest populations using scouting throughout the year on cowpea crops and wild alternative host plants in Ghana, Burkina Faso, Niger, and Benin. Insects will be genotyped at UIUC to determine pest movement patterns within regions (on cowpeas and alternative host plants). We will also develop interfaces to summarize our findings in a visual format.

Collaborators
Dr. Brad Coates, USDA, Iowa State University (Genomics)
Dr. George Czapar, UIUC (GIS systems)

Approaches and Methods
In FY13 we hosted a planning workshop to lay out the details of what will be accomplished in FY14.

The following activities will occur in FY14.IITA, INERA, INRAN, CRI, and SARI will scout for insects in their respective countries, both on cowpea plants and on wild alternative hosts. Technicians and students will be trained at each institution to properly identify each species as well as the host plants where they are known to occur. We also will work with SO1.A5 on the collection of insects from their field tests. As well, they will receive training in GIS documentation, so we can obtain information on when and where the species are occurring. This information will be placed up against GIS data (at UIUC) to better understand the impact of environmental parameters on the pest biology. The scouting will occur monthly during the time intervals when cowpeas are not being grown. Once cowpeas are planted, the scouting intensity will increase to upwards of once a week both in cowpea fields and on wild alternative host plants. Samples of these insects will be sent back to UIUC for SNP and microsatellite analyses. The intent of these experiments will be to determine the location and host plants that provide a reservoir for the pest populations that ultimately move to the cowpea crops during the cropping system. In terms of the IITA budget $5,000 of salaries will be used for this effort and $500 in benefits, along with $6,000 in travel and $2,000 in supplies and costs. In terms of the INERA budget $5,000 of salaries will be used for this effort and $500 in benefits, along with $1000 in travel and $1000 in supplies and costs. In terms of the INRAN budget $5,000 of salaries will be used for this effort and $500 in benefits, along with $1000 in travel and $1000 in supplies and costs. Both at SARI and CRI the following budget will be used for these activities: (1) $1000 in salaries, (2) $100 in benefits, (3) $500 in travel; and $350 in supplies. Our primary focus will be on the pests beyond *M. vitrata*. The samples will be sent to UIUC for SNP and microsatellite analyses (the $66,497.00 in salaries and in $29,705.00 benefits along with $13,200 supplies will benefit this section and the development of the interface to make the outputs available to the rest of the community).The UIUC and IITA team (in conjunction with the MO) is currently seeking funding for a planning grant from the Bill and Melinda Gates Foundation (BMGF) to develop a complex IPM-omics interface to collect data on pest populations (using cell phones) and deliver solutions (using cell phones) back into the field for people to make pest management decisions and push out to them educational solutions. If funded, we will determine, in that BMGF planning grant, what will need to go into that interface (which would be created only if a full grant from the BMGF were to occur).However, we will make efforts (as part of this project) to create a much simpler website to capture when and where the materials, knowledge and information we have to date along with basic GIS data (rainfall/temperature/moisture levels/levels of vegetation at the time of sampling) (in collaboration with Dr. Cazapar) to make our work and insights highly transparent to other researchers and outside groups that can help deploy our IPM approaches. We have found from our experience with the SAWBO program that making such materials available online in an easy to follow manner is important for bringing in other outside groups that can help us scale. Such data could then be feed into a more complex interface system, if funded by the BMGF; however, the BMGF site system will be about a highly interactive approach to capturing pest problems in real time and then guiding farmer pest management decisions in real time (using cell phones).Thus, there is no funding overlap in terms of interfaces and our interface (for this program) will be focused on helping IITA and NARS programs make better IPM decisions within the context of this project.

Objective 2: *In our IPM-omics equation the second step is* ***appropriate solutions****.*
We have developed a biocontrol/biopesticide pipeline, in order to develop a series of environmentally and economically appropriate pest control solutions.

During this phase we propose (1) to test novel natural enemies of the pod borer, including novel parasitoids from South East Asia (IITA); (2) to continue scaling up the rearing and releases of thrips parasitoids in all countries (IITA and NARS programs—funds for this work in Ghana will come from the IITA budget—however, they will interact with the NARS programs as part of these releases); (3) to develop and test novel release devices for egg parasitoids of pod sucking bugs (IITA); (4) to develop and test endophytic strains of biopesticides (IITA); (5) and to address technical aspects of cost effective, income-generating production of bio-pesticide products by youth and women groups (IITA) and (INRAB); and (6) interact with the UCR group to develop in field tests for potential host plant resistant/tolerant varieties that we will test in our FY15, and onwards, program (INERA). We expect to work on Steps 1-4 in our impact pathway for 2. Discover, document, and set the stage for scaling of appropriate solutions. In terms of Program Logic we will work on Step 4.1 for this section: (a) Novel *Maruca* parasitoids from Asia introduced to the IITA laboratories for initial screening; (b) scale-up the rearing and release of the thrips parasitoid in all participating countries; (c) sex and aggregation pheromones for pod sucking bugs investigated; (d) PCR techniques developed for detecting endophytic strains of *Beauveria bassiana* in the different tissues of cowpea; e) feasibility of storing *Maruca* virus both as liquid and solid substrate investigated (IITA).

Collaborators

Dr. Ramasamy Srinivasan, AVRDC, Taiwan (Biocontrol agents of M. vitrata)
Dr. Rousseau Djouaka, IITA, Benin (Molecular biology)
Dr. Ousmane Boukar, IITA, Nigeria (Resistant varieties)
Dr. Phil Roberts, UCR, USA (Resistant varieties)

Approaches and Methods

During FY13–14 we plan to conduct the following activities:

1. Testing at least two novel natural enemies of the pod borer *Maruca vitrata*, including novel parasitoids from South East Asia, which are currently in the process of being introduced into the IITA cultures in Benin (such as *Therophilus javanus and Phanerotoma philippinensis*). During FY13–14 we will be testing them in contained lab experiments, targeting interspecific competition with other available parasitoids, as well as host recognition in contained screen house trials.
2. We will continue to scale up the rearing and releases of the flower thrips parasitoid *Ceranisus femoratus* in all participating countries. For this purpose, nursery plots of *Tephrosia candida* will be established nine months ahead of the planned releases, targeting the Sudano–Sahelian zones of Burkina Faso and Niger.
3. We will start a new activity of investigating sex and aggregation pheromones in pod sucking bugs for developing rearing-cum-release devices for their egg parasitoids. During FY13–14 we will be carrying out olfactometric studies at IITA to detect responses of the egg parasitoid *Gryon fulviventre* to pheromones of the brown pod bug *Clavigralla tomentosicollis*.
4. We will develop and test molecular techniques for detecting endophytic strains of the entomopathogenic fungus *Beauveria bassiana* applied to cowpea at planting, while developing inside the vascular tissues of the cowpea plant during its growth. At the same time we will conduct on station experiments to assess the impact of this approach to the main cowpea pests.
5. We will assess the technical feasibility of storing *MaviMNPV* virus both as liquid and solid substrate for facilitating the cottage industry production of this bio-pesticide by self-help women groups. Production of the virus will continue at IITA and staff from the above grouping will undergo technical training sessions on how to produce good quality viral inoculum.
6. Our INERA team will continue to work with UCR to determine potential host plant resistance and tolerance traits (e.g. thrips, pod sucking bugs, etc.) for in field studies in FY15.

7. It is important to note that in the last phase of the CRSP we found that neem sprays and neem+*MaviMNPV* sprays were very effective in minimization of cowpea pest populations. Many aspects of the neem component of our program will be the focus of our proposed one-year BMGF planning grant and thus will not be included in our planned activities, with one notable exception. Our Ghana team (CRI and SARI) will explore the potential for the development of a locally created low-cost neem press; reducing the costs of such a press and making it more portable has the potential to increase the numbers of women's groups that could enter in the neem oil production market. They will hire an individual(s) with mechanical skills to help determine if the development of such a device (using local materials) is feasible. They will also work jointly on this project and the same amount of funds for each of the two groups will be dedicated to this activity; both at SARI and CRI the following budget will be used for these activities: (1) $1000 in salaries, (2) $100 in benefits, (3) $500 in travel; and $350 in supplies.
8. The following aspect of the IITA budget will be used for both these above steps and for the testing of these approaches in the field: (1) Salaries of $10,000, (2) benefits of $1,000, (3) $3,000 in travel costs, and (4) $17,145.00 in S&E costs. For the steps above that INERA will be involved in, the following funds will be used: (1) $5000 in salaries, (2) $500 in benefits, (3) $1000 in travel, and (4) $1000 in supplies.

Objective 3: *Scaling of solution*
When solutions have been developed we need mechanisms to effectively deploy them in a cost effective and sustainable manner. Discovering and testing such scaling pathways will be critical to determine which approaches will be most successful for scaling. Solutions, for scaling, fall into three categories: (1) direct release into the environment and natural establishment; (2) educational solutions; and (3) private sector and NGO involvement. This section some level each of the Steps 1-3, in the impact pathway, should occur within this year. In terms of Program Logic, step 4.1 will occur: 1) Releases of biocontrol agents scaled out; 2) Educational solutions–ICT training materials, online and in-country ICT training sessions available for testing with current partners and potential new partners, FFF program available for testing of impact leading to educational packages for scaling, Potential pathways for deployment of educational videos explored, and begin testing of pathways to deploy videos; and, 3) Private sector/NGO involvement. IITA will use $5,000 in salaries, $500 in benefits, $4,000 in travel and $3,000 in supplies to work with INRAB, UIUC, and MSU to investigate potential pathways for impact. For INERA the following funds will be used for scaling of solutions activities: (1) $10000 in salaries, (2) $1000 in benefits, (3) $1000 in travel, and (4) $3000 in supplies. For INRAN the following funds will be used for scaling of solutions activities: (1) $5500 in salaries, (2) $550 in benefits, (3) $2000 in travel, and (4) $1500 in supplies.

Collaborators
Mrs. Kemi Fakambi, Director of Entreprises Solidaires Benin (CBO)
Dr. Michelle Shumate, Northwestern University
Dr. Mywish Maredia, MSU

Approaches and Methods
1. Direct release into the environment and natural establishment–In FY13–14, we will continue to conduct inoculative releases of biocontrol agents against thrips (*Ceranisus*

femoratus) and pod borers (*Apanteles taragamae* and/or *Nemorilla maculosa*) at selected locations in Burkina Faso (INERA) and Niger (INRAN) according to the priority ecological zones established in the previous phase of the project. Natural enemies will be either brought from the IITA cultures, or reared locally prior to the releases, depending on the available capacities and infrastructures. In Burkina Faso, these releases will occur in the area where we performed (in collaboration with Dr. Maredia) a pre-biocontrol agent assessment with cowpea farmers. In FY17, we will look at the post release and establishment impact on cowpea crops and their expected positive impacts on cowpea farming systems and cowpea farmers themselves.

2. Educational solutions—Over F13–14 we will begin developing educational packages (both online and ones that will be printed booklets and CDs/DVDs) that will be used to train both groups on our teams and with groups outside our program for long-term scaling. These will include (1) continue to create educational content that people can use to educate farmers about IPM techniques and about pest problems (including animations, written materials for the educators, and these materials in a diversity of formats for people to use—all will be made available online to be shared on the SusDeViKI system and the animations on the Scientific Animations Without Borders Deployment sites); summarization of lessons learned from previous FFF and what the educators need to know to make these more successful along with beginning to develop training packages for educators (e.g., NGOs and extension agents) to successfully perform FFF on IPM for cowpeas and (2) refinement creation and deployment (online training sessions and in country training sessions) of ICT packages to educators outside of our groups on how to download our current content, translation of our current content into new languages (we will do the actual co-creation of new language variants).We expect the ICT package to be completed by the end of FY14.Our Chancellor's office at UIUC already funded in FY13 an in Ghana SAWBO training session for 28 representatives from two NGOs and one university. Four new language variants were created in this session and are now available for use in Ghana. Additionally, both NGOs are currently incorporating these materials into their educational programs and we have continued to interact with them virtually to create more language variant content. Additionally, experiences from this training session will (1) allow us to refine and complete an ICT training system (2) refine how these need to be organized and (3) develop a reporting system to assess the effectiveness of this approach for scaling and set the stage for potential impact assessment studies. Additionally, we tested out a new App for each access and download for our educational materials. This new App and a redesign of our interface for the "lite" version of the SAWBO site will occur in FY14 to make our materials more accessible for people to find and rapidly download.

For the upcoming Legumes Innovations Lab, we have educational animations on a series of IPM solutions: neem sprays, solar treating of cowpea seeds, the concepts explaining biocontrol, etc. In the past phase of the CRSP we observed that the animations spread rapidly, people learned from these videos the main concepts, they found these entertaining, and with groups outside of our CRSP program we worked with testing of animations as an educational tool, with the results strongly suggesting that people could easily understand the content and repeat the techniques (funded separately and done separately from the previous CRSP). Dr. Shumate also has experience working with deployment pathways for technology-based educational materials in

Burkina Faso. She has completed studies on (1) which groups in the country are the most logical to deploy the educational materials (through a nodal analysis of how these groups interact with each other—her group can now tell us which groups are logical for partnering for deployment and which groups are unlikely to have impact—a hypothesis we cannot test with our videos; see below). We need to continue to place many of these videos in more local languages; we have refined a system where we can work with groups virtually in a given country (they just need Internet access and a computer with a built in microphone) to develop new voiceovers in local languages and deliver videos back to them to use in the field.

For the animations we are in a strong position to perform tests in learning, impact, and potential for scalability. In collaboration with Dr. Shumate and IITA we will perform before and after knowledge gain for cowpea farmers given the cowpea related videos on their cell phones. We will also perform a one-month follow-up to determine how many time people have re-watched these videos, their knowledge retention, and their interest or use in adopting such technologies. As we already know the logical deployment partners in Burkina Faso, based on work by Dr. Shumate, we will take specific videos, label them with a code at the end of the video (with a unique code for each video given to each deployment group), and give each video out to groups we expect would deploy them and ones where we would expect to have little impact. For example, organization #1 we will give them the neem video and at the very end of the video we have a #1 on the screen and organization #2 will also be given the neem video and at the very end of the video we have a #2 on the screen. Our hypothesis, based on the nodal analysis was that group #1 would be more connected with the community to have impact. Thus, we will go into the community one to two months later to determine which videos people have on their cell phone—the one from group #1 or group #2.This will allow us to directly test which partner groups might be better in circulating these educational videos.

For the FFF that will be held in Niger and Burkina Faso we will work with partner groups where we will train them on proper experimental design such that from their results we will be able to obtain statistical data demonstrating potential increases in yields of specific IPM techniques. We will also incorporate animated videos into some of these FFF's to determine their usefulness in increasing learning in the FFF and potential impacts on positive outcomes of adoption of specific technologies.

(3) Private sector and NGO involvement–We will continue to collaborate with the self-help enterprise producing bio-pesticides in Benin, focusing on refining formulation and application methodology for bio-pesticides and their mixtures. Also, we will start training staff of the self-help group, with particular attention to women, in the production of pod borer larvae using the technology developed during the previous phase of the project, i.e. using cowpea sprouts. The larvae will be inoculated with the virus supplied by IITA (at least until they get their own stock cultures) and passed through the already existing biopesticide value chain within the self-help enterprise. The SAWBO program has had a significant amount of success with passing off educational animations to NGOs and we will seek to determine the numbers and the type of impact some of these organizations have had with such videos.

We also need to assess the market potential for biopesticides, potential groups that can develop these materials and logical pass-off groups in our host countries for our various technologies. In

Benin, INRAB will have the mandate to assess the market potential for such biopesticides (e.g., what farmers are willing to pay, what will be the costs to enter the market place for small industries, what are skill-sets that need to be developed for women's groups to potentially make and profit from selling such materials) and what will determine the networks of NGOs and other organizations where we can pass-off educational approaches (be it FFF or animations or both) for scaling. The full INRAB budget (of $5000) direct spendable will be used for these activities, including $1500 (non-degree training) of which will be used in INRAB personnel time to train IITA staff of these assessment approaches.

<u>**Objective 4: Capacity Building**</u> *To increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors in the target FTF* countries

Collaborators
Dr. Michelle Shumate, Northwestern University
Dr. Brad Coates, USDA, Iowa State University

Approaches and Methods
<u>**Objective—Capacity Building.**</u> *To increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors in the target FTF countries*.

This section some level each of the Steps 1-3, in the impact pathway, should occur within this year. In terms of Program Logic, step 4.1 will occur: 1) Ongoing graduate education across all four HC and a student at UIUC (funded by HHMI), 2) initial ICT training tools in progress that will be primarily created at UIUC, 3) technician training initiated for biocontrol agents that will be released (this will involve sending technicians across to different programs with the training primarily occurring at IITA, however the NARS programs will also exchange between Burkina Faso, Niger, and Ghana where necessary). Both at SARI and CRI $1100 of their budgets will be used for this technician training.

<u>**Approach**</u>
Degree training. We will have one West African graduate student (PhD), at UIUC, continue at UIUC through a Howard Hughes Fellowship. A second U.S. citizen (female PhD student) will also continue to be trained (no funds from the Legumes Innovations Lab will be directly used for her training).At IITA and all NARS programs the incoming students will be identified and we will report to the MO when they begin. We expect eight or more new students will be identified and accepted into labs and programs in the fall of 2013 to begin their training on the next phase of this program. We expect IITA and all NARS programs to have at least one student (with IITA having more) trained in their program.

We expect the following graduate students: (1) one BS (e.g., for an honors project) or MS student will be partially supported at SARI in Ghana (entomology: $1500), (2) one BS (e.g., for an honors project) or MS student will be partially supported at CRI in Ghana (entomology: $1500), (2) one PhD graduate student will work with both INRAB and IITA (but will be funded through IITA) (in order to strengthen their partnership, this student will work on assessment studies, degree program TBD; $5000 for this partial support), (3) one PhD student will be partially supported at INERA (entomology: $5000), (4) one honors or MS student will be partially or fully supported at INRAN in Niger (entomology $2950), and (5) three more PhD or MS students will be partially/fully supported at IITA in Benin (entomology—partial support for each student at $5000 per student).This brings a total of eight students. The HC student at UIUC will continue at least into FY14 under Howard Hughes fellowship and we expect her to complete her degree in 2014.This would in fact, bring our total to nine students, however, the ninth student is completely supported by other funds and represents a student from a previous funding cycle. The UIUC program will be actively looking to find another MS or PhD student from one of the HC to attend UIUC, however, this will not occur in FY14, as it will not be possible to bring in a student (from an admissions prospective) until the fall of 2014.

Short-term training. We will be developing tools for short term training and testing these. We see developing approaches for scaling of short-term training as part of a solution for cost-effective scaling of our outputs. We will develop tangible educational content for training of farmers both in terms of FFF and through ICT approaches.

For the ICT approaches we will (1) placing our existing animations in the diversity of major languages needed for each of these countries and initiate new animations where the educational content is needed), make available that educational content in a diversity of formats (online, on cell phones, USB-card SAWBO video libraries that people can carry in their wallets and distribute videos when needed, and we will develop and test Apps for educators to easily gain access to content based on country, language and topics, such that they can download what they need, take it to the field and distribute it on to people's phones with Bluetooth), (2) we will develop and perform ICT training sessions for our collaborators and outside groups like NGOs, other government and international organization (such training sessions will occur online three times per year and one in-country once per year).These sessions will be important as learning exercises for us to refine materials, but are absolutely critical for us to develop the necessary networks of outside collaborators who can help scale our efforts. It is important to note that with these ICT approaches we can measure online use and downloads of materials. Partner groups can also give us feedback on their use and potential for scaling in their programs. A total of $53,057.00 will be used at UIUC to support activities to develop and implement training materials and sessions. An additional $5005.00 will be set aside to bring HC scientists to UIUC to plan activities in the host countries as well at $1000 for supplies for them.

For the FFF program we will host a minimal of three (upwards of six) FFF in Niger and Burkina Faso. These will be hosted by outside groups that we will train and throughout the year we will work with them to develop the most effective training packages and ICT materials that can be incorporated into these programs. Where six FFF will occur in a given country, three will occur without ICT approaches and three with ICT approaches. At the end of the year we will perform focus group sessions to determine learning outcomes. Additionally, the FFF will include replicates of the technologies in the fields and we will train partner groups on the need for replicates so we can analyze the data to determine if there has been statistically significant yield increases. For INERA and INRAN each team will use $5000 for FFF and ICT activities.

