DRY GRAIN PULSES COLLABORATIVE RESEARCH SUPPORT PROGRAM (CRSP)

Technical and Administrative Performance Evaluation Report

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LISTS OF ACRONYMS

AOR	Agreement Officer Representative (USAID)
APLU	Association of Public Land grant Universities
ARS	Agriculture Research Service (USDA)
BCNM	Bean common Necrotic Mosaic
BIC	Bean Improvement Cooperative
BNF	Biological Nitrogen Fixation
Bt	Bacillus thuringiensis
BTD	Bean Technology Dissemination
CGIAR	Consultative Group for International Agricultural Research
CIAL	Committees of Local Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CRDA	National Seed Program, Ministry of Agriculture, Haiti
CRP3.5	CGIAR Research Program on Grain Legumes
CRSP	Collaborative Research Support Program
CSB	Community Seed Bank
DICTA	Dirección de Ciencia y Tecnología Agropecuaria (Honduras)
EAP	Escuela Agricola Panamericana-Zamorano
EAP	External Advisory Panel
ECABREN	Eastern and Central Africa Bean Research Network
EEP	External Evaluation Panel
EET	External Evaluation Team
FtF	Feed the Future
FUNDIT	Fundación para la Innovación Tecnológica, Agropecuaria y Forestal (Guatemala)
HAARV	Highly active antiretroviral
HC	Host Country
ICTA	Instituto de Ciencia y Tecnologia Agricolas (Guatemala)
IICA	Inter American Institute for Cooperation in Agriculture
INTA	Instituto Nicaragüense de Tecnología Agropecuaria (Nicaragua)
IEHA	Presidential Initiative to End Hunger in Africa
IIA	Instituto de Investigação Agronômica (Angola)
IIAM	Instituto de Investigação Agrária de Moçambique (Mozambique)
INERA	Institut de l'Envirenment et des Recherches Agricoles (Burkino Faso)
INIAP	Instituto Nacional de Investigaciones Agricola (Ecuador)
INTA	Instituto Nicaragüense de Tecnología Agropecuaria (Nicaragua)
IPM	Integrated Pest Management
IRAD	Institut de la Recherche Agronomique pour le Développement (Cameroon)
ISAR/RAB	Institute des Sciences Agronomique du Rwanda
ISRA	Institut Senegalais de Recherches Agricoles (Senegal)
ISU	Iowa State University

MAS	Marker Assisted Selection
ME	Management Entity
MO	Management Office
MSU	Michigan State University
NARS	National Agricultural Research Systems
NaCRRI	National Crops Resources Research Institute
NGO	Non-Governmental Organization
NuMaSS	Nutrient Management System Support
ORAC	Oxygen Radical Absorbance Capacity
P	Phosphorus
PABRA	Pan-Africa Bean Research Alliance
PCCMCA	Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos y Animales
PI	Principal Investigator
PSU	Pennsylvania State University
QTL	Quantitative Trait Locus
RFP	Request for Proposal
RIL	Recombinant Inbred Line
SABRN	South African Bean Regional Network
SAWBO	Scientific Animations without Borders
SUA	Sokoine University of Agriculture
TAMU	Texas A & M University
TMAC	Technical Management Advisory Committee
UCR	University of California-Riverside
UJES	University of Jose Eduardo Santos
UIUC	University of Illinois at Urbana Champaign
UPR	Universidad de Puerto Rico-Mayaguez
USAID	United States Agency for International Development
USDA	United States Agency of Agriculture
VEDCO	Volunteer Efforts for Development Concerns
WSU	Washington State University
ZARI	Zambia Agriculture Research Institute

EXECUTIVE SUMMARY

Dry grain pulses are an important group of food crops that contribute to household food security, income generation, and healthy diets for rural and urban poor worldwide. However, many small holder grain legume farmers continue to attain low levels of productivity, while many developing countries face food and nutritional insecurity. In 2007, Michigan State University was awarded a five-year contract to serve as the Management Entity (ME) for the Dry Grain Pulses CRSP (Pulse CRSP). A portfolio of multidisciplinary collaborative research, outreach, and institutional capacity building activities, focused primarily on bean and cowpea, addressed four strategic technical themes:

- Reduce production costs and risks for enhanced profitability and competitiveness of bean, cowpea and grain legume farmers,
- Increase the utilization of bean and cowpea grain and food products so as to expand market opportunities and improve community health and nutrition,
- Improve the performance and sustainability of pulse value chains, especially for the benefit of women, and
- Increase the capacity, effectiveness, and sustainability of agriculture research institutions that serve the pulse sectors and developing country agriculture in Sub Saharan Africa and Latin America.

The initial authorization of the Pulse CRSP implemented a two-phase technical program and project award cycle. During the first phase (Phase I) eight sub-awards (projects) were selected that best met the criteria of the four global themes. After two years, the projects were reviewed by the Technical Management and Advisory Committee (TMAC) for progress in completion of their annual workplan objectives. Seven projects, some with significant technical revisions, were carried forward as Phase II projects. In 2009, following an increase in Congress‘ authorization to the 10 CRSPs, four new Phase III projects were competitively selected and subcontracted under the Pulses CRSP. The new projects addressed strategic gaps in the Pulse CRSP research program, including biological nitrogen fixation, nutrition, value chain research, and impact assessment. An additional USAID Technology Dissemination Associate Award (BTD) for seed production was funded in 2010. Although this project was not a Pulse CRSP sub-award, the EET included the BTD within the review as its seed technology dissemination activities were based on the output of the Bean/Cowpea and Pulse CRSP projects.

An External Evaluation Team (EET) composed of five members was convened in April 2012 to assess the Pulse CRSP‘s overall performance and administrative management by the ME. This report represents the best efforts of the EET to conduct an in depth review of the Pulse CRSP Program. It was not feasible in the limited time period of the review to meet with all the U.S. and Host Country PIs and collaborators. Consequently, site visits and/or conference calls were made to all U.S. Lead Universities. Three Host Countries, each having two projects, were visited in Africa. One EET member also attended the BTD meeting in Nicaragua to meet with the Central American HC partners.