Additionally, we will hold technician training programs for the biocontrol agents that will be released. This will involve sending technicians across to different programs (training primarily at IITA, however the NARS programs will also exchange between Burkina Faso, Niger, and Ghana where necessary).This will occur where necessary and where time and resources permit. We expect at least one exchange to occur in FY14. IITA will use $11,300 of their budget for these activities.

Contribution of Project to USAID Feed the Future Performance Indicators
Please see our Performance Indicators–Targets form for the project for FY 2013, 2014 and 2015.

Outputs
Defining the pest problems.
We expect to collect one year of data on the major pests of cowpeas (beyond *Maruca*) in terms of timing, location, and wild alternative host plants. We expect to perform initial molecular work on these populations and we expect to lay these data over known GIS data.

Appropriate solutions. We will bring forward in the biocontrol pipeline new promising agents. We expect to bring forward biopesticides and develop tools and an understanding to take them to the next step towards commercial production (not only the technology, but a better understanding of who to work with to pass off the technologies to the marketplace. We also expect to have an understanding of the potential for a low-cost neem press.

Scaling of Solutions. We expect to continue to perform inoculative releases of natural enemies in Niger, Burkina Faso, and Benin; we expect these to ultimately suppress insect populations. We expect to have developed and expanded on partnerships that can help us scale our solutions; in the first year (FY14) we expect the most immediate tangible results will be NGOs using our educational materials. We expect this to be the beginning of developing larger-scale in country deployment networks for our materials. Also, as SAWBO materials have been translated into languages beyond these countries, we also expect to work with and interact with NGOs and other organizations that will use these materials in their educational programs. We also expect some of our assessments on the potential for scaling will give us important insights for continued scaling.

Engagement of USAID Field Mission(s)
USAID Mission Engagement. Dr. Pittendrigh, with Dr. Larry Beach, has already met with the Ghana mission during our program planning meeting and Dr. Pittendrigh will be presenting (this will likely be past tense by time the review of this document occurs) on IPM-omics at the Innovation Lab Workshop to be held in Accra, Ghana, on July 8 and 9, 2013, a meeting involving USAID Mission staff (FY13).Additionally, one of the Ghana mission's representatives has already begun to contact Drs. Tamo (at IITA) and Dabire (INERA) about the possibility of exploring intercropping of cowpea with crop(s) important for FTF value chains. They were interested in the IPM technologies we are working on and seek opportunities for connections with their focus. Thus, we have already begun this important process of engaging missions in West Africa in regards to our program. Our Ghanaian PIs are slated to be involved in the July 8 and 9 meeting involving USAID Mission staff. In FY14 we will follow-up on the leads (including potential visits) and opportunities that emerge from these two major interactions with the USAID Mission staff.

Partnering and Networking Activities
Our partnering activities have several aspects to them. First, IITAs development of novel pest control solutions (both technologies and biocontrol agents), through the biocontrol/biopesticide pipeline will be handed to NARS programs for testing, use and deployment in their host countries. The FFF will be conducted in conjunction with local NGOs and other non-Legumes Innovations Lab programs (i.e., groups that we are not funding, but can use our materials in their programs).We will have FFF in Niger and Burkina Faso, with these outside programs, and after training these groups on how to properly set up experiments in the FFF we will assess the impacts on yields in the experimental plots. We will also use our ICT training sessions (both online and one in-country one—Ghana) to meet with and partner with NGOs that can use our materials in scaling with their own educational programs. The travel funds for UIUC ($13,600.00) will be used for UIUC faculty, staff and/or students to visit with IITA and/or NARS scientists in the course of the FY14.

Leveraging of Legumes Innovations Lab Resources
The UIUC team will leverage funds from the ADM Institute for the Prevention of Postharvest Losses, endowment funds, and funds from the Chancellor's Office (UIUC).Additionally, a Howard Hughes Doctoral Fellowship will fund graduate student support, for one West African student at UIUC, for the FY13-FY14.Additionally, the MO, IITA and UIUC are currently preparing a one-year planning grant proposal from the he BMGF for a one-year grant to scale some of our IPM-omics technologies—the scaling of neem and laying the foundation for an infield system, using cell phones, to assess pest problems and receive IPM recommendations for farmers to use. However, it is important to note that activities for the BMGF will be kept separate from our Legumes Innovation Lab objectives. There exist multiple complementary technologies and scaling issues that will require funding levels in keeping with a BMFG planning grant. IITA will continue to receive funding through the CGIAR Research Program on Grain Legumes, including competitive grants. We also view the use of the SAWBO animations by NGOs in their educational programs as a leveraging of the Legumes Innovations Lab resources.

Timeline for Achievement of Milestones of Technical Progress
Please see out Milestones for Technical Progress form for the workplan period.

Training/Capacity Building

<u>Degree Training</u>
First and Other Given Names: Tolulope Adebimpe
Last Name: Agunbiade
Citizenship: Nigeria (but formerly living in Ghana and previously worked for IITA)
Gender: Female
Training Institution: UIUC
Supervising CRSP PI: Pittendrigh
Degree Program for training: PhD in Entomology
Program Areas or Discipline: Entomology

If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No; This student will be funded from a Howard Hughes Medical Institution grant
Host Country Institution to Benefit from Training: Benin
Thesis Title/Research Area: IPM-omics—Use of molecular tools to make better pest management decisions in cowpea cropping systems in West Africa
Start Date: Continuation (Started Fall 2009)
Projected Completion Date (Fall 2014)
Training status (Active, completed, pending, discontinued or delayed): Active
Type of CRSP Support (full, partial or indirect) g for training activity: Indirect

First and Other Given Names: Laura
Last Name: Steele
Citizenship: USA
Gender: Female
Training Institution: UIUC
Supervising CRSP PI: Pittendrigh
Degree Program for training: PhD in Entomology
Program Areas or Discipline: Entomology
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Host Country Institution to Benefit from Training: Benin, Niger, Burkina Faso, and Ghana – indirectly (this student has and will continue to play a major role in the development of ICT tools for these countries as well as work on the molecular aspects of our program
Thesis Title/Research Area: To be determined
Start Date: Continuation (Started Fall 2011)
Projected Completion Date (Fall 2016)
Training status (Active, completed, pending, discontinued or delayed): Active
Type of CRSP Support (full, partial or indirect) g for training activity: Indirect

NOTE: We expect to have eight more students identified and in place in the Benin, Niger, Burkina Faso and Ghana by December 2013.They are still, as of yet, to be named.

Short-term Training
Type of training: FFF
Description of training activity: These will be training of NGOs and outside groups and then these materials will be used in FFF, where INERA and INRAN will work with them closely throughout the FFF sessions
Location: Niger and Burkina Faso
Duration: Several months
When will it occur? Fall of 2013
Participants/Beneficiaries of Training Activity: We expect direct impact on NGOs and other groups that can use these in their educational programs. We expect benefits to cowpea farmers to also result.
Anticipated numbers of Beneficiaries (male and female): We expect 220 (equally split between males and females) to benefit
PI/Collaborator responsible for this training activity: Dabire and Baoua
List other funding sources that will be sought (if any): N/A

Training justification: We have already observed that training outside groups in our educational content has significant potential for scaling of our technologies and approaches that have been developed. This will both be a training system and a testing of scaling.

Type of training: ICT training sessions (online and minimally one in country)
Description of training activity: Online (three times per year and one in country)
Location: Online and one in Ghana with a potential for a second one in Benin
Duration: one-day sessions followed by week long collaborative efforts for new content
When will it occur? One online in the fall of 2013 and two in the spring of 2014; the in-country session(s) will occur before the end of FY14
Participants/Beneficiaries of Training Activity: We expect direct impact on NGOs and other groups that can use these in their educational programs. We expect benefits to cowpea farmers to also result. We will also involve senior scientists and technicians in these training sessions.
Anticipated numbers of Beneficiaries (male and female). In Fy13 we will have trained 28 individuals from NGOs in these technologies and expect over 100 NGO and government agents trained in this year (50 males and 50 females) From these training sessions we expect that these groups will take these materials out to other groups, and expose upward of 5200 people to our materials (conservative estimate)
PI/Collaborator responsible for this training activity: Pittendrigh
List other funding sources that will be sought (if any): ADM Institute for the Prevention of Postharvest Loss and the Chancellor's office
Training justification: We have already observed that training outside groups in our educational content has significant potential for scaling of our technologies and approaches that have been developed.

Type of training: Technician cross-training
Description of training activity: Technicians will be cross-trained across IITA and the NARS programs
Location: Niger, Burkina Faso, Ghana, and Benin
Duration: one-day to multiple weeks
When will it occur? Throughout FY14
Participants/Beneficiaries of Training Activity: minimally six technicians and/or students
Anticipated numbers of Beneficiaries (male and female): We expect the NARS programs to benefit and increase their ability to have impact with biocontrol agents and biopesticides
PI/Collaborator responsible for this training activity: Tamo, Baoua, Dabire, Braimah, and Asante
List other funding sources that will be sought (if any): N/A
Training justification: We have found this a highly cost-effective way to exchange the technologies between institutions.

Equipment (costing >$5,000): N/A
Specific Type of Equipment to be purchased
Justification for equipment to achieve workplan objectives
Institution to benefit from equipment
Institution to purchase equipment
Amount budgeted for equipment item

Performance Indicators for FY 13-FY14

IPM-omics: Scalable and Sustainable Biological Solutions for Pest Management of Insect Pests of Cowpea in Africa (SO1.B1)

Project Name:SO1.B1 IPM-omics: Scalable and sustainable biological solutions for pest management of insect p

Summary of all institutions

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	1	0	0	9	0	0	8	0	0
	Number of women	1	0	0	6	0	0	5	0	0
	Number of men	0	0	0	3	0	0	3	0	0
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	219	0	0	5444	0	0	11354	0	0
	Number of women	77	0	0	2692	0	0	5691	0	0
	Number of men	142	0	0	2752	0	0	5663	0	0
	Numbers by Type of individual				5444			11354		
	Producers	122	0	0	5134	0	0	10194	0	0
	People in government	36	0	0	59	0	0	154	0	0
	People in private sector firms	18	0	0	34	0	0	144	0	0
	People in civil society	47	0	0	217	0	0	862	0	0
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	5428	0	0	12400	0	0	34400	0	0
	New	28	0	0	6872	0	0	22000	0	0
	Continuing	5400	0	0	5528	0	0	12400	0	0
	Gendered Household Type				12400			32400		
	Adult Female no Adult Male (FNM)	1050	0	0	3210	0	0	5110	0	0
	Adult Male no Adult Female (MNF)	1050	0	0	3210	0	0	5710	0	0
	Male and Female Adults (M&F)	2802	0	0	4880	0	0	19080	0	0
	Child No Adults (CNA)	525	0	0	1100	0	0	2500	0	0

4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization				144			233		
	Private enterprises (for profit)	11	0	0	15	0	0	24	0	0
	Producers organizations	9	0	0	15	0	0	18	0	0
	Water users associations	0	0	0	1	0	0	1	0	0
	Women's groups	18	0	0	40	0	0	63	0	0
	Trade and business associations	5	0	0	10	0	0	14	0	0
	Community-based organizations (CBOs)	14	0	0	63	0	0	113	0	0
	New/Continuing (total)	29	0	0	121	0	0	199	0	0
	New	9	0	0	72	0	0	84	0	0
	Continuing	20	0	0	49	0	0	115	0	0
5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	48	0	0	62	0	0	75	0	0
	Agricultural production	23	0	0	30	0	0	42	0	0
	Agricultural post harvest transformation	22	0	0	30	0	0	32	0	0
	Nutrition	3	0	0	2	0	0	1	0	0
	Multi-focus	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	5162	0	0	15080	0	0	37070	0	0
	crop genetics	460	0	0	1070	0	0	4470	0	0
	animal genetics	0	0	0	0	0	0	0	0	0
	pest management	4102	0	0	9210	0	0	25000	0	0
	disease management	0	0	0	0	0	0	0	0	0
	soil-related	200	0	0	200	0	0	200	0	0
	irrigation	0	0	0	0	0	0	0	0	0
	water management	0	0	0	0	0	0	0	0	0
	post-harvest handling and storage	200	0	0	4300	0	0	7000	0	0
	processing	0	0	0	0	0	0	0	0	0
	climate mitigation or adaptation	200	0	0	300	0	0	400	0	0
	fishing gear/technique	0	0	0	0	0	0	0	0	0
	other	0	0	0	0	0	0	0	0	0
	total w/one or more improved technology	0	0	0	0	0	0	0	0	0
	New/Continuing hectares									
	New	10	0	0	7025	0	0	25015	0	0
	Continuing	5151	0	0	6055	0	0	12055	0	0
	Sex of person managing hectare									
	Male	2575	0	0	5761	0	0	19155	0	0
	Female	2565	0	0	5302	0	0	13800	0	0
	Association-applied	11	0	0	2017	0	0	4115	0	0

7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	36	0	0	38	0	0	36	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	22	0	0	19	0	0	15	0	0
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	13	0	0	16	0	0	14	0	0
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	1	0	0	3	0	0	7	0	0
8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	5	0	0	5	0	0	5	0	0
	Inputs	1	0	0	1	0	0	1	0	0
	Outputs	0	0	0	0	0	0	0	0	0
	Macroeconomic	0	0	0	0	0	0	0	0	0
	Agricultural sector-wide	1	0	0	1	0	0	1	0	0
	Research, extension, information, and other public service	1	0	0	1	0	0	1	0	0
	Food security/vulnerable	1	0	0	1	0	0	1	0	0
	Climate change adaptation or natural resource management (NRM) (ag-related)	1	0	0	1	0	0	1	0	0
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	1	0	0	2	0	0	2	0	0
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	1	0	0	2	0	0	2	0	0
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0	0	0	0	0	0	0	0	0
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0	0	0	0	0	0	0	0	0
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0	0	0	0	0	0	0	0	0

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13-FY14, IPM-omics: Scalable and Sustainable Biological Solutions for Pest Management …

Legume Innovation Lab Project : BUDGET SUMMARY FY 13												
SO1.B1 IPM-omics: Scalable and sustainable biological solutions for pest management of insect pests of cowpea in Africa												
	4/1/13 - 09/30/13											
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
Institution Name	UIUC		IITA	INERA	INRAN	INRAB	SARI	CRI				
HC or U.S. Institution	US	HC	HC	HC	HC	HC	HC	HC				
a. Personnel Cost												
Salaries	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Fringe Benefit	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
b. Travel	$10,000.00	$28,112.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$38,112.00
c. Equipment ($5000 Plus)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Supplies	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
e. Training												
Degree	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Non-Degree	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
f. Other	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
g. Total Direct Cost	**$10,000.00**	**$28,112.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$38,112.00**
h. Indirect Cost	$5,500.00	$15,462.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,962.00
i. Indirect Cost on Subcontracts (First $25000)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
j. Total Indirect Cost	$5,500.00	$15,462.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$20,962.00
Total	**$15,500.00**	**$43,574.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$59,074.00**
Grand Total	$59,074.00											

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	$10,000.00	26.24%
Total direct cost budgeted for H.C institution(s)	$28,112.00	73.76%

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
In-kind	$2,220.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,220.00
Cash	$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$ 2,220.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,220.00

Attribution to Capacity Building												
Percentage of effort	50.00%	50.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	50.00%
Amount corresponding to effort	$5,000.00	$14,056.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$19,056.00

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

	10/01/13 - 09/30/14											
	U.S. Institution	U.S. for Host Country	HC	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
Institution Name	UIUC		IITA	INERA	INRAN	INRAB	SARI	CRI				
HC or U.S. Institution	US	HC	HC	HC	HC	HC	HC	HC				
a. Personnel Cost												
Salaries	66,497.00	$0.00	$20,000.00	$20,000.00	$10,500.00	$1,500.00	$2,000.00	$2,000.00	$0.00	$0.00	$0.00	$122,497.00
Fringe Benefit	$29,705.00	$0.00	$2,000.00	$2,000.00	$1,050.00	$150.00	$200.00	$200.00	$0.00	$0.00	$0.00	$35,305.00
b. Travel	$13,600.00	$5,005.00	$13,000.00	$3,000.00	$3,000.00	$1,150.00	$1,000.00	$1,000.00	$0.00	$0.00	$0.00	$40,755.00
c. Equipment ($5000 Plus)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Supplies	$13,200.00	$1,000.00	$22,145.00	$5,000.00	$2,500.00	$700.00	$700.00	$700.00	$0.00	$0.00	$0.00	$45,945.00
e. Training												
Degree	$0.00	$0.00	$20,000.00	$5,000.00	$2,950.00	$0.00	$1,500.00	$1,500.00	$0.00	$0.00	$0.00	$30,950.00
Non-Degree	$53,057.00	$0.00	$11,300.00	$5,000.00	$5,000.00	$1,500.00	$1,100.00	$1,100.00	$0.00	$0.00	$0.00	$78,057.00
f. Other	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
g. Total Direct Cost	**$176,059.00**	**$6,005.00**	**$88,445.00**	**$40,000.00**	**$25,000.00**	**$5,000.00**	**$6,500.00**	**$6,500.00**	**$0.00**	**$0.00**	**$0.00**	**$353,509.00**
h. Indirect Cost	$96,832.00	$3,304.00	$13,090.00	$4,000.00	$2,500.00	$500.00	$650.00	$650.00	$0.00	$0.00	$0.00	$121,526.00
i. Indirect Cost on Subcontracts (First $25000)	$0.00	$0.00	$0.00	$0.00	$0.00	$3,025.00	$3,933.00	$3,933.00	$0.00	$0.00	$0.00	$10,891.00
j. Total Indirect Cost	$96,832.00	$3,304.00	$13,090.00	$4,000.00	$2,500.00	$3,525.00	$4,583.00	$4,583.00	$0.00	$0.00	$0.00	$132,417.00
Total	**$272,891.00**	**$9,309.00**	**$101,535.00**	**$44,000.00**	**$27,500.00**	**$8,525.00**	**$11,083.00**	**$11,083.00**	**$0.00**	**$0.00**	**$0.00**	**$485,926.00**
Grand Total	**$485,926.00**											

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	**$176,059.00**	**49.80%**
Total direct cost budgeted for H.C institution(s)	**$177,450.00**	**50.20%**

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
In-kind	$26,641.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$26,641.00
Cash	$0.00		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$ 26,641.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 26,641.00

Attribution to Capacity Building												
Percentage of effort	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	50.00%	0.00%	0.00%	0.00%	50.00%
Amount corresponding to effort	$88,029.50	$3,002.50	$44,222.50	$20,000.00	$12,500.00	$2,500.00	$3,250.00	$3,250.00	$0.00	$0.00	$0.00	$176,754.50

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

Milestones for FY 13-FY14, IPM-omics: Scalable and Sustainable Biological Solutions for Pest Management . . .

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

Research, Training and Outreach Workplans

(April 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: SO1.B1 IPM-omics: Scalable an

Provide abbreviated name of institutions in columns below

	UIUC			IITA			INERA			INRAN			INRAB			CRI			SARI		
Identify Milestones by Objectives	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14
	(Tick mark the time period for achieving identified milestones by institution)																				
Objective 1: Define the pest problems																					
1.1 Insect scouting					X	X		X	X		X	X					X	X		X	X
1.2 Molecular analysis		X	X																		
1.3 Planning meeting	X						X			X			X			X			X		
1.4																					
1.5																					
Objective 2: appropriate solutions																					
2.1 novel natural enemies of the pod borer					X	X															
2.2 rearing and releases of thrips parasitoids					X	X			X			X						X			x
2.3 novel release devices for egg parasitoids					X	X															
2.4 endophytes					X	X															
2.5 production of bio-pesticides					X	X			x			X						X			x
2.6 Work on resistant/tolerant varieties						X		X	X		X	X									
Objective 3: Scaling of solutions																					
3.1 Inoculative release of natural enemies						x			x			x						X			x
3.2 Development&Investigations of Educational	X	X	X			x			x			x			X			X			x
3.3 Involving private sector and NGO		X	X		x									X	X			X			x
3.4 Understanding the potential for scaling		X	X												X						
Objective 4: Capacity building																					
4.1 graduate training	X					x			x			x			X			X			x
4.2 ICT training tools		X	X		X	X		X	X		X	X		X	X		X	X		X	X
4.3 technician training					x	x		x	x		x	x					X	X		x	x
4.4 Short course online ICT training and in country		X	X																		
Name of the PI responsible for reporting on milestones	Barry Robert Pittendrigh			Manuel Tamo			Clementine Dabire			Ibrahim Baoua			Leonard Hinnou			Haruna Braimah			Stephen Asante		
Signature/Initials:																					
Date:	5-Jul-13			5-Jul-13			5-Jul-13			5-Jul-13			5-Jul-13			5-Jul-13			5-Jul-13		

Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize–Bean Production Systems (SO2.1)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
Robert E. Mazur, Iowa State University

Collaborating Host Country and U.S. PIs and Institutions
Eric Abbott, Iowa State University
Andrew Lenssen, Iowa State University
Ebby Luvaga, Iowa State University
Russell Yost, University of Hawaii at Manoa
Julia Bello-Bravo, University of Illinois at Urbana-Champaign
Barry Pittendrigh, University of Illinois at Urbana-Champaign
Moses Tenywa, Makerere University, Uganda
Onesimus Semalulu, Soils & Agro-meteorology, National Agricultural Research Laboratories, Uganda
Ricardo Maria, Institute of Agriculture Research of Mozambique

Project Problem Statement and Justification

Smallholder farmers in Africa—women and men—manage complex multifunctional maize–bean cropping systems in diverse landscapes and agroecosystems. Common beans serve multiple important roles in their cropping systems, food security, nutrition, incomes, and livelihood resilience. They register low yields, and experience pervasive poverty and food insecurity. Low productivity of beans in maize-bean systems is due to low soil fertility, limited availability of improved seed varieties, excess water during plant growth, insects, and diseases. Typical yields of 200 to 500 kg ha^{-1} are significantly less than the 2000 kg ha^{-1} often obtained in researcher-managed fields. Poor and declining soil fertility is considered by far the primary constraint to common bean productivity, responsible for 30 percent of the widely acknowledged yield gap. Grain legume research programs identify and develop improved technologies and management practices that can substantially increase yields. However, adoption of improved crop management practices, particularly those addressing soil fertility, has been modest for beans.

This research project is based on two premises: (1) sustainable intensification of agriculture production requires improved soil fertility management in which legumes are an integral part of cropping systems and (2) addressing soil-related constraints requires not simply increasing access to fertilizers or use of other soil amendments, but, fundamentally enhancing smallholder farmers' capabilities in diagnosing and finding solutions to important yield constraints.

Improved management capabilities will have four important short- and long-term benefits: (1) Empower farmers (especially women) to take an active role in identifying problems and solutions in bean production; (2) Improve household income through sale of increased bean production; (3) Provide higher volume of beans for traders along the value chain within the country as well as in cross-border trade; (4) Ensure greater availability of nutritious beans and less dramatic seasonal price fluctuations for net consumers (other rural households and urban consumers). The project will contribute directly to achieving four of the six Feed the Future focal areas: inclusive agriculture sector growth, gender integration, climate-smart development, and research and capacity building. For the Legume Innovation Lab, we address SO2 through improved smallholder production management decision-making.

Project activities will take place in key bean production regions in two important FTF focus countries—in Uganda (where maize and beans are promoted through FTF projects in 62 districts) and in Mozambique (FTF priority provinces are Nampula and Zambézia; beans is a priority crop). Increasing bean productivity can help reduce poverty and improve nutrition. In Uganda, beans are the most important legume crop, and fifth crop overall. In Mozambique, beans are a cash crop for 35 percent of producing households; the country is the largest informal exporter of maize and beans in southern Africa (50 percent share of regional exports in both). Poor soil fertility has been identified as a major factor in reduced bean yields, and both countries have weak extension systems and rural institutions, limiting access to crop technologies, inputs and credit to informal systems.

This project seeks to develop tools (methods and procedures) that enable smallholder farmers with varying levels of education to better diagnose soil-related production constraints, and make improved site-specific crop system management decisions that contribute to higher productivity (including grain legumes) in the short term as well as improvements in soil fertility in the long term. It will also assess the effectiveness of innovative communication approaches and technologies to engage farmers with diverse characteristics and other key stakeholders in widespread dissemination and adoption of diagnostic and decision support aids in different agroecological contexts.

Planned Project Activities for April 1, 2013–September 30, 2014

Objective 1. *Characterize Smallholder Farmers' Motivations, Current Knowledge and Practices, Problem Diagnoses and Solutions, and Risk Management Strategies*

Collaborators

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Approaches and Methods

The team will establish a base understanding of smallholder farmers' motivation, current knowledge and practices in maize-bean cropping systems, problem diagnoses and solutions adopted—especially pertaining to soil fertility management—in Masaka District, Uganda, and Gurué District, Mozambique. This effort will begin with a state-of-the-art review of available country-specific reports and publications to characterize farmers' practices of field selection and preparation, crop and variety selection, planting methods and spacing, use of various types of inputs, intercropping and rotation patterns, problem identification and management practices utilized by farmers to date. It will also include information on uses made of crops—consumption, market sales, and storage.

A Participatory Rural Appraisal (PRA) will initiate the community level research process in each country to create a multifaceted understanding of smallholder farmers' current knowledge, practices, motivations, experiences and conditions in three selected communities in each country. Researchers and facilitators will draw on an array of methods and techniques, including semi-structured key informant interviews, focus group discussions with 10-15 community members and situation analysis at community and farm level. A stratified random sample of 50 farmers in the community will be interviewed regarding sources and use of information about bean crop and soil fertility management, problem diagnoses and solutions adopted, decision making practices and risk management strategies. This information will form the baseline for the multi-disciplinary team of researchers to observe and learn how farmers can use the existing knowledge to help determine and leverage their own means of improving current conditions. This will be combined with information drawn from the global knowledge base of appropriate practices and technologies. Contextual elements that will be considered for their relevance include agroecosystem features (terrain, soil nutrient and physical properties, cropping system, rainfall, diseases, pests); availability and accessibility of key resources (natural, physical, financial); and value chain development (input and output markets, value capture, linkages). The farmer and soil surveys are initiated with informal meetings of groups of farmers to identify farmer leaders. Questions asked during this stage include "who is the best farmer in the village?" and "what is their yield?" Smallholder farmers often lack awareness of the importance of soil fertility management in achieving higher yields; however, some factors are widely recognized as relevant, including amount of rocks, shallow topsoil, slope, and color. The initial survey provides respondents the opportunity to select factors they believe impact bean production within their respective production systems and to rank the relative importance of their impacts. Factors considered in the survey instrument include water as a limiting factor, crop management, soil conditions, and biological factors. Water limitation includes inadequate and untimely rainfall, infiltration rate, and runoff. Crop management considerations are numerous and include inadequate plant populations due to poor seed, seedbed preparation, and stand establishment, stand loss, or adverse environmental conditions at key developmental stages. Soil conditions surveyed include physical and chemical properties. Physical properties include texture, coarseness, and susceptibility to crusting. Chemical properties that can influence yield include pH, concentrations of N, P, Ca, Mg, K, S, and various micronutrients. Biological factors potentially impacting yield include arthropods, diseases, and presence or absence of beneficial microbes, Rhizobium and mycorrhizae. Farmers within and among communities can be selected or stratified based on predominant soils characteristics for participation in development and testing of diagnostic aids, presented under Objective 3.

Obj. 1a. Conduct state-of-the-art reviews of literature and relevant management practices in Africa

(lead researchers: M. Tenywa, O. Semalulu, P. Musaali, R. Maria, C. Filimone, R. Chavana)
1a.1. Review reports and publications to characterize farmers' agricultural motivations, knowledge, practices, and problem diagnoses (also: S. Aly, M. Amane, A. Lenssen, R. Yost)
1a.2. Review reports and publications to characterize farmers' livelihoods, decision making processes, and institutional factors (also: E. Luvaga, R. Mazur)
1a.3. Review reports and publications to characterize rural information and communication agents and practices (also: S. Mocubme, E. Abbott, J. Bello-Bravo)

Milestones

Apr. 2013– Sept. 2013

- Initiate state-of-the-art reviews of literature and practices

Oct. 2013–Mar. 2014

- Complete reviews and identify knowledge gaps

Obj. 1b. *Collect and analyze primary data in research communities* (lead researchers: M. Tenywa, O. Semalulu, P. Musaali, R. Maria, C. Filimone, R. Chavana)
1b.1. Conduct participatory rural appraisals (PRAs) (also: R. Yost, E. Abbott, J. Bello-Bravo)
1b.2. Facilitate community identification of innovative farmers (also: R. Yost, A. Lenssen)
1b.3. Conduct household interviews (community cross-section) (also: S. Aly)

Milestones

Oct. 2013–Mar. 2014

- Conduct PRA and select study farmers in Masaka
- Conduct household interviews in Masaka

Apr. 2014–Sept. 2014

- Conduct PRA and select study farmers in Gurué
- Conduct household interviews in Gurué
- Complete report on PRA in Masaka
- Complete report on PRA in Gurué

Obj. 1c. Characterize farmers' agricultural motivations, knowledge, practices, problem diagnoses and solutions (lead researchers: M. Tenywa, O. Semalulu, R. Maria, C. Filimone, R. Chavana)
1c.1. Characterize farmers' motivations (also: P. Musaali, E. Luvaga)
1c.2. Characterize farmers' agronomic knowledge and practices (also: R. Yost, A. Lenssen)
1c.3. Characterize farmers' problem diagnoses and solutions (also: R. Yost, A. Lenssen)
Milestones
Apr. 2014–Sept. 2014

- Complete analysis of interview data in Masaka, identify gaps

<u>Objective 2:</u> *Develop and Refine Models about Smallholder Bean Farmers' Decision Making*

Collaborators

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Onesimus Semalulu, Soils and Agro-meteorology, o.semalulu@gmail.com

Approaches and Methods

Building on the information obtained through the PRAs, the baseline household survey of practices and conditions will provide a detailed community-wide profile regarding farmers' practices of field selection and preparation, crop and variety selection, planting methods and spacing, use of various types of inputs, intercropping and rotation patterns, problem identification and management practices utilized by farmers to date, consumption, market sales, and storage. Responses of key informants and innovative farmers previously identified as part of Objective 1 will be contrasted with responses from the general farming community. Network analysis will be conducted to understand flows of key resources—information, production materials, labor, food, money, etc. These baseline data will serve as the reference point for monitoring changes in knowledge, attitudes, practices and conditions over time.

Key social, cultural, economic, institutional and contextual factors that shape farmers' decision making—individually and collectively that will be analyzed include: gender and other roles (who makes which types of decisions); goals and priorities; criteria (factors considered and the relative importance of each); information base (nature, sources and credibility); resources required (and the social relationships and economic costs of accessing each); resource constraints (material, labor, etc.); risk assessment/tolerance; decision processes (timing, stages, sequencing); evaluation of experiences; and adjustments over time (responding to changes in both internal and external factors); group and network size and strength; collective action for enhancing access to vital resources; progress toward livelihood goals; and resilience. Institutional factors include culturally defined roles, community-based organizations, governance, and socioeconomic status (wealth, gender, ethnicity). These factors may influence current knowledge, attitudes, practices, and subsequently processes of information dissemination, training, utilization, and support to stimulate and sustain widespread implementation. Important outcomes from characterizing farmer decision-making processes in part comes from gaining insight into which households are more prone or able to make fundamental changes and why.

Obj. 2a. Characterize access to resources required for bean production (lead researchers: P. Musaali, R. Chavana)
2a.1. Analyze household survey data to describe resource base variation, characterize how access to key resources is obtained and negotiated, and describe the economic costs involved (also: C. Filimone, E. Luvaga)

2a.2. Interview farmers and key informants to explain criteria and process for land allocation and investments in farm inputs (also: R. Maria, M. Tenywa, O. Semalulu)
2a.3. Analyze household survey data to describe resource constraints (also: E. Luvaga, R. Mazur)
Milestones

Oct. 2013– Mar. 2014

- Interviews on land allocation and investments conducted
- Analysis of resource access and constraints

Apr. 2014–Sept. 2014

- Analysis of resource access and constraints

Obj. 2b. Characterize farmers' livelihood goals, resources, strategies and success through analysis of household survey data (lead researchers: R. Mazur, E. Luvaga, C. Filimone, R. Chavana, P. Musaali)

2b.1. Describe farmers' livelihood values, goals, and priorities
2b.2. Characterize their social networks, benefits derived, and risk management arrangements
2b.3. Describe sources, levels, and consistency of household income
2b.4. Analyze variations in household food security

Milestones
Oct. 2013– Mar. 2014

- Analysis of livelihoods

Apr. 2014–Sept. 2014

- Analysis of livelihoods

Obj. 2c. **Assess influence of institutional factors** (lead researchers: R. Maria, M. Tenywa, O. Semalulu)
2c.1. Identify farmer- and other community-based organizations (also: R. Chavana, P. Musaali)
2c.2. Identify nature of extension services (public and private) (also: C. Filimone)
Milestones
Oct. 2013– Mar. 2014

- Description of local organizations
- Description of extension services

Apr. 2014–Sept. 2014

- Description of local organizations
- Description of extension services

Objective 3: *Develop and Validate Diagnostic and Decision Support Aids*

Collaborators

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Russell Yost, Tropical Plant and Soil Sciences, rsyost@hawaii.edu

Approaches and Methods

To improve soil management decision making, diagnostic tools will be developed with and for farmers who have varying levels of education, based upon field-observable soil classification characteristics in diverse agro-ecologies in two target bean production regions in Uganda and Mozambique. Utilizing farmer experience and input from soil scientists and systems agronomists in the team who will draw from the global knowledge base of appropriate practices and technologies, soil and cropping systems management strategies and options appropriate for various smallholder farm systems will be identified.

Available soils maps developed by remote sensing technologies show that Gurué district has four predominant soil types, Ferralsols (Oxisols), Lixisols (Alfisols), Acrisols (Ultisols), and Nitosols-Luvisols (Ultisols and Alfisols). These soil orders vary widely in native fertility and bean production potential. Despite the lack of ground truthing during classification, reports are consistent that soil quality has suffered serious degradation. Shortened fallow periods, lack of fertilizer inputs, reduced organic matter concentration, and erosion from water have resulted in stagnant or decreased bean yields. Exactly which soil nutrients are inadequate for bean production has not been systematically addressed across a range of important soils. Additionally, because limestone was not available in either country, lime requirement for pH management is not known. Available aluminum (Al^{+3}) has not been determined in extensive areas. Where data are available, available P concentration usually is low in older, weathered soils typical of Uganda and Mozambique and other areas within SSA. The high concentrations of available Fe and Al in low pH soils rapidly complex available P, making it unavailable for uptake by plants, perhaps explaining in part why phosphorus fertilization does not always improve yield or N fixation by bean and other pulses.

To determine soil factors that limit bean productivity, a missing element study using bean and representative soils from each district studied will be conducted to determine nutrient deficiencies. This technique has been used successfully to identify the important soil factors that limit crop productivity in areas lacking substantial adequate databases on soil chemical and physical properties. Once chemical and physical constraints are identified, management strategies appropriate for smallholder farmers can be developed. Additionally, previously untested solution strategies can be tested on researcher-managed sites to determine validity of identified management strategies. Diagnostic aid development is in part based on results from the missing element studies. A key element in diagnostic aid development is the inclusion of farmers' input during all developmental phases, not just during testing.

Farmer assisted research studies will be conducted in each district comparing current farmer practices with practices developed by use of the diagnostic aid. Given inherent precipitation, soils, and other differences between Masaka and Gurué districts, we have the opportunity for a robust comparison of our overall methodology. Farmers will be surveyed annually after each cropping cycle to determine impact of diagnostic aids on bean productivity, soil quality, and potential for sustainable adoption.

An effective diagnostic aid provides implicit comparisons of what if scenarios. Highly observable characteristics are compared, often in a dichotomous series. These decision support aids will provide farmers with information on improved practices to achieve particular objectives, and enable farmers to weigh trade-offs between alternative approaches or practices. We anticipate that our diagnostic aid will rely in part on comparisons of plant growth and development, dry matter accumulation, and color of bean plants grown in the representative soils under different nutrient or management levels. Initially, images will be available from the nutrient omission and lime requirement studies, but in subsequent years, images will be available from innovative farmer fields where the aid was used, providing direct comparison of bean growth, development, and yield between management systems used with and without the aid. Additionally, comparisons can be done between innovative farmers and a control (not selected) farmer group where diagnostic aids were not used as a second level of comparison.

Actual data collected from the farmer assisted research include initial, annual, and final key soil chemical and physical properties. Initial properties determined typically will be those documented in the nutrient omission study in impact bean growth and development. Bean stand density, yield, yield components (pods/m^2, seed/pod, seed weight), seed protein and germination percentage are determined in fields under both management systems and for the non-selected farmer control group. Statistical analyses used with data from the farmer assisted research will include paired-T tests within selected farmer groups, and analysis of variance with appropriate mixed models, and nonparametric tests, depending on specific parameter. Based upon insights gained from socioeconomic research on farmer decision making, integrated soil and crop management decision tools appropriate for varying levels of formal education will be developed and tested in various contexts and evaluated for their effectiveness over multiple years. For sustained utilization, we must ensure that the tools are useful and accessible to diverse populations (low education/literacy, socioeconomic characteristics, etc.). This is accomplished in part by including an array of relevant stakeholders, including smallholder farmers.

Obj. 3a. *Determine soil fertility constraints for improved bean production among selected farmers/sites*
(lead researchers: M. Tenywa, O. Semalulu, R. Maria, M. Amane, R. Yost, A. Lenssen)
3a.1. Collect representative soil samples from selected farmers' fields
3a.2. Analyze physical and chemical characteristics of soil samples
3a.3. Initiate nutrient omission study
3a.4. Initiate lime requirement study (in Uganda)

3a.5. Complete characterization of representative soil samples
3a.6. Complete report on nutrient omission study

Milestones
Oct. 2013–Mar. 2014

- Collect soil samples in Masaka
- Analyze soil samples from Masaka
- Conduct nutrient omission study in Uganda
- Conduct lime requirement study in Uganda

Apr. 2014–Sept. 2014

- Analyze soil samples from Masaka
- Conduct nutrient omission study in Uganda
- Collect soil samples in Gurué
- Analyze soil samples from Gurué
- Initiate nutrient omission study in Gurué

Obj. 3b. Develop diagnostic aids (lead researchers: M. Tenywa, O. Semalulu, R. Maria, M. Amane, R. Yost, A. Lenssen)
3b.1. Compile current diagnostic criteria used by farmers
Milestones
Oct. 2013– Mar. 2014

- Determine diagnostic criteria used by farmers in Masaka

Apr. 2014–Sept. 2014

- Determine diagnostic criteria used by farmers in Gurué
- Synthesis developed of current state of farmer knowledge for soil fertility, agronomic practices, pests, diseases, and known limiting factors for bean production in Masaka and Gurué

Objective 4: *Develop and Assess Effectiveness of Innovative Approaches for Dissemination of Information and Decision Support Aids, Training, and Follow-up Technical Support*

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Approaches and Methods
The project will engage the core groups of farmers, women and men, in developing and testing innovative communications approaches and technologies for learning and sharing information about new options for sustainable improvement in increased yields and soil fertility. Given limited extension system resources in Uganda and Mozambique, horizontal peer-to-peer learning (field days, exchange visits, local community based organizations) and network dissemination will be important initial methods. To benefit those with low literacy skills, especially women, communication approaches and technologies that may be used include: print materials, participatory radio campaigns in local languages, portable and multifunctional MP3 recorder radios that can record and replay broadcasts, text and audio SMS messaging, on-air call-outs to farmers and to experts, smart phones, and visual decision aids, including farmer recorded videos and animated videos (Scientific Animations Without Borders).

Dissemination, training and support will target priority decision-making points for individuals and groups. Horizontal farmer to farmer learning has been found to be preferred by many communities. Optimum levels of training and follow-up support will be determined to identify efficient use of resources (extension personnel, material, financial); this will facilitate development projects being able to utilize our research results for scaling up and achieving widespread impact. Emphasis in each country will be placed on utilizing communication approaches/technologies that maximize available and sustainable resources.