The EET found that the ME/MO provided strong, effective, and proactive leadership in the development of the Pulse CRSP Technical Applications and Associate Awards to USAID and in

the subsequent management and evaluation of the program and projects. Drs. Irv Widders (Director), Cynthia Donovan (Deputy Director,) and Mr. Ben Hassankhani (Administrative Officer) were described by various PIs and collaborators as —helpful, straight forward, well organized, and dedicated". The EET was also impressed with the TMAC. Their dedication, professionalism, and hard work in the review of annual workplans and technical project reports gave support and validation to strong projects, helped strengthen and refocus others, and provided invaluable advice to the MO.

Among the twelve Phase I/II, and III projects, four were notable for their overall scientific excellence, documented impact, and strong capacity building. These projects benefited from being part of the previous Bean/Cowpea CRSP and having a long history of strong international collaboration:

MSU-1: breeding for economically important disease resistances and drought tolerance in Andean bush and climbing bean market classes

UCR-1: cowpea genomics and breeding for adaptation to drought, thrips, and seed quality

UIUC-1: IMP-omics for deployment of biological control agents and improved extension methods for the control of insect pests in cowpeas in West Africa

UPR-1: breeding for adaptation to low soil fertility, drought, biological nitrogen fixation and root rots in Mesoamerican bean market classes

Other projects with significant research output included:

MSU-4: ex-ante and ex-post impact assessment of Pulse CRSP technologies and design of impact assessment pathways for projects

PSU-1: improved common bean root architecture and function for phosphorus acquisition and water uptake

TAMU-1: identification of nutritional and health improving constituents in cowpea

Projects with a strong emphasis on Host Country activities:

ISU-1: sustainable rural livelihoods approach for beans in Uganda

ISU-2: symbiotic N fixation capacity in Andean beans

KSU-2: pulse sector value chain development for beans in Zambia

MSU2: fair trade beans from Honduras; market access in Mozambique

MSU-3: nutritional interventions with pulse-based foods for HIV positive children

The EET considers that the Bean Technology Dissemination (BTD) project, funded by an Associate Award from USAID, has had an outstanding performance during the short time it has been operational. We note, however, that it cannot be measured by the same yardstick as the other projects as this was a separate award.

The Pulse CRSP has generated significant achievements in bean and cowpea research, outreach, dissemination, capacity building, and impact through a successful model of U.S. and Host Country collaborative research and development projects. The EET supports the two phase model for project management as it empowers the MO to make timely adjustments to project objectives and methodologies, and to end or redirect unproductive projects. The EET commends the ME and MO for their professional and proactive leadership of this complex international program, and for their unequivocal commitment to the mission and goals of the Pulse CRSP and the Feed the Future (FtF) mandate of USAID.

The EET recommends that the plant breeding and the development of improved bean and cowpea varieties continue as primary activities, and that greater effort be given to the development and deployment of molecular markers for priority traits in the breeding programs. In addition, the development of a reliable plant transformation system for beans should receive greater attention so that future advances in the deployment of useful gene technologies could be realized. Research to understand the genetics, management, and deployment of biological control agents for cowpea pests in West Africa in UIUC-1 is very promising and should be continued.

The EET recommends that greater effort be given to understanding soil fertility and drought constraints in beans and cowpeas and the complex interactions with root architecture traits, root rots, native rhizobia, and other constraints, through a refocusing and merging of ISU-1, ISU-2, and PSU-1 projects, with close association and direct linkages to the breeding programs. Future work on Rhizobium inoculations should take place once the soil related issues are adequately addressed. Soil scientists need to be part of this effort.

The nutritional impact of beans and cowpeas in the diet of women and children is an important area of research and dissemination. A better understanding of the health benefits of beans and cowpeas in the gut could also lead to recommendations to increase pulse consumption. Value chain studies will help determine the primary constraints in bean/cowpea production and marketing, especially in Africa.

The EET also recommends that socio-economic studies, with the potential collaboration of economists, social scientists and anthropologists, be incorporated into all projects with applied research components. This is especially important for projects involving technology dissemination. The EET recommends that the MO, with the assistance of the AOR, actively seek additional funds from USAID‘s regional and country missions to support applied, site specific research and technology dissemination efforts that fit within the FtF mandates.

A significant concern to the EET is how the Pulse CRSP will contend with and prepare for upcoming retirements. A number of senior bean/cowpea scientists in U.S. and Host Country institutions who have been the backbone of the Bean/Cowpea and Pulse CRSPs, will be retiring within the next program phase. The EET was encouraged to see some new, early and mid-career scientists participating as U.S. PIs and HC partners in a number of projects. We recommend that the three plant breeding projects (MSU-1, UPR-1 and UCR-1) also bring in new plant breeder PIs to work closely with the current lead PIs before they retire. The ME should use their ―Institutional Representatives" and other stakeholders to encourage the institutions where these senior PIs are located to refill these positions once the senior PI retires. The EET recommends that in the next phase of the Pulse CRSP, that a mentoring program be established so that new PIs with more limited experience working with dry grain pulses or with resource poor farmers in Africa and Latin America can consult and interact with more experienced PIs in the design and operations of their projects.

The EET commends the Pulse CRSP on their capacity building efforts, particularly graduate student training, which should be continued in the next phase, with emphasis on training women where feasible. Short term in-country training for HC technicians, NGO staff, and other

personnel is also needed in many countries. Advances in Distance Education techniques should be more extensively utilized to develop specific training models in various languages.

In conclusion, the EET recommends that the Dry Grains Pulses CRSP be extended for another phase with funding equal to or greater than the total funding for Phases I, II, and III. If funding is reduced below that of the present level, then the MO and TMAC will have to make some difficult decisions about future priorities.