Monitoring and evaluating the impacts of project activities will involve collecting and analyzing baseline data, periodic monitoring of indicators, and time-lag evaluation. Methods for documenting outcomes in terms of increased productivity will involve one-time and some repeated measures using mobile phone-based surveys and other locally effective methods.
Obj. 4a. Assess existing information dissemination systems concerning bean production and soil fertility(lead researchers: P. Musaali, C. Filimone, S. Mocubme, E. Abbott, J. Bello-Bravo)
4a.1. Examine previous studies/projects on dissemination of information to farmers; build inventory of institutions, providers, and messages; examine past sustainability factors for disseminating information (also: M. Tenywa)

4a.2. Identify and interview current agricultural information providers (extension, research, NGOs, farmer associations, etc.)
4a.3. Identify channels used and potential additional channels to reach farmers with information; assess effectiveness, cost, and reach of each
4a.4. Review PRA and survey data to assess and rank types of information that influence farmers' decisions (also: R. Chavana)
4a.5. Map current information development and delivery systems
Milestones
Apr. 2013–Sept. 2013

- Review literature on bean production information dissemination systems

Oct. 2013– Mar. 2014

- Interview agricultural information providers
- Determine coverage and effectiveness of current information dissemination systems

Apr. 2014–Sept. 2014

- Determine relative importance of information dissemination systems that influence farmers

<u>Obj. 4b.</u> Work with existing institutions and organizations to identify and develop messages that would provide farmers with critical information to make decisions about beans and soil fertility, and pathways that could provide information in an effective, efficient, and sustainable manner (lead researchers: P. Musaali, C. Filimone, S. Mocubme, E. Abbott, J. Bello-Bravo, B. Pittendrigh)

<u>4b.1.</u> Convene collaborative workshop with agricultural scientists, extensionists, staff from local projects, NGOs, and farmers (also M. Tenywa, O. Semalulu, R. Maria)
<u>4b.2.</u> Develop and field test prototype messages
<u>4b.3.</u> Develop feedback system to enable farmers and farm groups to communicate to providers their needs, problems, and priorities
Milestones
Apr. 2014–Sept. 2014

- Conduct collaborative workshop
- Develop and test prototype messages
- Design farmer feedback system

<u>Objective 5:</u> *Enhance Institutional Research Capacity Relative to Grain Legumes*

Collaborators
Institute for Agricultural Research of Mozambique (IIAM– Maputo, Mozambique)
Manuel Amane, Agronomy and Natural Resources, mivamane@gmail.com
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Iowa State University (ISU– Ames, Iowa)
Eric Abbott, Greenlee School of Journalism, eabbott@iastate.edu
Andrew Lenssen, Agronomy, alenssen@iastate.edu
Ebby Luvaga, Economics, luvaga@iastate.edu
Robert Mazur, Sociology, rmazur@iastate.edu
Makerere University (MAK– Kampala, Uganda)
Moses Tenywa, Agricultural Production, tenywam@agric.mak.ac.ug
Paul Musaali, Geography, Geoinformatics and Climate Sciences, muspal@arts.mak.ac.ug
National Agricultural Research Laboratories Institute (NARL– Kampala, Uganda)
Onesimus Semalulu, Soils and Agro-meteorology, o.semalulu@gmail.com
University of Hawaii (UH– Manoa, Hawaii)
Russell Yost, Tropical Plant and Soil Sciences, rsyost@hawaii.edu
University of Illinois (UIUC– Urbana-Champaign, Illinois)
Julia Bella-Bravo, Strategic International Partnerships, juliabb@illinois.edu
Barry Pittendrigh, Entomology pittendr@illinois.edu

Approaches and Methods
A key element in building institutional research capacity to increase effectiveness and sustainability of agricultural research institutions that serve the bean sector in Uganda and Mozambique is to provide graduate student training. Our project will be training three graduate

students in academic program in U.S. institutions and in research activities in host countries. Specific research foci and affiliations follow:

- one M.S. student from Uganda will study Sustainable Agriculture at Iowa State University and conduct research on agronomic and livelihood aspects of smallholder farmer decision making
- one Ph.D. student from Mozambique will study soils/crops at the University of Hawaii and conduct research on management influences on soil C and N pools
- one M.S. student from Mozambique will study Communication at Iowa State University and conduct research on innovative socio-technical approaches for dissemination of information and decision support aids

One M.S. student studying Agronomy at Iowa State University will conduct M.S. thesis field research in Uganda as part of this project. The student receives stipend and tuition scholarship from ISU, not this project. The student's research will test the management strategies developed from Objectives 1, 2, and 3 in replicated, researcher-managed studies, complimenting the FAR. Three graduate students will receive training at Makerere University in M.S. programs that contribute directly to project objectives:

- one student will study soils/crops and conduct research on limiting nutrients (omission of elements) and lime requirements
- one student will study geography at Makerere University and conduct research on socioeconomic factors influencing decision making in crop and soil fertility improvement
- one student will study soils/crops at Makerere University and conduct research on assessment of suitability of decision support aids for different soils

Each county will have one research technician who gains experience in multidisciplinary research activities and specific skills in preparing and analyzing soil and crop samples. Additionally, short-term training needed for project work will be identified once the project research activities are initiated. Training will be needed by B.S. level agricultural technicians in techniques and methods of acquiring, verifying, and recording social science information. Training will also be needed regarding concepts for characterization of highly weathered, possibly acid, infertile soils to identify, verify, and record observations, perceptions and data documenting these conditions during visits with growers and producers. Ability to recognize other constraints to productivity will be evaluated and specific training to document observations and measurements developed based on initial exploratory surveys.

Milestones

Apr. 2013–Sept. 2013

- Two students initiate graduate studies

Oct. 2013– Mar. 2014

- Three additional students initiate graduate studies programs

Apr. 2014–Sept. 2014

- Five students continue graduate programs

Contribution of Project to USAID Feed the Future Performance Indicators

(Performance Indicators / Targets Spreadsheet for FY 2013, 2014 and 2015 = attached)

Outputs

Project activities are expected to produce the following outputs:

- Characterization of smallholder bean farmers' agricultural motivations, current knowledge and practices, problem diagnoses, and livelihood and risk management strategies (by 2015)
- Models of farmer decision making strategies that reflect Influences of social, cultural, economic, institutional and contextual factors are developed and refined (by 2016)
- Innovative diagnostic aids using observable characteristics that enable farmers to make site-specific management decisions are developed and validated (by 2016)
- Process for identifying alternative strategies and management practices for improving cropping system productivity and soil fertility is developed (by 2017)
- Effective and efficient methods and media for information dissemination to intermediate and end users are developed and assessed (by 2017)
- Capacity building through applied research-based training is conducted (2013 onwards)
- Research results published in peer-reviewed literature and at the Legume Innovation Lab website hosted by the Management Office at Michigan State University (2015 onwards)

The project's *Impact Pathway Worksheet* provides details of outputs, uses, and steps to achieving our vision of success.

Engagement of USAID Field Mission(s)

In Mozambique, project PIs from U.S. and Ugandan universities and from IIAM met with the USAID Mission Director and Feed the Future staff on May 29th in Maputo. This provided a tremendous opportunity for sharing information about USAID programs in Mozambique and the Legume Innovation Lab program. In-depth discussion of our project and the expertise of research team members revealed several key points of significant interest for Mission staff. These included soil test kits, animated videos about management practices, and use of agricultural technologies. In Uganda, the project Lead PI has met regularly since 2004 with USAID Mission agricultural development staff, and will continue to do so during future travel there to communicate the focus and approach of project activities and explore bases for collaboration. Once the Project Technical Description is finalized and approved by the Technical Management Advisory Committee, it will be shared with key staff in the Mission in Kampala. After communication is established with Mission staff regarding details of the project, the PI and Co-PIs will seek to establish ties with Mission development partners. We will be pleased to respond when the Missions express interest in an Associate Award that would enable us to provide technical assistance and access to grain legume technologies.

Partnering and Networking Activities

The project team will learn about relevant existing and emerging conservation agriculture approaches and technologies from WOCAT's global network of scientists, and explore opportunities to collaborate and coordinate research efforts with CGIAR scientists through CRP 3.5, the AGRA Soil Health Program, IFDC, CABI, McKnight Foundation which has programs with an integrated multi-functional intensification emphasis, Africa RISING which focuses on maize-legume based systems in the Eastern Highland of Africa, and the Bill and Melinda Gates Foundation. Project researchers will continue to explore bases for collaboration with two African based networks under PABRA (the Pan-African Bean Research Alliance): the Eastern and Central Africa Bean Research Network (ECABREN) and the Southern Africa Bean Research Network (SABRN).The project team, particularly collaborating research institutions in Uganda and Mozambique, will identify partnering and networking activities to ensure that appropriate public and private sector institutions can engage in follow-up adaptive research and field validation, in addition to technology transfer, in FTF countries and regions so that research outputs are disseminated on a wide scale for quantifiable developmental impact.

Leveraging of Legume Innovation Lab Resources
The project team will explore opportunities to collaborate and coordinate research efforts with CGIAR scientists through CRP 3.5, the AGRA Soil Health Program, IFDC, McKnight Foundation, Africa RISING, and the Bill and Melinda Gates Foundation. We will identify how such opportunities would complement and coordinate with planned activities described in this Workplan of the Legume Innovation Lab project.

Timeline for Achievement of Milestones of Technical Progress
(*Milestones of Progress* = attached)

Training/Capacity Building Workplan for FY 2013– 2014
Degree Training
Trainee #1
First and Other Given Names: Naboth
Last Name: Bwambale
Citizenship: Uganda
Gender: Male
Training Institution: Iowa State University
Supervising Legume Innovation Lab PI: Robert Mazur
Degree Program for training: M.S.
Program Areas or Discipline: Graduate Program in Sustainable Agriculture
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: Makerere University
Thesis Title/Research Area: agronomic and livelihood aspects of smallholder farmer decision making
Start Date: August 2013
Projected Completion Date: December 2015
Training status: (active, completed, pending, discontinued or delayed): Active
Type of USG Support (full, partial or indirect) for training activity: Full

Trainee #2
First and Other Given Names: *to be determined*
Last Name: to be determined
Citizenship: Uganda
Gender: to be determined
Training institution: Makerere University
Supervising Legume Innovation Lab PI: Moses Tenywa
Degree Program for training: M.S.

Program Areas or Discipline: Soil Science and Crop Production
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID?
Host Country Institution to Benefit from Training: Makerere University
Thesis Title/Research Area: limiting nutrients (omission of elements) and lime requirements
Start Date: August 2013
Projected Completion Date: August 2015
Training status: (active, completed, pending, discontinued or delayed): Pending
Type of USG Support (full, partial or indirect) for training activity: Partial

Trainee #3
First and Other Given Names: António José
Last Name: Rocha
Citizenship: Mozambique
Gender: Male
Training institution: University of Hawaii– Manoa
Supervising Legume Innovation Lab PI: Russell Yost
Degree Program for training: Ph.D.
Program Areas or Discipline: Agronomy and Tropical Soils
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: Institute of Agricultural Research of Mozambique (IIAM)
Thesis Title/Research Area: management influences on soil C and N pools
Start Date: January 2014
Projected Completion Date: September 2017
Training status: (active, completed, pending, discontinued or delayed): Pending
Type of USG Support (full, partial or indirect) for training activity: Full

Trainee #4
First and Other Given Names: Sostino
Last Name: Mocumbe
Citizenship: Mozambique
Gender: Male
Training institution: Iowa State University
Supervising Legume Innovation Lab PI: Eric Abbott
Degree Program for training: M.S.
Program Areas or Discipline: Communications
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? Yes
Host Country Institution to Benefit from Training: Institute of Agricultural Research of Mozambique (IIAM)
Thesis Title/Research Area: approaches for dissemination of information and decision support aids
Start Date: January 2014
Projected Completion Date: August 2016
Training status: (active, completed, pending, discontinued or delayed): Pending
Type of USG Support (full, partial or indirect): Full

Trainee #5
First and Other Given Names: Lance
Last Name: Goettsch
Citizenship: United States
Gender: Male
Training institution: Iowa State University
Supervising Legume Innovation Lab PI: Andrew Lenssen
Degree Program for training: M.S.
Program Areas or Discipline: Agronomy
Host Country Institution to Benefit from Training: Makerere University
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Thesis Title/Research Area: management strategies to enhance bean productivity and soil fertility
Start Date: August 2014
Projected Completion Date: December 2016
Training status: (active, completed, pending, discontinued or delayed): Active
Type of USG Support (full, partial or indirect): Partial

Trainee #6
First and Other Given Names: *to be determined*
Last Name: to be determined
Citizenship: Uganda
Gender: to be determined
University to provide training: Makerere University
Supervising Legume Innovation Lab PI: Paul Musaali
Degree Program for training: M.S.
Program Areas or Discipline: Geography
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID?
Host Country Institution to Benefit from Training: Makerere University
Thesis Title/Research Area: factors influencing decision making in crop and soil fertility improvement
Start Date: January 2014
Projected Completion Date: August 2016
Training status: (active, completed, pending, discontinued or delayed): Pending
Type of USG Support (full, partial or indirect): Partial

Trainee #7
First and Other Given Names: *to be determined*
Last Name: to be determined
Citizenship: Uganda
Gender: to be determined
Training institution: Makerere University
Supervising Legume Innovation Lab PI: Moses Tenywaand Onesimus Semalulu
Degree Program for training: M.S.
Program Areas or Discipline: Soil Science and Crop Production
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID?

Host Country Institution to Benefit from Training: National Agricultural Research Laboratories Institute
Thesis Title/Research Area: assessment of suitability of decision support aids for different soils
Start Date: January 2015
Projected Completion Date: August 2017
Training status: (active, completed, pending, discontinued or delayed): Pending
Type of USG Support (full, partial or indirect): Partial

Equipment (costing >$5,000)
Specific Type of Equipment to be purchased: four-wheel drive vehicle
Justification for equipment to achieve Workplan objectives: logistics for fieldwork in Gurué, Zambézia province, throughout the year, especially during the growing season (four-month period of intense rains)
Institution to benefit from equipment:Institute of Agriculture Research of Mozambique
Institution to purchase equipment:Institute of Agriculture Research of Mozambique
Amount budgeted for equipment item: $45,000

Performance Indicators for FY 13-FY14
Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize–Bean Production Systems (SO2.1)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 13 (Second Semester only), FY 14, and FY 15

Project Name: **Farmer Decision Making Strategies for Improved Soil Fertility Management in in Maize-Bean Production Systems**

Summary of all institutions

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	2	0	0	5	0	0	6	0	0
	Number of women	0	0	0	1	0	0	1	0	0
	Number of men	2	0	0	4	0	0	5	0	0
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	0	0	0	7	0	0	7	0	0
	Number of women	0	0	0	2	0	0	2	0	0
	Number of men	0	0	0	5	0	0	5	0	0
	Numbers by Type of individual									
	Producers	0	0	0	0	0	0	0	0	0
	People in government	0	0	0	7	0	0	7	0	0
	People in private sector firms	0	0	0	0	0	0	0	0	0
	People in civil society	0	0	0	0	0	0	0	0	0
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0
	Gendered Household Type									
	Adult Female no Adult Male (FNM)	0	0	0	4	0	0	4	0	0
	Adult Male no Adult Female (MNF)	0	0	0	2	0	0	2	0	0
	Male and Female Adults (M&F)	0	0	0	30	0	0	30	0	0
	Child No Adults (CNA)	0	0	0	0	0	0	0	0	0
4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization									
	Private enterprises (for profit)	0	0	0	0	0	0	0	0	0
	Producers organizations	0	0	0	0	0	0	0	0	0
	Water users associations	0	0	0	0	0	0	0	0	0
	Women's groups	0	0	0	0	0	0	0	0	0
	Trade and business associations	0	0	0	0	0	0	0	0	0
	Community-based organizations (CBOs)	0	0	0	0	0	0	0	0	0
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0

5	4.5.2(12) Number of public-private partnerships formed as a result of USG assistance									
	Number by type of partnership (total)	0	0	0	0	0	0	0	0	0
	Agricultural production	0	0	0	0	0	0	0	0	0
	Agricultural post harvest transformation	0	0	0	0	0	0	0	0	0
	Nutrition	0	0	0	0	0	0	0	0	0
	Multi-focus	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	0	0	0	9	0	0	9	0	0
	crop genetics	0	0	0	0	0	0	0	0	0
	animal genetics	0	0	0	0	0	0	0	0	0
	pest management	0	0	0	0	0	0	0	0	0
	disease management	0	0	0	0	0	0	0	0	0
	soil-related	0	0	0	**9**	0	0	**9**	0	0
	irrigation	0	0	0	0	0	0	0	0	0
	water management	0	0	0	0	0	0	0	0	0
	post-harvest handling and storage	0	0	0	0	0	0	0	0	0
	processing	0	0	0	0	0	0	0	0	0
	climate mitigation or adaptation	0	0	0	0	0	0	0	0	0
	fishing gear/technique	0	0	0	0	0	0	0	0	0
	other	0	0	0	0	0	0	0	0	0
	total w/one or more improved technology	0	0	0	0	0	0	0	0	0
	New/Continuing hectares									
	New	0	0	0	**9**	0	0	**9**	0	0
	Continuing	0	0	0	0	0	0	0	0	0
	Sex of person managing hectare									
	Male	0	0	0	**4**	0	0	**4**	0	0
	Female	0	0	0	**5**	0	0	**5**	0	0
	Association-applied	0	0	0	0	0	0	0	0	0
7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	0	0	0	2	0	0	2	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	0	0	0	**2**	0	0	**2**	0	0
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	0	0	0	0	0	0	0	0	0
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	0	0	0	0	0	0	0	0	0

8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs	0	0	0	0	0	0	0	0	0
	Outputs	0	0	0	0	0	0	0	0	0
	Macroeconomic	0	0	0	0	0	0	0	0	0
	Agricultural sector-wide	0	0	0	0	0	0	0	0	0
	Research, extension, information, and other public service	0	0	0	0	0	0	0	0	0
	Food security/vulnerable	0	0	0	0	0	0	0	0	0
	Climate change adaptation or natural resource management (NRM) (ag-related)	0	0	0	0	0	0	0	0	0
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	0	0	0	0	0	0	0	0	0
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	0	0	0	0	0	0	0	0	0
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0	0	0	0	0	0	0	0	0
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0	0	0	0	0	0	0	0	0
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0	0	0	0	0	0	0	0	0

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13-FY14

Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize–Bean Production Systems (SO2.1)

Legume Innovation Lab Project : BUDGET SUMMARY

ON SUMMARY PAGE TYPE PROJECT NAME HERE

	4/1/13 - 09/30/17					
	FY 13	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
a. Personnel Cost						
Salaries	$142.00	$85,926.00	$118,507.00	$104,788.00	$81,936.00	$391,299.00
Fringe Benefit	$7.00	$13,645.00	$15,578.00	$13,938.00	$11,488.00	$54,656.00
b. Travel	$30,087.00	$115,760.00	$131,811.00	$120,391.00	$116,760.00	$514,809.00
c. Equipment ($5000 Plus)	$0.00	$45,000.00	$0.00	$0.00	$0.00	$45,000.00
d. Supplies	$0.00	$82,700.00	$78,019.00	$76,099.00	$65,490.50	$302,308.50
e. Training						
Degree	$0.00	$9,048.00	$14,626.00	$9,679.00	$2,141.00	$35,494.00
Non-Degree	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
f. Other	$170.00	$15,900.00	$14,994.00	$14,988.00	$18,007.00	$64,059.00
g. Total Direct Cost	**$30,406.00**	**$367,979.00**	**$373,535.00**	**$339,883.00**	**$295,822.50**	**$1,407,625.50**
h. Indirect Cost	$7,906.00	$61,262.36	$70,105.64	$65,490.30	$55,109.44	$259,873.74
i. Indirect Cost on Subcontracts (First $25000)	$0.00	$30,772.00	$1,728.00	$0.00	$0.00	$32,500.00
j. Total Indirect Cost	$7,906.00	$92,034.36	$71,833.64	$65,490.30	$55,109.44	$292,373.74
Total	**$38,312.00**	**$460,013.36**	**$445,368.64**	**$405,373.30**	**$350,931.94**	**$1,699,999.24**
Grand Total	**$1,699,999.24**					

Cost Share	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
In-kind	$8,792.00	$31,165.00	$31,433.00	$32,401.00	$33,642.00	$137,433.00
Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$ 8,792.00	$ 31,165.00	$ 31,433.00	$ 32,401.00	$ 33,642.00	$ 137,433.00

Attribution to Capacity Building						
Percentage of effort	0.00%	32.39%	44.95%	39.31%	32.18%	36.65%
Amount corresponding to effort	$0.00	$119,191.00	$167,899.00	$133,593.00	$95,187.50	$515,870.50

Milestones for FY 13-FY14

Farmer Decision Making Strategies for Improved Soil Fertility Management in Maize–Bean Production Systems (SO2.1)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

Research, Training and Outreach Workplans

(April 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

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

Provide abbreviated name of institutions in columns below. Start with the U.S. institution.