FINDINGS AND CONCLUSIONS

I. INTRODUCTION

After an open and competitive competition to identify a university with the technical capacity to manage the new Dry Grain Pulses CRSP (Pulse CRSP), USAID signed a cooperative agreement award (EDH-A-00-07-0005-00) with Michigan State University (MSU) to serve as the Management Entity (ME) for a five-year period from October 1, 2007 through September 28, 2012. Prior to 2007, MSU had served as the ME of the Bean and Cowpea CRSP since 1980, with each extension of the Bean/Cowpea CRSP evaluated by an External Evaluation Panel (EEP) and the submission of new technical and multi-year budget proposals.

An External Evaluation Team (EET) (Appendix A) composed of five members with ―expertise in the focus area of the Pulse CRSP" was convened in April 2012 to assess the Pulse CRSP's overall performance and management of the program by MSU, to identify program successes and areas of concern, and to make recommendations on the Pulse CRSP's future to USAID. The EET considered four possible alternative recommendations: i) extend the Pulse CRSP as it currently exists, ii) suggest significant modifications to the program, iii) recompete, or iv) terminate funding for the Pulse CRSP (Appendix B, Scope of Work).

Although beans and cowpeas continue to be the principal pulse crops of interest, the Dry Grain Pulses CRSP differs from the Bean/Cowpea CRSP in the following ways: 1) research is being conducted on other diverse grain legume crops (pigeon pea, lima bean, lablab, and others) as well as beans and cowpeas, 2) its Global Program Vision is in alignment with the priorities of the Presidential ―Initiative to End Hunger in Africa" (IEHA) and ―Feed the Future (FtF), 3) four new Technical Themes were developed to reflect the program vision, and 4) the establishment of the Technical Management Advisory Committee (TMAC), which replaced the previous Board (comprised of Institutional Representatives from partner U.S. universities and Host Country institutions), the Technical Committee, and three Regional Project Committees.

<u>Global Program Vision</u>

The long-term goal of the Dry Grain Pulses CRSP is to alleviate poverty and achieve nutritional and food security through sustainable development of dry grain pulse value-chains. The global vision is encompassed in four Technical Themes:

1. Reduce production costs and risks for enhanced profitability and competitiveness of bean, cowpea and grain legume farmers,

2. Increase the utilization of bean and cowpea grain and food products so as to expand market opportunities and improve community health and nutrition,
3. Improve the performance and sustainability of pulse value chains, especially for the benefit of women, and
4. Increase the capacity, effectiveness, and sustainability of agriculture research institutions that serve the pulse sectors and developing country agriculture in Sub Saharan Africa and Latin America.

Through a competitive RFP process, the Management Office selected eight Phase I projects (FY08-10) subcontracted to seven "Lead" U.S. universities. Each project involved collaborative research, technology transfer, and capacity building by Principal Investigators (PIs) at U.S. universities and host country agricultural research institutions (universities and NARS) and NGOs in strategic countries in Sub-Saharan Africa and Latin America.

In FY 10, the Technical Management Advisory Committee (TMAC) reviewed the eight Phase I projects for technical progress and potential for development impact and recommended to the MO that seven projects be extended for an additional two years (Phase II projects) with technical adjustments incorporated into their FY 11-12 Work Plans and Budgets (Appendix B. Scope of Work).

In summer 2009, USAID informed MSU that it was going to increase the "authorization ceiling" for the Dry Grain Pulses CRSP from $9 million to $14,014,000 based on the successful submission and approval of a modified Technical Application that strengthened key areas of the program and a revised Cost Application for FY 2010 through 2012 (Appendix B. Scope of Work). The additional funds were awarded to address technical gaps in the program (e.g., nutrition, biological nitrogen fixation, and value chains), to strengthen technology dissemination activities, to assess both ex-post and ex-ante impact of research investments through both the Bean/Cowpea and Dry Grain Pulses CRSPs, and to improve communications and promotion of CRSP technical achievements and development impacts. Four new projects (called Phase III projects) were competitively selected for funding for FY 10-12.

In late 2009, with the establishment of the Presidential Initiative "Feed the Future" (FtF) and the federal government's supporting "Research Strategy for Global Food Security", the Pulse CRSP MO responded to USAID and adjusted the project Performance Indicators to support and contribute to the FtF research strategy. The MO also reached out to strengthen partnerships and better coordinate activities with the CGIAR centers and through the CRP3.5 process, and convened meetings with the international community of grain legume scientists.

EET Evaluation Process

Due to the need for a rapid appraisal of the Pulse CRSP, the EET met all the U.S. Lead PIs in person or via teleconference to verbally assess their programs. The EET also selected a limited number of countries in Africa and Latin America to visit, namely Burkina Faso, Nicaragua, Uganda and Zambia. Each of the countries visited in Africa was host to two projects with a wide variety of activities and varied recommendations from the TMAC. Nicaragua was the site of the BDT meeting with most of the Latin American host country partners participating. The EET

used the USAID Criteria for Assessment questions (see below and Appendix B Scope of Work) to assess the technical and administrative aspects of the Pulse CRSP projects and ME. A complete list of the EET visits and conference calls is available in Appendix C.

II. TECHNICAL REVIEW

A. Technical Leadership

1. What are examples of technical leadership displayed by the ME?

The EET believes that the Management Entity (ME) through its Management Office (MO) at Michigan State University provided strong technical leadership in the development of the 2007-2012 Dry Grain Pulses CRSP Technical Application to USAID. The administration of the sub-awards (projects) was divided into two project phases, Phase I and II, which permitted mid-stream adjustments to be made in the projects based on their technical performance. In 2010, the MO submitted a successful Phase III Technical Application to USAID with a focus on children's nutrition and health, nutritional value of cowpea, biological nitrogen fixation in beans, and program-wide impact assessment; additional funds were included to improve communication and promotion of the Pulse CRSP technical achievements and development impacts.

The EET supports the MO's emphasis on institutional capacity building as an integral component of all sub-awards to U.S. and Host Country PIs, and that it would include both short term and degree training. Each project was provided a separate institutional capacity budget line, with supplemental awards for HC institutions. CRSP U.S. PIs were expected to directly supervise the degree training of their students, and their thesis research topics were to be on areas identified in the CRSP project work plans.

In 2009, following the establishment of the Presidential Initiative "Feed the Future (FtF)" and the federal government's "Global Food Security Research Strategy", the Pulse CRSP initiated changes to the Performance Indicators for each project to address the three FtF research themes: Advancing the Productivity Frontier, Transforming Production Systems, and Enhanced nutrition and Food Safety (www.feedthefuture.gov). The MO also initiated consultations with The Pennsylvania State University and Michigan State University on research priority settings to achieve the FtF research objectives as they relate to pulse productivity and nutrition.

Another area of technical leadership displayed by the ME is through its active participation of in the CRP3.5 Grain Legumes for Health and Prosperity initiative of the Consultative Group on International Agricultural Research (CGIAR). CRP3.5 is a new initiative and its research agenda and proposed activities have not yet had a significant impact on the Pulse CRSP technical program. However, the MO has been an active partner in the CRP3.5 deliberations and is aware that future Pulse CRSP projects will need to be active in this initiative.

2. What are examples of technical leadership displayed by the individual project Principal Investigators (PIs)?

- Beaver, Rosas and Porch- breeding for adaptation to low soil fertility, drought, biological nitrogen fixation and root rots in Mesoamericans bean market classes
- Kelly- breeding for economically important disease resistances and drought tolerance in Andean bush and climbing bean market classes
- Snapp- Participatory approaches to improving cropping system productivity and sustainability
- Roberts/Ehlers- cowpea genomics and breeding for adaptation to drought, thrips, etc.
- Lynch- Improved common bean root architecture and function for soil phosphorous acquisition and water uptake
- Pittendrigh- IPM-omics for deployment of biological control agents and improved extension methods for the control of insect pests of cowpea in West Africa
- Mazur- Sustainable rural livelihoods approach for beans in Uganda and development of extension services to disseminate bean production and management technologies
- Bernsten and Donovan- Fair trade beans from Honduras; market access in Mozambique
- Bennink- Nutritional interventions with pulse-based foods for HIV positive children
- Awika- Identification of nutritional and health improving constituents in cowpeas
- Westgate, Cichy, Miklas- Symbiotic N fixation capacity in Andean common bean
- Amanor-Baodu - Pulse sector value chain development for beans in Zambia
- Maredia- Ex-ante and ex-post assessments of Pulse CRSP technologies and design of impact assessment pathways for projects;

3. **How are the separate research activities integrated into a broader strategy or thematic programming areas including Feed the Future?**
   The separate research activities are integrated into a broad strategy that complements the Feed the Future (FtF) initiative, launched by the United States Government and led by the U.S. Agency for International Development (USAID). Under this strategy, the Pulse CRSP has aligned all of its targets toward tackling the two major problems that the FtF initiative seeks to address; global hunger and food security. All of the programs within the CRSP seek to increase the productivity and increase the incomes of medium and small-holder farmers and therefore directly address the global hunger and food security aspects of FtF. Further, the Pulse CRSP has strived and made great progress in integrating other aspects of FtF into their programs such as gender equality on an as needed basis.

4. **How and with what results has gender been taken into consideration in research design, training and outreach strategies at the research activity level?**
   According to the FY2011 Technical Progress Reports for degree training, 31 of the 53 ~~–a~~ctive" trainees were women. Overall, the EET found that most of the projects had been very successful in including women in their research, training, and outreach strategies, with few exceptions. Each project workplan and technical progress report includes an evaluation of gender equity activities (including training), which are reviewed by the TMAC and MO.

5. **How does the ME facilitate engagement of the research activities or themes to other development programs in regions where the CRSP is active?**
   The EET found evidence of the following:
   a. The MO has strengthened it ties with CIAT and improved coordination of common bean research activities with the African regional bean programs: PABRN (Pan-Africa Bean

Research Alliance), ECABREN (Eastern and Central Africa Bean Research Network) and SABREN (Southern Africa Bean Research Network). Steve Beebe, CIAT scientist, is a TMAC member.

b. The Pulse CRSP supports the regional bean network (nurseries) in Central America through the UPR-1 project with EAP-Zamorano (in the absence of CIAT support)
c. The MO has cultivated ties with the McKnight Foundation for pulse research in Eastern Africa (PSU-1/MSU-1)
d. The UCR-1 and UIUC-1 projects support regional cowpea breeding and IPM-omics efforts in West Africa, respectively.
e. The Bean Technology Dissemination project in Central America is promoting community seed banks in Nicaragua, Honduras and Guatemala.
f. Research consultations were organized with co-sponsorship by CIAT, IITA and ICRISAT and participation by N2Africa, McKnight, USDA (ARS and NIFA), etc.
g. The MO has been an active partner in research priority setting for grain legumes in CRP3.5 Grain Legumes.

6. How well has the ME facilitated the participation of new partners? Give examples of how program RFPs are designed and how opportunities are advertised and made available for new PIs.

The ME obtained "Expressions of Interest" from host country agriculture research institutions prior to issuing the initial RFP in 2007. HC institutions were asked to complete a form indicating their research capacity, areas of research interest relative to pulses, and identities of scientists engaged in pulse research. U.S. universities submitting proposals were encouraged to partner with the suggested HC institutions in USAID priority countries. RFPs were also distributed through the Association of Public and Land-grant Universities (APLU) and Bean Improvement Cooperative (BIC) listserves.

As a result of this effort, the EET was pleased to learn that five of the twelve Phase I projects were awarded to new PIs (Mazur, Lauren, Amanor-Baodu, Westgate, Awika) and U.S. universities (ISU-1, Cornell, KSU, ISU-2, and TAMU), which had not been previously involved in the Bean/Cowpea CRSP (pre 2007). In addition, new host country institutional engagements were established by the Pulse CRSP in Rwanda, Uganda, Kenya, Zambia, and Angola.

7. Are the levels of effort, award size and research project duration sufficiently balanced to allow the CRSP to achieve program goals and objectives?