Identify Milestones by Objectives	Iowa State University			University of Hawaii			University of Illinois			Makerere University			Nat'l Ag. Res. Lab - Ug.			Inst. Ag. Res. - Moz.		
	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14	10/1/13	4/1/14	10/1/14
	(Tick mark the time period for achieving identified milestones by institution)																	
Objective 1:	**Characterize Smallholder Farmers' Motivations, Current Knowledge and Practices**																	
1.1 Initiate reviews of lit. & practices	X			X						X			X			X		
1.2 Identify knowledge gaps		X			X						X			X			X	
1.3 Conduct PRA, select farmers Masaka		X			X			X			X			X				
1.4 HH Interviews conducted in Masaka		X			X			X			X			X				
1.5 Conduct PRA, select farmers Gurué			X			X			X									X
1.6 HH Interviews conducted in Gurué			X			X			X									X
1.7 Report on PRA in Masaka			X			X			X			X			X			
1.8 Report on PRA in Gurué			X			X			X									X
1.9 Report on interviews in Masaka			X			X			X			X			X			
Objective 2:	**Develop and Refine Models about Smallholder Bean Farmers' Decision Making**																	
2.1 Interviews on land & investments		X									X						X	
2.2 Analyze resource access/constraints		X	X								X	X					X	X
2.3 Analyze livelihoods & goals		X	X								X	X					X	X
2.4 Description of extension services											X	X					X	X
2.5 Description of local organizations											X	X					X	X

Objective 3:	**Develop and Validate Diagnostic and Decision Support Aids**																	
3.1 Collect soil samples from Masaka										X			X					
3.2 Analyze soil samples from Masaka		X	X		X	X					X	X		X	X			
3.3 Conduct nutrient omission study UGA		X	X		X	X					X	X		X	X			
3.4 Conduct lime requirement study UGA		X	X		X	X					X	X		X	X			
3.5 Collect soil samples in Gurue																		X
3.6 Analyze soil samples from Gurue			X			X												X
3.7 Nutrient omission study Gurue			X			X												X
3.8 Determine farmer diagnost. criteria Ug		X			X						X			X				
3.9 Determine farmer diagnost. criteria Moz			X			X						X						
3.10 Synthesis farmer ag. knowledge Ug			X			X						X			X			
3.11 Synthesis farmer ag. knowledge Moz			X			X												X
Objective 4:	**Develop and Assess Effectiveness of Innovative Approaches for Dissemination**																	
4.1 Conduct lit. rev. info dissem. systems	X						X			X						X		
4.2 Interview information providers		X						X			X						X	
4.3 Determine effectiveness info systems		X						X			X						X	
4.4 Determine importance info. systems			X						X			X						X
4.5 Conduct info. practitioner workshop			X						X			X						X
4.6 Develop and test messages			X						X			X						X
4.7 Design farmer feedback system			X						X			X						X
Objective 5:	**Enhance Institutional Research Capacity Relative to Grain Legumes**																	
5.1 Two students start graduate studies	X									X								
5.2 Three students start graduate studies		X			X						X							
5.3 Students continue graduate studies		X	X		X	X					X	X						
Name of the PI responsible for reporting on milestones	Robert Mazur			Russell Yost			Barry Pittendrigh			Moses Tenywa			Onesimus Semalulu			Ricardo Maria		
Signature/Initials:																		
Date:																		

Enhancing Pulse Value-Chain Performance through Improved Understanding of Consumer Behavior and Decision-Making (SO2.2)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
Vincent Amanor-Boadu, Kansas State University

Collaborating Host Country and U.S. PIs and Institutions
Gelson Tembo, University of Zambia
Lawrence Mapemba, Lilongwe University of Agriculture and Natural Resources, Malawi
Fredy Kilima, Sokoine University of Agriculture, Tanzania
Allen Featherstone, Kansas State University
Kara Ross, Kansas State University

Project Problem Statement and Justification
Unlike maize, grain legumes (focusing on beans and cowpeas) are not traditional staples in Zambia, Malawi and Tanzania. Thus, increased consumption to support smallholder producer economic wellbeing must be based on clear appreciation of food choices' decision-making processes. The trend in average per capita consumption of grain legumes is declining in Tanzania, flat in Malawi and increasing in Zambia. However, the relative share of grain legumes in Zambian food baskets is very small and not high enough in Malawi. Yet, the nutritional benefits of grain legumes are well-known. Furthermore, the regional trade opportunities for these crops is high given that the region is a net importer of grain legumes from outside the region (CGIAR, 2012).The opportunity for domestic consumption and trade both promise potential economic improvement for smallholder producers. But achieving this requires a careful understanding of how consumer characteristics and food attribute-level combinations shape that consumers' decisions and choices.

The fundamental problem of this project, therefore, is to develop new understanding of the forces and factors shaping and influencing consumers' food choice decisions in eastern and southern Africa and use this understanding to facilitate improvements in legume value chains. The project has three integrated dimensions. First, it develops an empirical foundation for understanding the factors and the extent that these factors influence food choices. This will be the first empirical evaluation of the complex factors influencing consumer choice of grain legumes in eastern and southern Africa. The research then employs the results of the factors and their extent of shaping consumer choices to engage industry stakeholders (private businesses, non-governmental organizations, producers, traders, processors, etc.) and public institutions (research institutes, universities, extension, government, etc.) in a search for value creation and value expansion opportunities as well as solutions to challenges preventing value chain effectiveness. The third dimension involves using the information collected on industry capacity gaps to carefully develop and deliver training and outreach programs aimed at enhancing strategy development, management and decision-making. In the end, the project provides innovative and unique pathways that bring smallholder producers and the other stakeholders into specific value chain alliances to help smallholder producers improve their economic wellbeing.

The research's geographic scope covers Zambia, Malawi and Tanzania, all Feed the Future focus countries. These countries represent the different changes that are occurring in eastern and southern Africa: increasing urbanization; economic growth and increasing but unequally distributed incomes; and changing demographics, including in agricultural production. This research's findings will provide insights into how and where these changes are affecting legume consumption. They will provide insights into how to overcome domestic consumption barriers and build stronger value chains to seize new markets, including the $50 billion per annum staple foods' regional trade in eastern and southern Africa (Feed the Future).These improvements should contribute directly to the solutions to age-old challenges facing smallholder producers.

Planned Project Activities for the Workplan Period (April 1, 2013–September 30, 2014)
The research team convened in Lusaka, Zambia from May 24-31 to plan the activities laid out in this plan period. The outcome of that planning process is the project proposal as well as the development of a stronger relationship among the research team.

In the work plan period starting April 1, 2013 to September 30, 2014, we envisage completing the survey work in Zambia and producing the report of the analysis. This deliberate process of completing the survey work in Zambia is to allow for the incorporation of lessons from that activity in the execution of the activities in Tanzania and Malawi, which will run concurrently from October 2014 to June 2015. This is a result of an agreement reached among the research team to minimize errors and risks working across three countries by working out all the bugs in one country before proceeding to the other countries.

The table below identifies the specific tasks and their time lines as well as the team members who have the primary responsibility or oversight responsibility for delivering the requisite results. The table shows the components of the different objectives that are scheduled to be completed in this reporting period. The second column indicates the objective to which the task is related. The first three rows labelled "A" are related to the planning and preparation for undertaking the tasks associated with this project.

The host country production situation analyses as defined under Objective 2 are led in each country by the HC PI with direct support from the U.S. PIs in terms of supporting and helping with modeling and writing in order to achieve the timely delivery of the reports. Objective 3 activities that would be commenced in this reporting period include recruiting students for both the HC MS programs and the MAB program. The staggered nature of the recruitment as well as ensuring that HC PIs are not overwhelmed by supervisory responsibilities support the performance and reporting process. Therefore, it is expected that by the end of September 30, 2014, we would have two MS students at each institution and two industry professionals enrolled in the MAB program.[1]We also anticipate having started the train-the-trainer programs to help expand our outreach initiatives in the development of effective governance mechanisms to unlock value in this industry. We also envisage having started building/facilitating new governance systems in the industry in Zambia through our industry short courses

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1 Nyumbani Moyo and Timothy Sichilima are scheduled to join the program at LUANAR as soon as funds become available. The former is a Malawian and the latter Zambian and they will be co-supervised by Dr. Lawrence Mapemba and Dr. Gelson Tembo.

Task		Start	End	Responsibility
Team building and project planning meeting	A	May-13	May-13	Research Team, Amanor-Boadu leading
Team capacity development	A	Jun-13	Dec-13	Amanor-Boadu leading with Research Team support
Case-based workshop on DCE	A	Jan-14	Jan-4	U.S. PIs (Amanor-Boadu & Ross lead)
Develop survey instrument	1	Jan-14	Jan-14	Research Team with Amanor-Boadu leading
Test & refine the instrument	1	Jan-14	Jan-14	Research Team with Amanor-Boadu leading
Conduct survey in Zambia	1	Jan-14	Mar-14	Research Team with Tembo, Amanor-Boadu & Ross leading
Analyze Zambian survey data	1	Apr-14	Jun-14	Tembo, Amanor-Boadu & Ross with Research Team Support
Produce report for Zambia	1	Jul-14	Sep-14	Tembo, Amanor-Boadu & Ross with Research Team support
Primary production situation analysis in Zambia, Malawi and Tanzania using secondary data	2	Oct-13	Dec-14	Research Team with HC PIs in lead in their countries and Amanor-Boadu coordinating
Degree Programs (MS, MAB)	3	Jan-14	Sep-17	HC PIs with Amanor-Boadu support
Conduct train-the-trainer sessions in all countries	3	Apr-14	Jun-17	U.S. PIs with HC PI support
Facilitate of governance systems in all countries	3	May-14	Sep-17	U.S. PIs with HC PI support

Collaborators
Mr. Chance Kabeghe, IAPRI, Zambia {Policy Advocate}
Mr. Simon Mwale, CCARDESA, Botswana {Policy Advocate}
Ms. Grace Mijiga Mhango, Grain Traders and Processors Association, Malawi {Private Sector}
Dr. Kennedy Muimui, ZARI, Zambia {Breeder}
Dr. Susan Nchimbi-Msola, SUA, Tanzania {Breeder}
Dr. Rowland Chirwa, CIAT, Malawi {Breeder}
Others in the CIAT/PBRA/SABRN research community

We are still working on recruiting other private sector participants to engage them more intensely in the project over the course of our activities.

Approaches and Methods for Objective 1and Objective 2
Objective 1 employs a Discrete Choice Experiment method to compete Objective 1.This method is superior to others (such as conjoint analysis) in that it is rooted in stated preference theory,

which has its foundation in random utility theory. Additionally, statistical methods are employed to conduct the ranking of beans/cowpeas in consumers' food baskets in Zambia.

The DCE method has not been used by HC PIs before even though they are all extremely well-verse in econometrics. Therefore, we intend to do capacity building in this area by conducting training on DCE in Zambia. The training session will be open to faculty members of the University of Zambia and staff of our partner institutions who are interested to participate.

Two groups of variables are included in the experiment (1) The different product attributes (availability, accessibility, perceived nutritional characteristics (fiber, protein, etc.), preparation time and preparation options, color, storage characteristics, taste and size as well as prices); (2) Consumer characteristics (including frequency of consumption, quantities consumed and expenditure shares) and preference influencers (cultural, and biologic ecologic variables) (after Parraga, 1990).Its unique theoretical strength is that the choice set always includes at least one feasible alternative.

Because there is random component in random utility theory, preferences are inherently stochastic. Therefore, the foregoing analytical approach facilitates only the prediction of the probability that an individual *i* will choose beans/cowpeas. The approach, thus, leads to the development of a family of probabilistic discreet choice models that describe how probabilities respond to changes in the choice options (attributes) and/or the covariates representing differences in individual consumers. Therefore, the probability (ρ) that individual *i* chooses option j from her set of competing options, C_i, equals the probability that systematic (V) and random (ε) components of option j are larger than the systematic and random components of all other options competing with j. That is:

$$\rho(j|C_i) = \rho[(V_{ji} + \varepsilon_{ji}) > \max(V_{ki} + \varepsilon_{ki})] \quad \forall \text{ j, k} \in \{C_i\} \qquad (1)$$

The systematic components include attributes explaining differences in the choice alternatives and covariates explain differences across individuals. The random components, a fundamental aspect of the model's authenticity, capture all the unidentified factors that influence choices. Together, they define the latent utility, u_{ji}, individuals associate with each alternative as follows:

$$u_{ji} = V_{ji} + \varepsilon_{ji} \qquad (2)$$

The approach, thus, provides an opportunity to provide empirical foundations for both business strategy and public policies once the desired objectives are stated. The results also provide empirical information for breeders to determine the characteristics and attribute sets of existing technologies that can be brought to market or what needs to be developed for specific markets and consumer profiles.

Objective 2 employs econometric analyses on secondary data collected by various institutions in the partner countries to develop a deeper appreciation of the grain legume production environment, including the gender issues underscoring the environment. In Zambia, we are using the Food Security Research Project and the Central Statistics Office of Zambia's data (2008) to explore the latest situation regarding grain legume production. In Malawi and Tanzania, we use the data from the Third Integrated Household Survey (2010/2011) and the World Bank's National Panel Survey (2010/2011) respectively to develop insights into factors that are influencing consumption of particular foods as well as production of grain legumes vis-à-vis other crops. There are a number of specific questions that we seek answers to:

- What is the relative position of grain legumes in producers' production portfolios in the different countries?
- To what extent are females engaged in grain legume production in the focus countries?
- What is the extent of market participation among grain legume producers in the different countries and how do females compare to males in market participation?
- What is the relative position of grain legumes in consumers' food choices in Malawi and Tanzania (because we have the secondary data for these two countries)?

The results from the choice experiments and the situation analyses would feed into the industry focus group that will be conducted in the next reporting period in all three countries to develop a full picture of the grain legume industry—producers, traders, processors, policy makers, supporters, consumers. This knowledge would help in identifying the outreach and intervention initiatives that may be implemented to enhance investments in the industry from breeders and producers to processors and the governments.

Contribution of Project to USAID Feed the Future Performance Indicators
Participants in the Discrete Choice Experiments will be provided training on the importance and role of grain legumes in diets with the help of a nutritionists from the Host Country institution's relevant department or its Ministry of Health. It is expected that participants in this capacity building exercise who are rural residents will count towards Indicator # 3 in the Performance Indicators Handbook. This is the only relevant indicator for this period.

Outputs
Three specific outputs will be completed this Work plan period:

- A reporting detailing the relative position of beans/cowpeas in consumers' food ranking in Zambia
- Report describing the factors that define consumption of beans/cowpeas in Zambia and the attendant response of consumption to changes in the various factors (elasticities)
- The draft of a policy brief report on addressing the bean/cowpea consumption challenge in Zambia and its potential implications for production and smallholder producer well-being. This draft policy document will be in circulation for comments by collaborators and other parties awaiting finalization and release by end of Q1-2015

Engagement of USAID Field Mission(s)
Our previous activities in Zambia have already provided us with some level of relationships with some of the Mission Staff. However, with the turnover that is the reality of the Missions, we have been lucky to have national staff who are already familiar with our work.

To this end, meetings have already been arranged with the USAID/Zambia Mission to inform them about this project and its expected outputs and impacts. During this meeting, PIs will also seek how the Mission's activities could be helped by the activities defined in this project.

Together, we intend to explore ways of leveraging our collective resources to enhance the effective impact of this project and those being undertaken by the Mission through associate awards or similar structures. Similar meetings are planned for Malawi and Tanzania.

Partnering and Networking Activities
There are three important partners who can carry the outputs from this stage of the work forward and the US PI is collaboration with the Zambia PI will passionately pursue the development and nurturing of their relationship with these partners:

- Researchers, such as Dr. Kennedy Muimui, who is collaborating with us on this project.(This relationship is anchored by our ongoing work with SABRN in Zambia).
- Policy advocacy institutes, IAPRI and CCARDESA
- Relationship with nutrition outreach specialists in Host Country Institutions and government agencies.

By engaging these organizations at this stage of the project, we ensure that they will support the development of sustained impact by:

1. Facilitating the wide distribution of the policy reports that emerge from this research
2. Facilitate the wide distribution of the research reports that are developed on the position of beans/cowpeas and the factors shaping decisions for these food products in Zambia
3. Find ways to incorporate the results into breeding and nutrition programs

Leveraging of CRSP Resources
The Gates Foundation is currently funding a capacity building initiative in the agri-food and agribusiness sector in Africa. The US Lead PI is an advisor to this initiative and will explore opportunities to leverage resources from this initiative to complement the development and capacity building efforts in later stages of this project. We will continue to explore other initiatives in other agencies of the US Government, private foundations, development partners and donor agencies working in the region whose vision are congruent with ours.

Timeline for Achievement of Milestones of Technical Progress
See Milestones for Technical Progress Worksheet.

Training/Capacity Building Workplan for FY 2013–2014
<u>Degree Training</u>
Recruitment in process. No data to report. However, it is expected that at least 50 percent of recruited students will be female. It is also expected that there will two MS students each in this reporting year in each of the Host Countries. They will be supervised by the respective HC PI and their program area of study will be agricultural economics or agribusiness. They will not be enrolled in US institution and their projected completion dates will be academic year 2015.The support provided will be partial of the total cost of their training cost.(As soon as data becomes available, this section of the work plan will be updated).

Short-term Training
Type of training: Workshop on Discrete Choice Experiments
Description of training activity: This is a program that is specifically developed for the HC PIs to enhance their capacity to use the primary tool for undertaking the analyses of Objective 1. It will, however be open to other interested parties from the university, including collaborating institutions, such as IAPRI, USAID Mission, UN Mission and WFP.
Location: University of Zambia, Lusaka
Duration: One Week
Date: January 6-12, 2014 (Specific dates to be determined)
Participants/Beneficiaries of Training Activity:
Anticipated numbers of Beneficiaries (male and female): 10 (seven Males and three Females)
PI/Collaborator responsible for this training activity: Vincent Amanor-Boadu
List other funding sources that will be sought (if any): None
Training justification: Research team needs to develop the skills in DCE to enable it perform its responsibilities under Objective 1.