As would be expected, different areas of research require greater or lesser investments. For example, socio-economic studies are usually less expensive than genomics/phenomics and nutrition research. The EET believes that funding and the institutional capacity of some host country institutions during Phase I and II was insufficient to allow some of the Pulse CRSP projects to achieve some proposed research objectives. Overall, the award size was insufficient considering the number of U.S. and HC PIs involved in each project and the cost of graduate training. The additional funding for Phase III projects in 2010 also presented challenges. Two to three years were found to be inadequate in a large part for these projects to achieve their research objectives, considering the challenges of starting up new projects especially in host countries.

In the next phase, the EET recommends that mature projects going forward be supported at a higher level commensurate with their research and capacity building objectives. Since the primary institutional relationships are in place and a foundation of research has been established, the project teams should be better positioned to receive, administer and effectively take advantage of larger amounts of project funding. The EET recommends that the overall strategy of the Pulse CRSP be to invest in a portfolio of fewer, high priority multidisciplinary projects and to adequately support these efforts.

The EET would like to commend the U.S. and HC PIs for successfully leveraging additional financial support for their research programs, for graduate students, and for international engagement activities. The EET considers that projects that require access to high cost, cutting edge research equipment and additional technical staff will see an increasing need of leveraged financial support to help fund their activities. However, not all PIs will be able to leverage large amounts of additional support. The EET recommends that the MO establish a pool of funds to be competitively awarded based on need and project performance that will permit U.S. and HC PIs the ability to purchase essential equipment not supported by leveraged or direct funds.

The EET supports the current policy that a minimum of 50% of the direct funds be allocated to the Host Country institutions for research and capacity building activities in each project.

As the cost of graduate student training at U.S. universities continues to increase, greater participation in regional African and Latin American universities should be encouraged.

8. What have been the significant accomplishments in terms of research, outreach, and dissemination?

The Pulse CRSP has produced a number of significant accomplishments which are noted in Section B Project Evaluations. Below are some examples:

- Over the past 30 years, a total of 146 improved bean varieties and 25 improved cowpea varieties released in the U.S. and many HCs, were the outputs of the Bean/Cowpea and Pulse CRSP and its collaborators. Many of these varieties have enhanced levels of pest resistance and tolerance to abiotic constraints.
- Pulse CRSP bean and cowpea plant breeders have employed novel methods to detect molecular markers for resistance genes (gene mapping, QTLs and RILs) and used marker assisted selection in their breeding programs.
- Extensive bean and cowpea seed multiplication and distribution efforts involving HC research and extension institutions, NGOs, and farmer organizations in Latin American, East Africa, and West Africa have successfully produced and distributed seed of new and local varieties using ~~–s~~ustainable" multiplication and dissemination systems approaches.
- Research on cowpea pest management has led to the successful development of seed-applied biocontrol treatments, neem extraction and application methods, maps of cowpea insect pest hot spots, IPM packages that include biocontrol agents, biopesticides and pest resistance management plans, and non-chemical seed storage technologies for beans and cowpeas.

- CRSP supported research gives evidence that bean/cowpea-based foods have potential for use as supplementary/rehabilitation foods, for improving health conditions of children with HIV/AIDS, and contain anti-inflammatory properties that lower the risk of chronic inflammatory conditions.
- Value chain research in a number of host countries has identified both constraints and opportunities for pulse producers, processors, traders and vendors, and consumers to expand the role of pulse crops in their livelihoods.

9. How has the ME built on earlier investments?

The Pulse CRSP was able to build and expand on the Bean and Cowpea CRSP and a well-functioning and experienced ME at Michigan State University. The transition from one CRSP to the next was straight forward with little time or resources spent in delayed startup. Earlier investments in the Bean/Cowpea CRSP have enabled the Pulse CRSP to build on the following achievements:

<u>Bean and cowpea breeding</u>

a. Bean breeding program in Honduras for lowland tropics (UPR-1)
   - Breeding pipeline is full resulting in continued release of new varieties
   - Project contributing to the re-establishment of bean breeding program in Angola
   - Incorporate breeding for adaptation to low N and BNF into project
   - Extend Mesoamerican small red lines to Southern Africa
   - Disseminate seed of improved CRSP varieties to 120,000 smallholder farmers in Guatemala, Honduras, Nicaragua and Haiti.
b. Bean breeding of Andean types for highlands (Ecuador and Rwanda) (MSU-1)
   - Breeding pipeline is full in Ecuador resulting in continued release of new varieties
   - Marker Assisted Selection capacity of INIAP developing and being utilized
   - Rwanda program able to access new genes for disease resistance
   - Germplasm and advanced lines from Ecuador made available to program in Rwanda
c. Cowpea breeding program in West Africa and Angola (UCR-1)
   - Breeding pipeline is full in Senegal and Burkina Faso resulting in continued release and dissemination of new cowpea varieties in region
   - Project contributing to the establishment of a cowpea breeding program in Angola
   - Marker Assisted Selection (MAS) capacity of ISAR/RAB-Rwanda developed and being utilized
   - The UC-Riverside and ISRA scientists assuming a leadership role in cowpea genomics in Tropical Legumes I project

<u>IPM-omics</u>

a. IPM strategies for management of Maruca pest of cowpea, including use of biological control agents, were studied under Bean/Cowpea CRSP (UIUC-1).
b. Previous Bean/Cowpea CRSP research focused on refugia management strategies for when a Bt cowpea is approved for commercial production. Pittendrigh's knowledge, HC partners, and insect genomics tools were valuable for monitoring cowpea insect pest movements and developing effective IPM strategies, especially the use of biological control strategies.

Role of bean-based foods in child nutrition

1. MSU-3 project builds upon the findings of child feeding intervention study in Botswana and Tanzania supported by Beans for Health Alliance (and managed by Pulse CRSP MO).

10. What can be done to capitalize on these - to broaden or accelerate progress?

a. Expand use of molecular marker selection technology in breeding programs
b. Improve phenotyping/phenomics to exploit the potential of genomics
c. Develop a functioning transformation system in beans
d. Develop a better understanding and management of soil constraints in Africa, and the role of native Rhizobia, to improve bean yields
e. Deployment of biological control strategies in West Africa to help close the yield gap in cowpea
f. Access to quality seed and sustainable seed systems are an ongoing constraint to widespread adoption of improved varieties.