Equipment (costing >$5,000)
None

Performance Indicators for FY 13-FY14

Enhancing Pulse Value-Chain Performance through Improved Understanding of Consumer Behavior and Decision-Making (SO2.2)

Project Name: Grain Legume Value Chain Initiative

Summary of all institutions

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	0	0	0	4	0	0	10	0	0
	Number of women	0	0	0	2	0	0	4	0	0
	Number of men	0	0	0	2	0	0	6	0	0
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	0	0	0	67	0	0	0	0	0
	Number of women	0	0	0	27	0	0	0	0	0
	Number of men	0	0	0	40	0	0	0	0	0
	Numbers by Type of individual									
	Producers	0	0	0	5	0	0	0	0	0
	People in government	0	0	0	30	0	0	0	0	0
	People in private sector firms	0	0	0	9	0	0	0	0	0
	People in civil society	0	0	0	23	0	0	0	0	0
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	0	0	0	0	0	0	300	0	0
	New	0	0	0	0	0	0	300	0	0
	Continuing	0	0	0	0	0	0	0	0	0
	Gendered Household Type									
	Adult Female no Adult Male (FNM)	0	0	0	0	0	0	0	0	0
	Adult Male no Adult Female (MNF)	0	0	0	0	0	0	0	0	0
	Male and Female Adults (M&F)	0	0	0	0	0	0	0	0	0
	Child No Adults (CNA)	0	0	0	0	0	0	0	0	0
4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization									
	Private enterprises (for profit)	0	0	0	0	0	0	0	0	0
	Producers organizations	0	0	0	0	0	0	0	0	0
	Water users associations	0	0	0	0	0	0	0	0	0
	Women's groups	0	0	0	0	0	0	0	0	0
	Trade and business associations	0	0	0	0	0	0	0	0	0
	Community-based organizations (CBOs)	0	0	0	0	0	0	0	0	0
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0

5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	0	0	0	0	0	0	0	0	0
	Agricultural production	0	0	0	0	0	0	0	0	0
	Agricultural post harvest transformation	0	0	0	0	0	0	0	0	0
	Nutrition	0	0	0	0	0	0	0	0	0
	Multi-focus	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	0	0	0	0	0	0	0	0	0
	crop genetics	0	0	0	0	0	0	0	0	0
	animal genetics	0	0	0	0	0	0	0	0	0
	pest management	0	0	0	0	0	0	0	0	0
	disease management	0	0	0	0	0	0	0	0	0
	soil-related	0	0	0	0	0	0	0	0	0
	irrigation	0	0	0	0	0	0	0	0	0
	water management	0	0	0	0	0	0	0	0	0
	post-harvest handling and storage	0	0	0	0	0	0	0	0	0
	processing	0	0	0	0	0	0	0	0	0
	climate mitigation or adaptation	0	0	0	0	0	0	0	0	0
	fishing gear/technique	0	0	0	0	0	0	0	0	0
	other	0	0	0	0	0	0	0	0	0
	total w/one or more improved technology	0	0	0	0	0	0	0	0	0
	New/Continuing hectares									
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0
	Sex of person managing hectare									
	Male	0	0	0	0	0	0	0	0	0
	Female	0	0	0	0	0	0	0	0	0
	Association-applied	0	0	0	0	0	0	0	0	0
7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	0	0	0	0	0	0	0	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	0	0	0	0	0	0	0	0	0
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	0	0	0	0	0	0	0	0	0
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	0	0	0	0	0	0	0	0	0

8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs	0	0	0	0	0	0	0	0	0
	Outputs	0	0	0	0	0	0	0	0	0
	Macroeconomic	0	0	0	0	0	0	0	0	0
	Agricultural sector-wide	0	0	0	0	0	0	0	0	0
	Research, extension, information, and other public service	0	0	0	0	0	0	0	0	0
	Food security/vulnerable	0	0	0	0	0	0	0	0	0
	Climate change adaptation or natural resource management (NRM) (ag-related)	0	0	0	0	0	0	0	0	0
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	0	0	0	0	0	0	0	0	0
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	0	0	0	0	0	0	0	0	0
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0	0	0	0	0	0	0	0	0
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0	0	0	0	0	0	0	0	0
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0	0	0	0	0	0	0	0	0

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13-FY14

Enhancing Pulse Value-Chain Performance through Improved Understanding of Consumer Behavior and Decision-Making (SO2.2)

Legume Innovation Lab Project : BUDGET SUMMARY						
GRAIN LEGUME VALUE CHAIN INITIATIVE						
	41/13 - 09/30/17					
	FY 13	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
a. Personnel Cost						
Salaries	$0.00	$68,000.00	$46,000.00	$46,000.00	$44,000.00	$204,000.00
Fringe Benefit	$0.00	$12,500.00	$10,700.00	$10,700.00	$10,600.00	$44,500.00
b. Travel	$31,091.00	$45,000.00	$57,782.00	$35,951.00	$32,834.00	$202,658.00
c. Equipment ($5000 Plus)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
d. Supplies	$0.00	$25,400.00	$11,700.00	$4,500.00	$4,500.00	$46,100.00
e. Training						
Degree	$0.00	$105,000.00	$90,000.00	$30,000.00	$15,000.00	$240,000.00
Non-Degree	$0.00	$0.00	$0.00	$21,000.00	$21,000.00	$42,000.00
f. Other	$18,085.00	$20,250.00	$76,250.00	$15,250.00	$9,250.00	$139,085.00
g. Total Direct Cost	**$49,176.00**	**$276,150.00**	**$292,432.00**	**$163,401.00**	**$137,184.00**	**$918,343.00**
h. Indirect Cost	$17,366.40	$36,486.00	$45,993.20	$29,889.10	$30,343.40	$160,078.10
i. Indirect Cost on Subcontracts (First $25000)	$12,000.00	$0.00	$0.00	$0.00	$0.00	$12,000.00
j. Total Indirect Cost	$29,366.40	$36,486.00	$45,993.20	$29,889.10	$30,343.40	$172,078.10
Total	**$78,542.40**	**$312,636.00**	**$338,425.20**	**$193,290.10**	**$167,527.40**	**$1,090,421.10**
Grand Total	**$1,090,421.10**					

Cost Share	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
In-kind	$35,000.00	$35,000.00	$35,000.00	$35,000.00	$35,000.00	$175,000.00
Cash	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$ 35,000.00	$ 35,000.00	$ 35,000.00	$ 35,000.00	$ 35,000.00	$ 175,000.00

Attribution to Capacity Building						
Percentage of effort	30.00%	78.08%	137.20%	250.60%	220.72%	146.34%
Amount corresponding to effort	$14,752.80	$215,625.57	$401,219.78	$409,480.90	$302,797.10	$1,343,876.15

Milestones for FY 13-FY14

Enhancing Pulse Value-Chain Performance through Improved Understanding of Consumer Behavior and Decision-Making (SO2.2)

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes

Research, Training and Outreach Workplans

(April 1, 2013 -- September 30, 2014)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: ***Consumer-Driven Value Enhancement***

	Provide abbreviated name of institutions in columns below. Start with the U.S. institution.																	
	KSU			**Zambia**			**Malawi**			**Tanzania**			**Institution 5**			**Institution 6**		
Identify Milestones by Objectives	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**
	(Tick mark the time period for achieving identified milestones by institution)																	
Objective 1:																		
1.1 Case-based DCE workshop for PIs		√			√			√			√							
1.2 Conduct DCE survey in Zambia					√													
1.3 Analyze Zambian DCE data		√			√			√			√							
1.4 Produce Zambian DCE results report			√			√			√			√						
1.5 Conduct DCE survey in Malawi																		
1.6 Conduct DCE survey in Tanzania																		
1.7 Analyze DCE data from Malawi and Tanzania																		
1.8 Produce DCE results report for Malawi and Zambia																		

Objective 2:																		
2.0 Collecting and organizing secondary data for analyses		√			√			√			√							
2.1 Primary production situation analyses		√			√			√			√							
2.2 Primary production situation report			√			√			√			√						
2.3 Conduct industry focus group interviews in Zambia																		
2.4 Conduct industry focus group interviews in Malawi																		
2.5 Conduct industry focus group interviews in Tanzania																		
2.6 Producer industry focus group interviews report for Zambia																		
2.7 Producer industry focus group interviews report for Malawi and Tanzania																		
2.8 Launch Zambia report and conduct industry workshop																		
2.9 Launch Malawi and Tanzania reports and conduct industry workshops																		
Objective 3:																		
3.1 Industry outreach programs						√			√			√						
3.2 MAB Students					√			√			√							
3.3 MS Students					√			√			√							
3.4. Facilitatation of innovative governance mechanisms																		
3.5 Train the trainer programs			√			√			√			√						

Name of the PI responsible for reporting on milestones	Amanor-Boadu	Tembo	Mapemba	Kilima		
Signature/Initials:	VAB	GT	LM	FDK		
Date:	24-Oct-13	24-Oct-13	24-Oct-13	24-Oct-13		

DRAFT May 6, 2014 DRAFT — Pending Review of TMAC

Legumes and Growth (S03)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
Mark Manary, Washington University School of Medicine in St. Louis

Collaborating Host Country and U.S. PIs and Institutions
Ken Maleta, University of Malawi College of Medicine
Chrissie Thakwalakwa, University of Malawi College of Medicine
Indi Trehan, Washington University School of Medicine in St. Louis

Project Problem Statement and Justification
Each year millions of children in Africa die from malnutrition and even more are stunted due to nutritional and absorption deficiencies, interventions to help children affected and at risk are urgently needed to improve the lives of these children. Environmental enteropathy (EE), a pervasive chronic subclinical gut inflammatory condition is prevalent amongst these children and places them at high risk for stunting, malabsorption, and poor oral vaccine efficacy. EE is characterized by T-cell infiltration of the intestinal mucosa leading to a chronic inflammatory state with increased intestinal permeability, translocation of gut microbes, micro- and macronutrient malabsorption, poor weight gain, stunted physical and cognitive development, frequent enteric infections, and decreased response to enteric vaccines. EE often develops within the first three years of life, a high-risk period marked also by the transitions from exclusive breastfeeding to mixed feeding with complementary foods to the complete reliance on adult foods for sustenance. In traditional sub-Saharan African societies, complementary foods are dominated by protein-poor and micronutrient-poor starches such as maize, cassava, and sorghum. Alternative, yet culturally acceptable, complementary foods that could provide a better and more palatable balance of nutrients would potentially decrease in EE and improve growth amongst these at risk children. Legumes provide just such an opportunity, as their protein content is significantly higher than cereals, and they are rich in dietary fiber, starch, minerals, vitamins, and antioxidants.

Planned Project Activities for the Work plan Period
We will prepare to conduct a randomized, controlled clinical trial to investigate the effect of cowpea or common bean consumption on infant growth and gut health.

Objective 1 *Develop a working Manual of Operations to conduct the research projects in the field.*

Collaborators
Malawi College of Medicine

Approaches and Methods
Chrissie Thakwalakwa and the research team will develop a method of operations and standard operating procedures that will be followed throughout the duration of the project. The study

procedure guide will describe the mode of operations for all study related participant and community interactions, including clinic operations, patient and participant screening, participant consent, enrollment, and food distribution. The methodology will also provide guidelines for data collection, giving instructions on surveys, home visits, and anthropometric measurement guidelines including taking mid-upper arm circumference and collecting biological samples. We will also develop an events reporting procedure for any unexpected and adverse events that could occur during the duration of the project. The manual will provide the field work directives for the Malawian graduate students and the local research team. Ms. Thakwalakwa will lead the development of the operations manual.

Objective 2 *Develop and test the acceptability of two sets of three to four recipes that include either cow peas or common beans for use infants in the clinical trial.*

Collaborators
The Department of Food Science and Technology on the Bunda Campus of the Lilongwe University of Agriculture and Natural Resources (LUANAR): LUANAR, formerly known as the Bunda College of Agriculture
Malawi College of Medicine

Approaches and Methods
Using food development techniques used by the Washington University team and the resources of LUANAR, the research team will develop food recipes using cowpeas and common beans. The recipes will be developed in accordance with the WHO specifications: 200 kcal/d for children 6–9-months old and 300 kcal/d for children 9–11 months old. The candidate recipes will then undergo acceptability testing in 6–11-month-old Malawian infants over a two-week period to select those to be used in the study, the acceptability studies will receive the support of the Malawi College of Medicine. Prior to initiating the acceptability trial, we will submit ethical approvals for both the Malawian College of Medicine and the Washington University Human Research Protection Office for approval. About three to four recipes will be selected for each of the target legumes (cowpea and common bean) to offer diversity and choice to the caretakers, as they will be asked to feed the food to their child daily for six months.

Objective 3: *Complete preparations to initiate study aim 1, including staff recruitment, training and community engagement and organization.*

Approaches and Methods
Working with our staff in Malawi and at the College of Medicine, the research team will be hired to initiate specific aim 1. A graduate student will be recruited by the College of Medicine in Malawi to take on the responsibilities of this project. Study staff including drivers, nurses and research assistants will undergo extensive training by the PI and his team in Clinical Good Practice techniques and in data collection methods to properly conduct all enrollment and data collection. The research team will visit Mitondo district clinics to mobilize and engage them in the upcoming research project. The team will also conduct meetings with local community leaders and health centers. Concurrently, all ethical approvals will be initiated to conduct the study; approvals will be sought from the Malawi College of Medicine and Washington University Board of Ethics.

Objective 4: *Increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors in Malawi.*

Approaches and Methods

While initiating Study Aim 1, the PI and his research team will promote sustainable research through relationships with the Malawi College of Medicine and with colleagues at LUANAR. The research team recognizes how integral it is that local Malawi institutions be equipped to initiate and conduct operational health, nutrition and agriculture studies to improve the health and wellness of its population, and extensive training and support will be offered. Chrissie Thakwalakwa of the College of Medicine will be charged with developing the study procedures, guidelines and materials for the study, she will be under the guidance of the PI and his research team. The Agriculture Department at LUANAR, led by Vernon Kambambe, will be engaged developing formulations and recipes using cowpeas and common beans, the PI and his team will train two student LUANAR food scientists on the development processes used in the Washington University food science labs.

Trainees

- Chrissie Thakwalakwa—PhD Candidate, Malawi College of Medicine
- Two students from LUANAR to develop recipes
- One COM PhD student to conduct the research project

Contribution of Project to USAID Feed the Future Performance Indicators

This project supports the US Government's Feed the Future commitment to a multifaceted approach to nutrition and sustainably reducing global poverty and hunger. EE is estimated to cause about one third of the child stunting seen worldwide and the causes of EE are multifactorial. Our project aligns with these goals: developing a dietary intervention for children at risk for malnutrition and enteropathy using legumes, a local and common Malawian crop, is an opportunity to harness a local crop to resolve widespread condition afflicting children across the developing world. In the first year of the project we will set forth the methodology and training to develop a food that can treat this condition, and also train local universities and students on the methods to conduct this kind of research.

Outputs

- Manual of Operations for Field Work
- Recipe development report on lab development of cowpea and common bean interventions

Engagement of USAID Field Mission(s)

Continued communication, engagement and collaboration are planned with Cybill Sigler and John Edgar from the FTF team at the USAID mission in Lilongwe, Malawi. They will take on an associate role in this project. The PI and his team will remain in communication with their team and look for the potential of future engagements.

Partnering and Networking Activities

The PI and his team will work with the Program Manager for the Soil Health Consortium of Malawi about spreading the word about the projects development. The main role of the consortium is to encourage stakeholders to disseminate knowledge on Integrated Soil Fertility Management (ISFM), which includes legume rotation. The consortium holds ISFM symposia, travel workshops, and annual meetings, producing technical and policy briefs after these various consultations. Our research team will communicate with their group about relevant advances and technologies in the legume sector. All project outputs will be shared with these groups and the research team will seek out opportunities for synergy and collaboration.

<u>Leveraging of CRSP Resources</u>

Timeline for Achievement of Milestones of Technical Progress
See attached

Training/Capacity Building Workplan for FY 2014– 2015
<u>Degree Training</u>
First and Other Given Names: Chrissie
Last Name: Thakwalakwa
Citizenship: Malawi
Gender: Female
Training Institution: Malawi College of Medicine
Supervising CRSP PI: Ken Maleta and Mark Manary
Degree Program for training: Public Health Nutrition
Program Areas or Discipline: Public Health
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Host Country Institution to Benefit from Training: Malawi College of Medicine
Thesis Title/Research Area: Public Health Nutrition
Training status: Active
Type of CRSP Support (full, partial or indirect) g for training activity

<u>Short-term Training</u>
Recipe Development
Type of training: Recipe development for dietary interventions
Description of training activity: Develop recipes based on WHO recommendations for dietary interventions using cowpeas and common beans
Location: LUANAR
Duration: two months
When will it occur? September 2015
Participants/Beneficiaries of Training Activity: Graduate students and researchers at LUANAR
anticipated numbers of Beneficiaries (male and female): two
PI/Collaborator responsible for this training activity: Mark Manary
List other funding sources that will be sought (if any): None
Training justification: By engaging students and faculty at LUANAR, the development of appropriate recipes for our chosen legume varieties will also be culturally sensitive and feasible in the village setting, and the interventions that are successful are more likely to be implemented for the long term. Students will also be trained by the Washington University research team, a group that has successfully developed over 50 recipes in prior studies that have been accepted by the Malawian general population.

Short-term Training

Staff Field Training

Type of training: Field training for research activities
Description of training activity: Training study research nurses, drivers, research assistants and staff on the field study guidelines. Trainees will receive training in Good Clinical Practice guidelines, anthropometric data collection skills, biological sample collection methods and community engagement.
Location: Malawi College of Medicine
Duration: one week
When will it occur? Aug 2015
Participants/Beneficiaries of Training Activity: Research team
Anticipated numbers of Beneficiaries (male and female): 10
PI/Collaborator responsible for this training activity: Indi Trehan and Ken Maleta
List other funding sources that will be sought (if any): None
Training justification: this training is necessary to conduct the research projects, having a knowledgeable and capable staff is imperative to conducting this research.

Equipment (costing >$5,000):
-80C freezer

Performance Indicators for FY 13-FY14

April 30, 2013–September 30, 2014

In process

Budget for FY 13-FY14

Legumes and Growth (S03)

Legume Innovation Lab Project : BUDGET SUMMARY					
ON SUMMARY PAGE TYPE PROJECT NAME HERE					
	1/01/14-09/30/2017				
	FY 14	**FY 15**	**FY 16**	**FY 17**	**Total**
a. Personnel Cost					
Salaries	$222,430	$380,395	$312,216	$178,847	$1,093,888
Fringe Benefit	$44,483	$65,766	$62,826	$44,739	$217,814
b. Travel	$12,500	$17,000	$17,000	$13,500	$60,000
c. Equipment ($5000 Plus)	$10,000	$0	$0	$0	$10,000
d. Supplies	$103,600	$127,437	$103,200	$39,950	$374,187
e. Training					
Degree	$64,000	$84,000	$64,000	$44,000	$256,000
Non-Degree	$10,000	$2,500	$10,000	$7,500	$30,000
f. Other	$70,000	$106,000	$106,000	$70,000	$352,000
g. Total Direct Cost	**$537,013**	**$783,098**	**$675,242**	**$398,536**	**$2,393,889**
h. Indirect Cost	$131,250	$186,996	$181,321	$93,544	$593,111
i. Indirect Cost on Subcontracts (First $25000)	$13,000	$0	$0	$0	$13,000
j. Total Indirect Cost	$144,250	$186,996	$181,321	$93,544	$606,111
Total	**$681,262**	**$970,094**	**$856,563**	**$492,080**	**$3,000,000**
Grand Total					

Cost Share	**FY 14**	**FY 15**	**FY 16**	**FY 17**	**Total**
In-kind	$38,276.70	$49,750.35	$47,866.95	$30,848.55	$166,742.55
Cash	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$ 38,276.70	$ 49,750.35	$ 47,866.95	$ 30,848.55	$ 166,742.55

Attribution to Capacity Building					
Percentage of effort	44.59%	44.08%	37.19%	46.77%	42.70%
Amount corresponding to effort	$239,471.09	$345,161.99	$251,143.40	$186,399.59	$1,022,176.07

Milestones for FY 13-FY14, Legumes and Growth (S03)

Research, Training and Outreach Workplans
(April 1, 2014 -- September 30, 2015)

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: Legumes and growth

	WUSM			MCM			LUANAR		
Milestones by Objectives	**10/1/14**	**4/1/15**	**10/1/15**	**10/1/14**	**4/1/15**	**10/1/15**	**10/1/14**	**4/1/15**	**10/1/15**
Objective 1: Develop Manual of Operations									
1.1 Develop enrollment and consent plan					**1**				
1.2 Develop data collection methodology					**1**				
1.3 Develop biological sample collection and storage methodology					**1**				
1.4 Create unexpected and adverse event plan					**1**				
1.5 PI and research team review and finalization of manual			**1**						
Objective 2: Recipe Development									
2.1 Development of recipes	**1**						**1**		
2.2 Examination of orginal recipes and formulations	**1**						**1**		
2.3 Acceptability trial preparations and approval		**1**			**1**				
2.4 Conduct field acceptability trial			**1**			**1**			
2.5 Select and finalize food formulations			**1**			**1**			**1**
Objective 3: Prepare for specific aim 1									
3.1 Staff recruitment	**1**			**1**					
3.2 Staff training			**1**			**1**			
3.3 Secure ethics approvals		**1**			**1**				
3.4 Conduct community engagement programs			**1**			**1**			
Objective 4: Collaboration with Malawi Research									
4.1 Chrissie Thakwalakwa develops operations manual		**1**	**1**		**1**				
4.2 Training on the development of food formulations		**1**						**1**	
4.3 Recruitment of local staff for training positions		**1**			**1**		**1**	**1**	
4.4 Training on study methodology and data collection		**1**			**1**			**1**	
4.5 Community engagement activities			**1**			**1**			**1**
Name of the PI responsible for reporting on milestones	Mark Manary			Mark Manary			Mark Manary		

Impact Assessment of Dry Grain Pulses CRSP Investments in Research, Institutional Capacity Building and Technology Dissemination for Improved Program Effectiveness (SO4.1)

Lead U.S. Principal Investigator (PI) and Affiliated Lead U.S. University
Mywish Maredia, Assoc. Professor, Agricultural, Food and Resource Economics (AFRE), Michigan State University

Collaborating Host Country and U.S. PIs and Institutions
Eric Crawford (Co-PI) and Byron Reyes (Collaborator), Michigan State University
US and HC PIs/collaborators of other Legume Innovation Lab Projects

Project Problem Statement and Justification
Impact assessment is essential for evaluating publicly-funded research programs and planning future research. Organizations that implement these programs should be accountable for showing results, demonstrating impacts, and assessing the cost-effectiveness of their implementation strategies. It is therefore essential to document outputs, outcomes and impacts of public investments in research for development (R4D) activities. Anecdotal data and qualitative information are important in communicating impact to policymakers and the public, but must be augmented with empirical data, and sound and rigorous analysis.