11. How does the ME continue to be forward thinking about research ideas and plans associated with the CRSP?

The EET encourages and supports the new partnership and coordination of Pulse CRSP research with CRP3.5 Grain Legumes to help achieve synergies between USAID investments. Opportunities to complement and address technical gaps in CRP3.5 include:

a. Phenomics for physiological and biochemical traits (photosynthesis, assimilate transport, root uptake of nutrients and water, etc.)
b. Nutrition and health research
c. IMP-omics in cowpea and beans
d. Institutional capacity building especially as related to the development of sustainable breeding programs

Niches where U.S. universities afford comparative research advantage and can effectively contribute to international CGIAR efforts for grain legumes, include:

a. Increase pulse productivity through enhancement of genetic yield potential with a focus on abiotic (drought, high temperature) and edaphic constraints (low P and N fertility)
    - Phenomics for marker identification of physiological and biochemical traits
    - Use of association mapping to identify molecular markers
    - Collaborate with HC breeders to develop capacity for using molecular genetic markers and approaches to enhance effectiveness of grain legume breeding programs
b. Increase pulse productivity by closing the yield gap
    - IPM-omics to control cowpea insect pests in West Africa using biologicals.
    - Strengthening soil fertility management decision-making by resource-poor smallholder farmers for increased pulse productivity.
c. Transform pulse systems and value chains for the benefit of stakeholders
    - Enhance achievement of sustainable multi-functional productivity goals for smallholder grain legume-based cropping systems
    - Enhance women equity, access and participation in input and output markets

- Improve decision making in trading systems to enhance market opportunities for farmers and traders, and reduce transaction costs for lower consumer prices.

d. Enhance nutritional quality of diets
   - Controlled feeding studies to understand the possible contribution of grain legumes in diets to improve nutrition for young children (first 1000 days) and pregnant women. Findings can impact both developing countries and the U.S.
   - Biochemical and feeding studies to understand the role of grain legumes in gut health and function. This approach has implications for addressing both under and over-nutrition among the poor.
   - Understand how pulse grain prices relate to pulse consumption by both urban and rural poor populations, and thus their influence on nutritional quality of diets, nutritional security, and ultimately, public health especially of young children and women.

B. Project Evaluations

The EET evaluated each of the 13 projects (including the Bean Technology Dissemination Associate Award) for their depth, breadth, rigor and completion of goals and objectives. We reviewed the Project Work Plans, Technical Progress Reports, budgets, scientific publications and other reports, and the TMAC reviews and recommendations. The EET also conducted targeted site visits and meetings with U.S. and HC PIs and other stakeholders and institutions (Appendices C). Where site visits were not possible, phone interviews with U.S. PIs were conducted. The evaluations of the individual Pulse CRSP projects are as follows:

MSU-1 *Combining Conventional, Molecular and Farmer Participatory Breeding Approaches to Improve Andean Beans for Resistance to Biotic and Abiotic Stresses in Ecuador and Rwanda*

Phases: I/II
U.S. Principal Investigators and Institutions:
James Kelly , Michigan State University; Sieglinda Snapp Michigan State University; George Abawi, Cornell University
Host Country Collaborators and Institutions:
Eduardo Peralta, INIAP Ecuador; Agustin Musoni, ISAR/RAB Rwanda
Total Activity Budget: $825,000

Background, Objectives, and Progress:
Beans are an important food and source of income for Ecuadorian and Rwanda families, and the most important source of protein for Rwandans, with over 120,000 hectares of beans grown in Ecuador and 300,000 hectares grown in Rwanda. Andean beans, having mid-to-large seed size in a wide variety of colors and patterns, are the preferred bean types in both countries, and both bush and climbing beans are grown. The INIAP Ecuador breeding program for Andean beans has successfully developed and released numerous bush and climbing bean cultivars that are widely grown throughout the country. INIAP has the potential to develop and deploy improved bean cultivars for Rwanda, especially in the upland farming regions where climbing beans are

widely grown. ISAR/RAB Rwanda has also released a number of climbing bean cultivars that have been widely adopted in the highland region. The MSU Bean Breeding Program has a long and distinguished track record of developing improved high yielding and disease resistant lines for U.S. production. Working together and with a broad set of international bean germplasm from CIAT/PABRA and other sources, significant progress is being made toward understanding and developing breeding lines with resistance to multiple biotic and abiotic stresses, while advancing and using modern breeding tools and methods.

The MSU-1 project has four objectives:
Objective 1:Develop through traditional breeding and marker-assisted selection (MAS) in a range of large-seeded Andean Bean germplasm with differing combinations of resistance to major foliar disease in contrasting bean growth habits for distribution and testing in the Highlands of Ecuador, Rwanda and the Midwestern U.S.
Objective 2: Develop inbred backcross lines in a range of commercial seed types for testing under drought and root rot pressure in Ecuador, Rwanda and the U.S.
Objective 3: Collect and characterize pathogenic and genetic variability of isolates or root and foliar pathogens in Ecuador and Rwanda
Objective 4: Employ participatory plant breeding and agroecological methods to assist the breeding process in Ecuador and Rwanda to enhance productivity and market quality of beans under development.

The MSU-1 program has made significant advances in the development of parental lines, breeding populations, and new cultivar releases that are high yielding and resistant to important bean diseases for the major production regions in Ecuador, Rwanda and Michigan. In collaboration with CIAT/PABRA, a number of lines with iron content in the seed have also been developed and evaluated at different sites in Rwanda. Inbred populations have been made and genotyped using SSR markers to map QTL associated with specific traits (such as drought tolerance, aluminum toxicity resistance) and for the development of molecular markers for use in the breeding program. Disease isolates were collected in Ecuador, Rwanda and Michigan and evaluated using specific pathogen differentials to identify pathogen races. Farmer participatory methods have been used to evaluate breeding lines and agroecological practices in Rwanda and Ecuador, and to promote farmer seed multiplication of the new variety releases. Bean germplasm has been evaluated for resistance to Fusarium root rot in Ecuador. The use of cover crops, tillage, and crop rotations on yield of beans and other crops and for managing root diseases were initiated at Cornell University. Root rot evaluations in peas were also conducted.