Building on the momentum and experience gained over the last three years, the proposed research will contribute towards evidence-based rigorous ex ante and ex post assessments of outputs, outcomes and impacts 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.

Planned Project Activities for the Workplan Period (April 1, 2013–September 30, 2014)

Objective 1. *Conduct impact pathway analysis, provide advisory role to the MO, and be responsible for technical leadership in the design, collection and analysis of data for strategic input and impact evaluation*

Collaborators
Byron Reyes, MSU
U.S. and HC PIs from other Legume Innovation Lab projects

Approaches and Methods
Legume Innovation Lab's investments in research for development fall across the wide spectrum of activities ranging from basic/fundamental research to applied/adaptive research to technology transfer. Since resources to conduct research are scarce, many Innovation Lab projects undertake pilot scale initiatives and programs designed to test science-based interventions in a developing

country setting with the aim of identifying the most effective strategies/models which can then be scaled up to achieve developmental impacts. For a research project to be successful in achieving this goal requires some forethought on the design of field activities and a strategy for collecting appropriate baseline and follow-up data or making use of available data. The purpose of such strategizing is to make sure that at the end of an intervention/activity, opportunity to assess the cause-effect relationship between a research project and indicators of outcomes/impact is not lost. As part of this project, the PIs will work with other research project PIs to assess the feasibility of integrating data collection and impact evaluation strategies as part of their Legume Innovation Lab project design. The project team will use the opportunity of participation in the planning meetings and follow-up discussions while the teams are finalizing their workplans, to identify opportunities for collecting baseline data and integrating impact evaluation research as part of the project design.

After consulting with the PIs of each of the funded projects, the several opportunities were identified for baseline assessments and/or impact studies and these are grouped into three types—activities for which there is agreement and resources to do the study, activities for which there is a need to explore resources, and activities which are not ready for impact assessment. The outcome of this consultation and review of each project is summarized in Table 1. In FY 14, this project plans to collaborate on the following proposed baseline data collection efforts:

1. Socioeconomic baseline study on the constraints and opportunities for research to contribute to increased productivity of climbing beans in Guatemala: This will be a joint activity with the SO1.A1 project team under their objective *Genetic improvement of climbing black beans for the highlands of Central America*. This study will be designed to establish a baseline about production of climbing beans in the highlands of Guatemala, and to better understand the current status of the climbing bean/maize intercropping production system. Information and data concerning cultivated area, number of different species grown, number of farmers utilizing this cropping system, production problems, seed quality and culinary preferences will be collected to help establish priorities for the climbing bean breeding program.

2. Study on the market potential for biopesticides in Benin: This will be a collaborative activity with the SO1-B1 project team, specifically with Dr. Leonard Hinnou from INRAB-Benin, under their objective 3 *Scaling of solutions.* This study will be designed to assess the potential groups that can develop, market and sell biopesticides, and serve as the logical pass-off groups in host countries for scaling up these technologies. This study will serve as a baseline to assess the market potential for biopesticides (e.g., what farmers are willing to pay, what will be the costs to enter the market place for small industries, what are skill-sets that need to be developed for women’s groups to potentially make and profit from selling such materials, etc.) and will determine the networks of NGOs and other organizations where the project can pass-off educational approaches (e.g., animations) for scaling.

Table 1. Summary of projects and outcomes that fall into one of the three potential groups of projects

Project	Lead PI	A) project activities for which there is agreement and resources to conduct impact assessment	B) project activities appropriate and ready for impact assessment but there is need to explore funding opportunities	C) projects/activities which are not ready for impact assessment
SO1-A3	Kelly		Ecuador: Ready for IA in later years	
			Uganda and Zambia: Ready of baseline survey in later years	
SO1-A1 and SO1-A4	Beaver/Osorno	Guatemala: baseline assessment surveying two production systems (actual plan contingent on the planning meeting in October and collaboration with MasFrijol)	Tanzania: baseline assessment to measure potential impact of bruchid resistant varieties	
SO1-A5	Roberts		Burkina Faso: ready for baseline survey in year 4	
			Senegal: ready for IA in year 4-5	
SO1-B1	Pittendrigh	Benin: socio-economic assessment study on the market potential for biopesticides (which will serve as a baseline for future IA)—FY14-15	Benin and other countries: Follow-up survey for IA (of biopesticides) to be planned under the BMGF project	
		Burkina Faso: Follow-up survey to assess the impact of bio-control strategy (FY 17)		

Project	Lead PI	A) project activities for which there is agreement and resources to conduct impact assessment	B) project activities appropriate and ready for impact assessment but there is need to explore funding opportunities	C) projects/activities which are not ready for impact assessment
SO2.1	Mazur	Project plans to conduct a baseline survey in Uganda in early 2014 and in Mozambique in mid-2014.They expect to conduct follow up surveys before project completion in late 2017 (these surveys will have small sample size and as such are not designed for impact assessment)	If dissemination of project outputs is likely, the project would like to explore jointly accessing more resources to conduct and analyze farmer level surveys with a large enough sample to meet statistical power requirements before and after such dissemination efforts.	Not ready for meaningful medium- or long-term impact assessment for the larger # of farmers who will be involved in the research-on-dissemination phase of the project (in 2016 and 2017).The project won't know until at least 2015 how localized some management package recommendations might be, or even how many might be viable for targeted groups of local farmers—and beyond.
SO2.2	Amanor-Boadu			X

For these two studies, the Impact Assessment team will provide technical leadership in the form of human resources and professional expertise in data collection (i.e., sample design, evaluation design, designing data collection instruments, training enumerators, data entry templates, etc.) and analysis. This will be a joint activity with the relevant research team and rely on the logistical support from the host country partners. Resources for data collection have been budgeted under the relevant research projects.

In addition to these two baseline assessment studies, this project will work with the SO2.1 and SO2.2 project teams and provide input in the survey and data collection efforts planned under their project in FY 14. This input will be in the form of review of survey instruments, sampling strategy, and the method and approach of collecting desired data to achieve the research objectives. We will seek for opportunities to use this planned surveys to achieve broader research questions from the perspective of the Legume Innovation Lab, and/or design the sampling plan such that it can also serve as a baseline for a future impact evaluation study.

Other activities to be conducted under this subobjective in FY13 and FY14 include:

1. Finalizing the report of the pre-biocontrol agent baseline assessment study conducted in Burkina Faso in 2012. This report will be published as an MSU Staff paper before the end of 2013.
2. Continue discussions with the existing and new project teams (that will be awarded through a competitive process) to assess the following:
   a. Potential of existing data sets that can inform about the baseline and help in the analysis of impact attribution
   b. Possibility of collecting relevant baseline data in FY 15 through FY 17.
   c. Possibility of writing joint proposals to leverage resources from other sources to conduct impact evaluation studies of pilot activities.
3. Plan for two socio-economic assessment studies which will occur in FY 16 or FY 17 to assess the impact of biocontrol research in Burkina Faso (in collaboration with SO1-B1 project team) and the impact of bruchid resistant bean varieties in Tanzania (in collaboration with SO1-A4 project team).

Objective 2. *Conduct ex ante and ex post impact assessments*

Collaborators

Byron Reyes and Robert Shupp, Department of Agricultural, Food and Resource Economics
Enid Katungi and Jean Claude Rubyogo, CIAT/PABRA
Barry Pittendrigh and Julia Bello-Bravo, UIUC and Malick Ba, INERA (Burkina Faso)
U.S. and HC PIs from other Legume Innovation Lab projects
HC collaborators of the BTD project in Honduras, Guatemala and Nicaragua

Approaches and Methods

Under this objective, this project plans to 1) assess the realized (ex post) impact of the Legume Innovation Lab (and the predecessor CRSP programs') investment in technologies/outputs where there is evidence of adoption, and 2) enhance future impacts by engaging in innovative and evidence-based research that will serve as an input in making strategic research priority decisions by the Legume Innovation Lab program, and in developing strategies for technology dissemination for maximum impact.

In FY 13 and FY 14, following research studies and activities will be undertaken under this objective based on discussions with and interest expressed by the Management Office and the AOR, USAID.

2a. The economics of supply and demand for the sustainable development of legume grain seed system: The impact of research investment in crop improvement research is dependent upon the availability (supply) and affordability (demand) of seeds of improved varieties. Assessment of factors that contribute to the success and sustainability of seed systems for grain legumes in different socio-economic and agricultural systems contexts is therefore an important area of research to enhance the impact of past research by the CRSP and future investments by the Legume Innovation Lab. This project will conduct field research to address the following research question:

What factors contribute to the sustainability of seed systems?
The seed dissemination project implemented in four countries in Central America under the Bean Technology Dissemination (BTD) project offers a good opportunity to do an in-depth analysis of the unique features of different models for seed multiplication and distribution so as to identify principles of sustainability present/absent from these different models and derive implications and lessons for broader applicability to other countries where Innovation Lab research programs are active. A research study focused on identifying elements of sustainability of the bean seed system is jointly planned with the Monitoring and Evaluation (M&E) component of the BTD project (led by M. Maredia), and includes the following components: a) Three surveys in Nicaragua (completed in 2012): i) A survey of 153 Community Seed Banks (CSB), ii) a survey of 480 Nicaraguan farmers who received bean seed in 2011, and iii) the cost of production record keeping by158 CSBs during the 2011-12 bean seed growing season; b) Assessments in Honduras and Guatemala (to be completed in FY 14, as described below) to evaluate the effectiveness of different models of bean seed dissemination used in the two countries and assess the constraints, challenges, and factors contributing to the success (or failure) of different models, and to evaluate the benefits of improved seed distributed by the BTD project from the perspective of the Beneficiaries

The proposed work to address the objectives of the assessment studies in Honduras and Guatemala will involve 1) Conducting interviews (using semi-structured questionnaires) with representatives of organizations/entities along the seed value chain and collecting data/information that will help us assess the constraints, challenges, and factors contributing to the success (or failure) of different seed distributions systems. These interviews will be conducted in July-August 2013 by Dr. Byron Reyes, Assistant Professor and David DeYoung, a graduate student in AFRE, MSU. Both have the necessary language skills and have extensive experience working in this region. 2) Conducting surveys of beneficiaries of the seed distribution efforts. The sample of farmers to be surveyed (500 in each country) will be selected using a two-stage cluster sampling method. The survey will focus on farmers' perception of the efficiency and effectiveness of the methods used to distribute the seeds, the quality of seed received through the BTD project, and the economic gains experienced from planting improved variety seeds. The field work will be carried out in summer 2013 (July-August) through NITLAPAN of the *Universidad Centroamericana* (UCA). David DeYoung from MSU will participate in enumerator training and provide supervisory role during the field work, along with the staff of NITLAPAN.Data entry and cleaning will be done by NITLAPAN and survey data files will be submitted to MSU for analysis and reporting (to be completed in FY 14).

Potential work beyond C. America
Assessment of factors important for the sustainability of bean seed systems is a high priority area also for PABRA. Our interactions with the PABRA Theme Leader (J. C. Rubyogo) and CIAT socio-economist (E. Katungi) indicates some ongoing research by PABRA/CIAT in Uganda, Ethiopia and Tanzania to understand the complexity of legume seed availability and accessibility, and their keen interest to collaborate with us in expanding the research to other grain legumes (i.e., cowpea) and other countries. In FY 13–14, we plan to explore collaborative research opportunities with the PABRA/CIAT team focused on following research topics:

- Role of grain market in sustaining seed demand

- Limitations and potential of private seed sector and farm based seed production in bean seed production and marketing
- Viability of quality declared seed (QDS)
- Strategies to reduce the cost of production and distribution of quality declared seeds or certified seeds
- Willingness of small holder farmers to pay for quality seed over grain?

The scope of activities addressing these research questions in FY 14 and beyond will be contingent upon availability of resources. As a priority, if funds are available, we plan to implement research studies in one or two countries addressing the question of willingness to pay for quality seed over grain. The methodology/ approach to address this research question will consist of first conducting field experiments in farmers' fields to demonstrate the value of planting seed vs. grain of the same variety (to keep the genetic component of the planting material constant) and then conducting choice experiments (CE) and/or biding experimental auctions (BEA) to test farmers' willingness to pay for seed vs. grain. These experiments could include three treatments related to the type of materials used for planting: grain (saved from previous harvest or purchased from the market), quality-declared seed, and certified seed. The experiments could be designed to understand the following elements of seed demand—quantity of seed, frequency of seed purchase, and willingness to pay for seed for a given quantity and frequency. The major field costs of doing this study will include conducting the field experiments in different sites (to represent different agro-ecological and socio-economic conditions) (estimated to be $5,000/site) and going to the field (after harvest) to conduct the CE/BEA experiments (crude estimate = $ 7,500/site).

2b. Systematic analysis of existing datasets to assess the role of grain legumes in smallholder farming systems

In FY13–14, as part of objective 2, we plan to utilize available secondary data (i.e., the Living Standards and Measurement Survey/Integrated Agricultural Surveys—LSMS/ISA, agricultural censuses, other nationally representative surveys such as TIA in Mozambique or panel surveys in Kenya and Zambia by FSG) to develop profiles of potential clients and beneficiaries of grain legume research, and to understand the constraints and potential impact of the adoption of new technologies by grain legume growers. Descriptive and statistical/econometric analysis techniques will be used to generate information that can help us understand:

1. The role of grain pulses in farmers' livelihood and food security strategies
2. Potential role of pulses in diet diversification
3. Factors influencing the adoption of productivity enhancing technologies in grain legumes by resource poor farmers

A graduate student will be recruited to help put together the datasets and do the analysis. Results of this study will be made available in the form of a report as well an Impact Brief and will highlight major results of this cross-country study and include implications of the findings on what might the Legume Innovation Lab be doing to increase adoption and impact from its investments in research.

2c. Field Experiment on the Dissemination of Post-harvest Technologies in Burkina Faso: This is a carry-forward activity from FY 12, jointly conducted with the UIUC and INERA research team (under the former CRSP IPM-omics research project). The field activities for this study were concluded in January 2013 and data were submitted to MSU in late Spring 2013. We plan to complete the data analysis and report writing as part of the FY 13–14 workplan. The description of this study as implemented in late 2012/early 2013 (FY 13) is as follow.

Problem statement and study objectives

Globally every year, substantial resources are invested by the public sector on agricultural research to generate new knowledge, technologies, and practices targeted towards small-scale farmers living in developing countries. Although there currently exist a number of innovative solutions in the scientific literature that can help improve the lives of people in developing nations, much of this is in a form (for e.g., articles in scientific journals, research reports, extension bulletins) that is not reaching the true target audience at a scale required to generate impact. This is due to a variety of constraints, including the low literacy level on the part of the target audience, and a weak and often an ineffective agricultural extension system that is not able to scale up and scale out the transfer of scientific knowledge to end users living in remote rural areas. This study is an attempt to test the effectiveness of an approach (i.e., the use of animated educational videos) to address both these constraints so as to increase the impact of agricultural research investments, focusing on cowpea producers in Burkina Faso.

Cowpea bruchids (*Callosobruchus maculatus*) can cause damage to cowpea (*Vigna unguiculata*) seeds in storage, resulting in post-harvest losses. To avoid these losses, many farmers sell their cowpea soon after harvest when the price is low. This not only reduces income for farmers but also makes the household more vulnerable as they cannot afford to buy back cowpeas during the lean period, when the prices are typically higher than when they sold. Chemical control methods can be used to control this pest, but growers in Africa often do not have access to the chemicals, or cannot afford them. To address these problems researchers have tested and come up with several non-chemical, low-cost and simple approaches such as (i) exposing the grain to the solar heat to kill the insects and eggs, and (ii) triple bagging the grain in plastic sacks, among other solutions. These techniques have been developed and well-recognized among the scientific community for a long time. Recently, as part of the "Scientific Animations without Borders℠" (SAWBO) project, researchers at the University of Illinois at Urbana Champaign (UIUC) and its partners have developed animated videos on these two technologies to increase accessibility of this knowledge to low-literate farmers around the world. These educational videos can be delivered at a low cost through the Internet and easily shared with a large number of end-users through digital media such as cell phones and DVDs. This approach thus has the potential to bridge the gap that exists between research and impact by using the information and communication technology and a community's own social networks as mediums to transfer scientific knowledge at a low cost to a large number of farmers.

The success of this approach, however, depends on two critical ingredients: 1) the effectiveness of the animated educational materials in inducing learning among low-literate farmers; and 2) the development of innovative (i.e., cost-effective) strategies to deploy these educational materials to a large number of farmers. This study uses a randomized control trial (RCT) field experiment conducted in Burkina Faso in 2012-13 to primarily address the first issue. However, one of the indicators of learning (and thus the success of the knowledge delivery method) is the use/adoption of the technology/practice being conveyed through a delivery mechanism, and often the constraint to the adoption of a technology is that it is either not available or economically inaccessible to farmers in rural areas. Thus, a second research question addressed by the field experiment is whether the technology adoption outcome (after learning takes place) is a function of the availability/accessibility of inputs to farmers or the nature of technology itself.

Methodology and Data

Under a collaborative research project, the UIUC and the Agricultural and Environmental Research Institute (INERA) had planned to pilot test the deployment of the two videos on post-harvest technologies in selected villages in Burkina Faso using the government extension system. This opportunity was used to design the pilot initiative as a field experiment based on the principle of randomization in the assignment of the treatments. The experiment consisted of two treatments (labeled 1 and 2) to address research question one (i.e., effectiveness of animated videos in inducing learning), and two treatments (labeled A and B) to address research question two (i.e., does learning induce adoption, if input availability is not a constraint). For research question two the focus was only on the triple bagging technology. In treatment 1, extension agents used the animated videos to deliver the information on the two post-harvest technologies. In contrast, in treatment two they used the traditional extension method (i.e. live demonstration) to deliver the same information. In treatment A, extension agents left in the village (i.e. made available) a number of sets of plastic bags that farmers could buy and use for triple bagging. In contrast, in treatment B they did not leave plastic bags in the village; instead, they only provided to the participants information on where to buy these plastic bags.

The combination of these two sets of treatments resulted in four groups of treatment villages labeled 1A, 1B, 2A and 2B. Twelve villages across two provinces were randomly assigned to each of these four treatment groups (using randomized cluster experiment design). The experiment was divided into two phases. In the first phase, extension agents implemented the treatments after the cowpea crop was harvested (November 2012). Within each village, farmers were invited to attend a training session where the two post-harvest technologies were disseminated as per the treatment group a village was randomly assigned. Prior to the session, 20 attendees were randomly selected to collect baseline data on their prior knowledge about the storage techniques and exposure to the two technologies. In the second phase, a follow-up impact evaluation survey was conducted six to eight weeks after the training for a subset of 12 farmers per village (total sample size = 576 farmers). These farmers were randomly selected from the list of 20 farmers who attended the training session and had completed the pre-treatment knowledge module. The research paper to be completed in the next few months will present the results of the field experiment survey data analysis by estimating the average treatment effects and comparing the outcomes across four randomized treatment groups. The pre- and post-treatment data will be used to estimate the treatment effect related to learning using difference-in-difference analytical approach. This will also serve as a robustness check for the estimated treatment effects to address the first research question.

<u>Objective 3:</u> *To build institutional capacity and develop human resources in the area of impact assessment research*

Collaborators
Byron Reyes, MSU, and NARS and CIAT partners

Approaches and Methods
This project will address the objective of institutional capacity building and human resource development through the following activities planned in FY 13 and FY 14:

1. Presentations and interactions with other Legume Innovation Lab research project teams: As part of objective 1a, we plan to conduct educational sessions at project planning meetings (FY 13) and/or Global PI meetings (FY 14) to build capacity across the Legume Innovation Lab in developing and using impact pathways, understanding the concepts related to theories of change, and in systematically collecting credible data for reporting on FTF performance indicators. The discussion and exchange of information/ideas envisaged in this process will increase awareness and influence the outlook of CRSP scientists towards impact assessment research and its importance. This will help contribute to enhancing the impact culture within the host country partner organizations.
2. Research activities under objectives 1b and 2 will involve host country PIs/collaborators in the planning and conduct of field data collection as much as possible.
3. Activities planned under this project will involve following graduate students in the planning and conduct of field research and write-up of research results. These students will be recruited from within the Department of Agricultural, Food and Resource Economics at MSU (see the details on trainees in the Training section).
    a. David DeYoung (US citizen)—Partial support
    b. Syed Hamza Haider (Pakistan citizen)—Indirect support (leveraged funding)
4. Short course on impact assessment. A short-term training on novel methods to assess impact of agricultural projects is planned for early 2014 in Honduras and possibly at the PCCMCA meeting in 2014 to be held in Nicaragua (contingent on budget availability). This course will focus on teaching theoretical concepts and demonstrating practical applications of these concepts to economists, faculty, and students from local universities and research centers, including the use of statistical software. Researchers and economists from national research centers and universities (e.g. DICTA, FHIA, INTA, INIAP, Zamorano, CURLA, UNA, UNAN) will be invited to attend. This course will be led by Legume Innovation Lab PIs fluent in the local language and will include possibly a graduate student from MSU, an economist from Zamorano, and possibly an economist from CIAT (to be determined). The duration of the course will be three full days. This will be a joint activity in collaboration with NARS partners, who will cover the local cost of organizing the short course and supporting the participants.

Contribution of Project to USAID Feed the Future Performance Indicators
See the attached excel file

Outputs
Specific outputs to result from this project by the end of FY 14 (September 30, 2014) include:

1. Completion of one thesis papers on the economics and sustainability of bean seed systems in Central America.
2. Completion of two Impact Briefs
3. Completion of two manuscripts for publication in academic journals and/or presentations at professional meetings.

Engagement of USAID Field Mission(s)
No specific plans for engagement of USAID Field Mission(s) are envisioned in FY 13 and FY 14. Project activities in host countries will mainly involve data collection, accessing secondary data, and information gathering through stakeholder interviews. Data collection will be done in collaboration with HC partners in countries where Legume Innovation Lab is already engaged and where activities are occurring in concurrence with USAID country or field missions.

Partnering and Networking Activities
All the activities occurring in specific countries through field research will involve collaboration with host country institutions and partners. Host country institutions will not only be involved in the planning and design of data collection efforts, conducting surveys, data entry and report writing, but also in the dissemination of results to broader audience and stakeholder groups. Opportunities will be sought to present papers based on this project's research results in national and international policy and professional forums.

Results emanating from this impact assessment research project will be published in the form of Impact Briefs and will be posted on the Legume Innovation Lab website. They will be also shared with appropriate USAID mission offices through the Legume Innovation Lab Management Office and host country partners.

Leveraging of Legume Innovation Lab Resources
The project PIs will be actively engaged in identifying opportunities to partner with other international impact assessment and Grain Legume research programs/projects and seek for opportunities to leverage resources to achieve common research goals. Some examples of anticipated leverage activities include:

- Planned adoption studies by CIAT and PABRA: In the coming six to nine months, PABRA (in collaboration with CIAT and NARS partners) is planning to implement bean adoption surveys in Zambia (July–August 2013), Malawi (September 2013), Burundi (August-September 2013) and Mozambique (February-March 2014).This project will try to coordinate with CIAT/PABRA team to leverage this opportunity to design these surveys such that they can serve as baseline assessment for future evaluations of grain legume research efforts in FTF focused countries. The cost of implementing these surveys to achieve the objectives of PABRA in each country range from $20,000 to $30,000.Potential exists to use this opportunity to establish sentinel sites representing grain legume cropping systems in East and Southern Africa with the aim of collecting longitudinal data that can help address important research questions on the role of beans in the livelihood and dietary strategies of small holder farmers and the adoption (or constraints to the adoption) of new technologies. However, achieving these broader goals requires resources beyond those committed by PABRA. Thus, opportunities to leverage additional resources to achieve broader objectives (i.e., establishment of sentinel sites to monitor the role and contribution of grain legumes in household livelihood and dietary strategies) will be sought. In the absence of these additional resources, efforts will be made by this project to partner with CIAT/PABRA by providing technical input in the questionnaire design, sampling strategy, and data analysis to ensure that quality data are collected that will be helpful in addressing important (but limited) research questions.

- MSU-based research project funded by the Gates Foundation called *Guiding Investments in Sustainable Agricultural Intensification in Africa (GISAIA)*. The GISAIA project offers another opportunity to address common research objectives related to the role of grain legumes in agricultural intensification in small holder farming systems. The GISAIA project is planning to use nationally representative panel data from Kenya, Zambia, Malawi, Ethiopia and Tanzania to address research questions related to factors influencing the adoption of productivity enhancing technologies by resource poor small holder farmers. We plan to partner with them to seek for opportunities to include related questions focused on grain legume crops. Discussions are currently underway to explore the possibility of expanding the analysis to include Central American and South Asian countries to get a cross-regional comparative study on the use of inputs and improved technology in cereal-legume cropping systems.
- Exploring funding opportunities in response to RFAs in the area of impact assessment research. For example, the International Initiative for Impact Evaluation (3ie) routinely issues RFPs to promote research in the area of impact evaluation of development interventions in developing countries. In the next round, opportunities will be sought to leverage funding from this organization to conduct impact evaluation of a legume based project in partnership with host country PIs and collaborators to promote objective 2 of this project.
- The Department of Agricultural, Food and Resource Economics at MSU has awarded a Graduate student recruitment fellowship to Mr. Syed Hamza Haider for Fall 2013 under the mentorship of M. Maredia. This project will use this fellowship opportunity to fund this student to contribute towards data analysis planned under Objective 2 (activity 2b).

Timeline for Achievement of Milestones of Technical Progress

See the attached excel file

Training/Capacity Building Workplan for FY 2013–2014

Degree Training

First and Other Given Names: David
Last Name: DeYoung
Citizenship's
Gender: Male
Training Institution: Michigan State University
Supervising CRSP PI: Mywish Maredia
Degree Program for training: M.S.
Program Areas or Discipline: Agricultural Economics

If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Host Country Institution to Benefit from Training: None
Thesis Title/Research Area: Assessment of bean seed systems in Central America
Start Date: Fall 2011
Projected Completion Date: Spring 2014
Training status (Active, completed, pending, discontinued or delayed):Active
Type of CRSP Support (full, partial or indirect) for training activity: Partial

First and Other Given Names: Syed
Last Name: Haider
Citizenship: Pakistan
Gender: Male
Training Institution: Michigan State University
Supervising CRSP PI: Mywish Maredia
Degree Program for training: Ph.D.
Program Areas or Discipline: Agricultural Economics
If enrolled at a US university, will Trainee be a Participant Trainee as defined by USAID? No
Host Country Institution to Benefit from Training: None
Thesis Title/Research Area: Role of grain legume crops in the small holder farming systems
Start Date: Fall 2013
Projected Completion Date: Spring 2017
Training status (Active, completed, pending, discontinued or delayed):Pending
Type of CRSP Support (full, partial or indirect) for training activity: Indirect

Short-term Training
Type of training: Introduction to the concepts, tools and methods related to impact pathways and FTF performance indicators
Description of training activity: Conduct educational sessions at project planning meetings on constructing impact pathways and collecting/reporting performance indicators data
Location: Various (Puerto Rico, Quito, Lusaka, Maputo, Accra, Dakar)
Duration: two hours
When will it occur? May–June 2013
Participants/Beneficiaries of Training Activity: US and HC PIs of the Legume Innovation Lab program
Anticipated numbers of Beneficiaries (male and female): 70 (50 male, 20 female)
PI/Collaborator responsible for this training activity: M. Maredia and B. Reyes
List other funding sources that will be sought (if any):none
Training justification: Proper understanding of the concepts and importance of achieving impacts on developmental goals is critical to instill at the outset of project development so that the project teams can integrate this understanding in their project workplans and plan for appropriate outreach, linkages and partnership activities needed to translate project outputs into outcomes and impacts.

Type of training: Introduction to novel methods to assess impact of agricultural projects and practical applications.
Description of training activity: Conduct a three-day intensive training on current theory to

assess impact and practical applications of this theory. The training will also include basic use of statistical software (i.e. STATA, SPSS) for data manipulation and analysis.
Location: Honduras (Tegucigalpa), Nicaragua (place TBD) (tentative)
Duration: Three days

When will it occur? January 2014 (Honduras), April 2014 (Nicaragua during the PCCMCA meeting).
Participants/Beneficiaries of Training Activity: Economists, researchers, and students from National Research Centers and universities (private and public). The beneficiaries will also include staff from collaborating Legume Lab projects from Honduras, Ecuador, and possibly Guatemala (conditional on them attending the PCCMCA meeting in 2014 in Nicaragua).
Anticipated numbers of Beneficiaries (male and female): 40–70 (five to eight female)
PI/Collaborator responsible for this training activity: B. Reyes and M. Maredia
List other funding sources that will be sought (if any):The cost of organizing the event and supporting the participants will be covered by local NARS partners

Training justification: Having worked in developing countries for several years, one of the challenges we face is the absence of trained personnel to conduct impact assessment of Legume Lab projects and agricultural projects in general. Further, having participated in regional scientific meetings have made us realize that faculty at national universities and research centers many times lack the theoretical and practical experience to conduct sound and rigorous research. Thus, we consider it is of extreme importance for us to contribute with our knowledge to help build local capacity in research centers and universities in developing countries. Further, it is expected that this training could foster links and create opportunities for potential research collaboration between participants.

Equipment (costing >$5,000)
None

Performance Indicators for FY 13-FY14

Impact Assessment of Dry Grain Pulses CRSP Investments in Research, Institutional Capacity Building . . .

Feed the Future Innovation Lab for Collaborative Research on Grain Legumes
PERFORMANCE INDICATORS / TARGETS SPREADSHEET for FY 13 (Second Semester only), FY 14, and FY 15

Project Name: SO4-1 Impact Assessment

Institution 1 Name (one sheet per institition): Michigan State University

Indic. numbe	Output Indicators	FY 13 Target	FY 13 Revised	FY 13 Actual	FY 14 Target	FY 14 Revised	FY 14 Actual	FY 15 Target	FY 15 Revised	FY 15 Actual
		(only April 1, 2013 - September 30, 2013)			(October 1, 2013 - September 30, 2014)			(October 1, 2014 - September 30, 2015)		
1	4.5.2(6) Degree Training: Number of individuals who have received degree tr	0	0	0	0	0	0	0	0	0
	Number of women	0	0	0	0	0	0	0	0	0
	Number of men	0	0	0	0	0	0	0	0	0
2	4.5.2(7) Short-term Training: Number of individuals who have received short-term training									
	Total number	60	0	0	45	0	0	0	0	0
	Number of women	15	0	0	7	0	0	0	0	0
	Number of men	45	0	0	38	0	0	0	0	0
	Numbers by Type of individual									
	Producers	0	0	0	0	0	0	0	0	0
	People in government	60	0	0	45	0	0	0	0	0
	People in private sector firms	0	0	0	0	0	0	0	0	0
	People in civil society	0	0	0	0	0	0	0	0	0
3	4.5.2(13) Beneficiaries: (numbers of households)									
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0
	Gendered Household Type									
	Adult Female no Adult Male (FNM)	0	0	0	0	0	0	0	0	0
	Adult Male no Adult Female (MNF)	0	0	0	0	0	0	0	0	0
	Male and Female Adults (M&F)	0	0	0	0	0	0	0	0	0
	Child No Adults (CNA)	0	0	0	0	0	0	0	0	0
4	4.5.2(11) Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and community-based organizations (CBOs) receiving USG assistance									
	Type of organization									
	Private enterprises (for profit)	0	0	0	0	0	0	0	0	0
	Producers organizations	0	0	0	0	0	0	0	0	0
	Water users associations	0	0	0	0	0	0	0	0	0
	Women's groups	0	0	0	0	0	0	0	0	0
	Trade and business associations	0	0	0	0	0	0	0	0	0
	Community-based organizations (CBOs)	0	0	0	0	0	0	0	0	0
	New/Continuing (total)	0	0	0	0	0	0	0	0	0
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0

5	4.5.2(12) Number of public-private partnerships formed as a result of CRSP assistance									
	Number by type of partnership (total)	0	0	0	0	0	0	0	0	0
	Agricultural production	0	0	0	0	0	0	0	0	0
	Agricultural post harvest transformation	0	0	0	0	0	0	0	0	0
	Nutrition	0	0	0	0	0	0	0	0	0
	Multi-focus	0	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0	0
6	4.5.2(2) Developmental outcomes:									
	Number of additional hectares under improved technologies or management practices									
	Number under specific technology types (total)	0	0	0	0	0	0	0	0	0
	crop genetics	0	0	0	0	0	0	0	0	0
	animal genetics	0	0	0	0	0	0	0	0	0
	pest management	0	0	0	0	0	0	0	0	0
	disease management	0	0	0	0	0	0	0	0	0
	soil-related	0	0	0	0	0	0	0	0	0
	irrigation	0	0	0	0	0	0	0	0	0
	water management	0	0	0	0	0	0	0	0	0
	post-harvest handling and storage	0	0	0	0	0	0	0	0	0
	processing	0	0	0	0	0	0	0	0	0
	climate mitigation or adaptation	0	0	0	0	0	0	0	0	0
	fishing gear/technique	0	0	0	0	0	0	0	0	0
	other	0	0	0	0	0	0	0	0	0
	total w/one or more improved technology	0	0	0	0	0	0	0	0	0
	New/Continuing hectares									
	New	0	0	0	0	0	0	0	0	0
	Continuing	0	0	0	0	0	0	0	0	0
	Sex of person managing hectare									
	Male	0	0	0	0	0	0	0	0	0
	Female	0	0	0	0	0	0	0	0	0
	Association-applied	0	0	0	0	0	0	0	0	0
7	4.5.2(39) Number of new technologies or management practices in one of the following phases of development: (Phase I/II/III)	0	0	0	0	0	0	0	0	0
	Phase 1: Number of new technologies or management practices under research as a result of USG assistance	0	0	0	0	0	0	0	0	0
	Phase 2: Number of new technologies or management practices under field testing as a result of USG assistance	0	0	0	0	0	0	0	0	0
	Phase 3: Number of new technologies or management practices made available for transfer as a result of USG assistance	0	0	0	0	0	0	0	0	0

8	4.5.1(24) Numbers of Policies/Regulations/Administrative Procedures in each of the following stages of development as a result of USG assistance in each case: (Stage 1/2/3/4/5)									
	Sector (total)	0	0	0	0	0	0	0	0	0
	Inputs	0	0	0	0	0	0	0	0	0
	Outputs	0	0	0	0	0	0	0	0	0
	Macroeconomic	0	0	0	0	0	0	0	0	0
	Agricultural sector-wide	0	0	0	0	0	0	0	0	0
	Research, extension, information, and other public service	0	0	0	0	0	0	0	0	0
	Food security/vulnerable	0	0	0	0	0	0	0	0	0
	Climate change adaptation or natural resource management (NRM) (ag-related)	0	0	0	0	0	0	0	0	0
	Stages of development									
	Stage 1 of 5: Number of policies / regulations / administrative procedures analyzed	0	0	0	0	0	0	0	0	0
	Stage 2 of 5: Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation	0	0	0	0	0	0	0	0	0
	Stage 3 of 5 : Number of policies / regulations / administrative procedures presented for legislation/decree	0	0	0	0	0	0	0	0	0
	Stage 4 of 5 Number of policies / regulations / administrative procedures prepared with USG assistance passed/approved	0	0	0	0	0	0	0	0	0
	Stage 5 of 5: Number of policies / regulations / administrative procedures passed for which implementation has begun	0	0	0	0	0	0	0	0	0

Notes:

These indicators are developed under the Feed the Future Monitoring System. Please provide 'total' numbers and also disaggregate where applicable. Just providing 'totals' will not be approved.

This table corresponds to the Feed the Future Performance Indicators data collection sheet under the FTFMS system. Where an indicator does not apply to the type of work done under the project, leave it blank.

Please follow the indications in the Legume Innovation Lab Indicators Handbook that will be provided to you by the Management Office. Contact Mywish Maredia (maredia@anr.msu.edu) for further information.

There is additional guidance on the USAID website http://feedthefuture.gov/sites/default/files/resource/files/ftf_handbookindicators_apr2012.pdf

Budget for FY 13-FY14, Impact Assessment of Dry Grain Pulses CRSP Investments in Research, Institutional …

Legume Innovation Lab Project : BUDGET SUMMARY FY 14

SO4.1 Impact Assessment of Dry Grain Pulses CRSP investments in research, institutional capacity building and technology dissemination for improved program effectiveness

	10/01/13 - 09/30/14											
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
Institution Name	MSU		enter name here	enter name here	enter name here	enter name here	enter name here	enter name here	enter name here	enter name here	enter name here	
HC or U.S. Institution	US	HC	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	Enter HC or US	
a. Personnel Cost												
Salaries	$84,356.00											$84,356.00
Fringe Benefit	$24,629.50											$24,629.50
b. Travel	$15,000.00											$15,000.00
c. Equipment ($5000 Plus)	$0.00											$0.00
d. Supplies	$2,603.00											$2,603.00
e. Training												
Tuition and fees	$8,240.00											$8,240.00
Non-Degree	$0.00											$0.00
f. Other (survey/data collection	$28,969.00											$28,969.00
g. Total Direct Cost	**$163,797.50**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$163,797.50**
h. Indirect Cost	$80,890.00											$80,890.00
i. Indirect Cost on Subcontracts (First $25000)	$0.00											$0.00
j. Total Indirect Cost	$80,890.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$80,890.00
Total	**$244,687.50**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$244,687.50**
Grand Total	$244,687.50											

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	**$163,797.50**	**100.00%**
Total direct cost budgeted for H.C institution(s)	**$0.00**	**0.00%**

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	HC or U.S. Institution (5)	HC or U.S. Institution (6)	HC or U.S. Institution (7)	HC or U.S. Institution (8)	HC or U.S. Institution (9)	Total
In-kind												$0.00
Cash												$0.00
Total	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Attribution to Capacity Building												
Percentage of effort												0.00%
Amount corresponding to effort	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Milestones for FY 13-FY14

Impact Assessment of Dry Grain Pulses CRSP Investments in Research . . .

SEMI-ANNUAL MILESTONES OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title:	**SO4.1 Impact Assessment of Dry Grain Pulses CRSP investments in research, institutional capacity building and technology dissemination for improved program effectiveness**								
	Provide abbreviated name of institutions in columns below								
	MSU			**other**			**other**		
Identify Milestones by Objectives	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**	**10/1/13**	**4/1/14**	**10/1/14**
	(Tick mark the time period for achieving identified milestones by institution)								
Objective 1: Technical assistance for baseline data collection									
1.1 Identify opportunities for collecting baseline data through partnership with other project teams	X								
1.2 Complete the report on baseline survey (biological control study in Burkina Faso)	X								
1.3 Develop survey instruments and research design for baseline data collection in Guatemala		X							
1.4 Develop survey instruments and research design for baseline data collection in Benin		X							
Objective 2: Ex ante and ex-post impact assessment									
2.1 Complete French versions of Impact Briefs # 3 and 4	X								
2.2 Complete the report on the RCT study in Burkina Faso		X							
2.3 Complete a report based on available secondary data analysis		X							
2.4 Complete one thesis research paper on seed system issues			X						
2.5 Complete two manuscripts for publication in refereed journal		X	X						
2.6 Complete 2 Impact Briefs			X						
Objective 3: Capacity building									
3.1 Conduct educational sessions at project planning meetings on constructing impact pathways and collecting/reporting on performance indicators data	X								
3.2 Design and conduct short courses on impact assessment		X	X						
Name of the PI responsible for reporting on milestones	Mywish Maredia								
Signature/Initials:	MM								
Date:	8-Jul-13								