Training Objectives:
Two doctoral students are completing their studies at MSU.
Gerardine Mueshimana (Rwanda) studied drought tolerance in beans. Part of her research was conducted in Rwanda and at CIAT. She received a Borlaug LEAP Fellowship to help support her travel.
Krista Isaac (U.S.) studied agrodiversification of bean based cropping systems and nutrition, and part of her work was conducted in Rwanda. She received partial support from Fulbright Fellowship.

Other non-degree training and extension activities were also conducted in Rwanda, including seed multiplication training and the production of a booklet that promotes bean production chain for farmers.

EET Observations and Recommendations:
The MSU-1 project has a strong combination of well-established and successful breeding programs at MSU, INIAP Ecuador, and RAB/CIAT/PABRA in Rwanda that has resulted in the release and seed distribution of numerous new bean cultivars that have, and will have, a significant impact on the lives and livelihood of many small, resource poor farmers. It is particularly exciting to see the INIAP bean program providing genetic resources and breeding lines to both the Michigan and Rwandan bean programs. CIAT's interaction with the Pulse CRSP through PABRA and with the high iron seed breeding lines is also noteworthy. The EET believes that the Pulse CRSP plays an extremely important role in encouraging and supporting these types of collaborations.

In addition to the development of improved breeding lines and cultivar releases, the project has advanced our knowledge of bean genetics through work to genotype different inbred populations for the identification of QTLs that can be used in marker assisted breeding. The project has also continued and enhanced the use of differentials to identify races of important pathogens, and the screening of germplasm for new sources of resistance to biotic and abiotic constraints.

The EET is also encouraged to see the cooperation between the technical breeding program and farmer participatory research in variety testing, seed multiplication, and agroecological crop management studies. Whether it is working with the CIALs in Ecuador or farmer community groups in Rwanda, farmer participation in the evaluation and testing of new technologies and practices is critical for success, especially for complex traits, and sustainable seed production. The EET believes that the MSU-1 project is greatly strengthened by having a strong socio-economic focus in the project.

In Rwanda and Ecuador, root rots are generally part of a complex problem involving disease pathogens, drought, and low soil fertility. In Rwanda, bean fly also contributes to these complex interactions and cause high yield reductions, even the complete loss of the crop. To address and reduce the impact of these complex constraints, breeders, pathologists, entomologists, and agronomist are needed to develop genetic and crops management strategies that are acceptable to farmers. Neither genetics nor agronomy alone will be sufficient to manage these constraints.

The EET recommends that the MSU-1 project be continued within the next phase of the Pulse CRSP with further strengthening of efforts related to the complex problem of root rot, drought, and soil fertility through breeding and crop management. The efforts to develop genetic markers for important biotic and abiotic constraints should continue. Additional efforts should be made to develop successful transformation technologies in beans to take advantage of future opportunities in this area.

If the MSU-1 is to continue in Rwanda, a better division of breeding responsibilities with RAB/CIAT/PABRA is needed to increase collaboration, target specific problems, and to minimize duplication of efforts. One suggestion is that MSU-1 focus on the root rot/low soil

fertility/low BNF complex, with greater input from plant pathologists. The expansion and adaptation of climbing beans in Uganda and other Pulse CRSP countries in Africa has the potential for significant impact and farmer participatory research and on-farm variety testing will be needed.

Finally, the EET recommends that an additional U.S. university plant breeder be added to the MSU-1 project to interact with the MSU breeder and to ensure continuation of this program in the future.

MSU-2 ***Expanding Pulse Supply and Demand in Africa and Latin America: Identifying Constraints and New Strategies***

Phases: I/II
U.S. Principal Investigators and Institutions: Rick Bernsten, Eric Crawford, Cynthia Donovan, Michigan State University, East Lansing, US
Host Country Collaborators and Institutions: David Kiala, University of José Eduardo dos Santos (UJES, formerly UAN), Angola; Feliciano Mazuze, Instituto de Investigação Agrária de Moçambique (IIAM), Mozambique; and Juan Carlos Rosas, Escuela Agricola Panamerican Zamorano (EAP) Honduras
Total Activity Budget: $763,565

Background, Objectives, and Progress: This project focuses on three countries in Central America and Africa: Honduras, Angola and Mozambique. In all of these countries, beans are widely grown by small holders as revenue generators (as well as a food source). The objective of this project has been to better understand how different levels of market development affect incentives for technology adoption, as well as to expand market opportunities and accelerate the transformation from semi-subsistence to commercial farming. Pulse markets in Angola, Mozambique, and Honduras present a continuum in terms of the level of market infrastructure. Angola is characterized as having minimal price information, low yields/production, unpredictable market channels, and poor quality although infrastructure is improving. Mozambique is characterized by a relatively effective market information system, low yields/production, and some farmer organizations, but minimal production for markets (market participation) due to a lack of information on quantity/demand. In contrast, Honduras is characterized by an effective market information system, strong farmer organizations, widespread adoption of improved bean varieties, market-oriented production, and a potential to produce for specialty/niche markets.

The MSU-2 project thus has three objectives, to evaluate and analyze the value chains for beans and other pulses to determine gaps and thereby identify opportunities for increasing small holder farm income in

1. Angola
2. Mozambique and
3. Honduras

It is noted that the work in Honduras terminated after four years, while that in Mozambique and Angola has continued throughout the five years of the project award.

The MSU-2 project has made significant advances in understanding the value chains in these three countries. In Honduras, the research activities have resulted in farmer adoption of organic technologies which has enabled a reduction in production costs and increases profits. Fair trade certification was obtained through a third party trade certifying organization. Although contracts to sell fair trade beans to the "Whole Foods Market" chain were not signed due to lack of agreement on prices, the structure is now in place to move forward in the future. In Angola and Mozambique the research revealed much useful information on constraints in the value chains such as lack of quality storage, poor quality of grain in markets, lack of information for farmers to determine where and when to market and at what price, and high transport costs. Poor grain quality is due to a lack of available certified seeds, lack of pest control in production and in storage, lack of returns for quality product, as well as poor market conditions. Strong seasonal variability in volumes trade indicates opportunities for temporal arbitrage, especially for cowpeas, if farmers and traders can overcome the constraints in storage. Market information is almost completely lacking in Angola, thus farmers rely on the traders or neighbors for almost all information, such that they simply sell based on trader conditions and harvest.

Although farmers in Mozambique have greater access to information, the timeliness and quality of the information could be improved using modern communication technologies. In both Angola and Mozambique, traders tend to be segregated by commodity, with traders specialized in either common beans or in cowpeas. In Angola, project research has identified high margins for traders in key common bean marketing channels, for which high transport costs are just one of the factors. In Mozambique, traders specializing in cowpeas were more likely to sell to large warehouse agents (LWA), whereas bean traders were likely to sell to retailers—likely due to the developing value chain for cowpea processing/export. Cowpea traders are more local and less likely than common bean traders to work in more than one district. This value chain may lend itself more to developing targeted actions to improve quality/post-harvest handling, since wholesalers can be a more easily organized.

Training Objectives:
Two master's degree students completed training at non US Institutions with full CRSP support.
Ana Lidia Gungulo from Mozambique completed a master's program in Agricultural Economics at the University of Pretoria in 2011.
Estevão Chaves from Angola completed a master's program in Agricultural Economics at the Federal University of Viçosa in Brazil in 2011.

In addition CRSP support is listed for the scholarly activities resulting in the production of a thesis by Artur Paulino, submitted to the University of José Eduardo dos Santos in Mozambique.

No graduate students from Honduras were listed as being supported.

A number of other short term non-degree training and extension activities were also conducted in Angola, Honduras and Mozambique.

EET Observations and Recommendations:
The EET considers that this MSU-2 project has resulted in many positive findings in all three countries that have resulted from strong collaborative partnerships between scientists, economists and institutions in all three countries. Given the almost complete absence of information in markets in Angola and Mozambique at the beginning of the project, the EET is not overly concerned at the absence of publications in peer reviewed journals. However the EET would have liked to have seen evidence of presentations at national and/or international meetings describing some of the results from the project and analyzing possible interventions. The EET considers that there could be great value and potential in continuing the work in Angola and Mozambique. The EET considers that further clarity concerning the value chains, particularly in Angola could lead to significant interventions that could positively affect small holder farmer incomes. The EET is of the impression that the progress made in Mozambique was due in large part to one of the MSU-2 investigators (C. Donovan) being located in the country during much of the funding period.

Although the EET considers that the project has strong merit, and equally strong potential, it is considered that leadership changes among the MSU-2 team severely compromise its future. The EET was informed that Dr. Bernsten is retiring, and notes that Dr. Donovan has recently relocated from Maputo to East Lansing in order to assume the position as Associate Director of the CRSP.

In general the EET considers that socio-economic studies such as this are an important component of a multidisciplinary project focusing on beans and other pulses. Although work in Angola is particularly challenging and may not yield results as rapidly as in other CRSP partner countries, the EET commends the CRSP for choosing to work there. The EET feels that there is much valuable work to be done in Angola which can result in qualitative incremental advances. Accordingly, the EET recommends that the MO consider supporting a similar project focusing on the two Lusophone countries in Africa.

The EET notes that none of the members of the team were able to conduct site visits to Mozambique and Angola, and so our information is limited to discussions in East Lansing and review of the documents provided.

MSU-3 Improving Nutritional Status and CD4 Counts in HIV- Infected Children through Nutritional Support

Phase: III
Lead U.S. Principal Investigator and Institution: Maurice Bennink, Michigan State University (MSU)
Host Country Collaborators and Institutions:
Theobald Mosha, Sokoine University of Agriculture (SUA), Tanzania
Henry Laswai, Sokoine University of Agriculture (SUA), Tanzania
Elizabeth Ryan, Colorado State University, USA
Reuben Kadigi, Sokoine University of Agriculture, Tanzania
Total Activity Budget: $863,125.00

Background, Objectives, and Progress:
The overall goal of this research project is to determine if eating beans will improve the immune status of HIV positive children who are not being treated with antiretroviral drugs. The global theme addressed by this research is —To increase the utilization of bean and cowpea grain, food products and ingredients so as to expand market opportunities and improve community health and nutrition" and the topical area that will be addressed is –Achieving Nutritional Security for Improved Health of Target Populations".

HIV is a major cause of morbidity and mortality, especially in children in areas such as Sub-Saharan Africa. Malnutrition is considered the primary cause of immunodeficiency worldwide and because malnutrition is more common in infants and children, they suffer the greatest effect to the immune systems. It is well known that insufficient intake of macronutrients and some micronutrients leads to a decrease in immune function and an increases incidence of infectious diseases in children. Even before there is a significant decrease in CD4 cells, the immune system's response to the virus leads to an acute-phase response that in turn causes protein catabolism and deficiencies of some micronutrients. If an HIV infected person becomes malnourished, the effects of malnutrition and HIV on the immune system are synergistic. Young children with HIV are 2.5 to 4 times more likely to die than their counterparts who are not infected.

So far, the results of MSU-3 project are very promising. The PIs have demonstrated that bean-containing food supplements improve the immune status (CD4 cell count) of HIV-infected children. This improvement in immune status has been noted to be greater in children not receiving anti-retroviral treatment (ART) than in children receiving ART, and it is the children lacking ART who have the greatest need of intervention. Most children living with HIV are infected during pregnancy.

MSU-3 project has three objectives as follows:
Objective 1: Determine if HIV infected, Highly Active Antiretroviral (HAARV) naïve, 2- to 15-year-old children and adolescents eating a bean-maize or cowpea-maize supplement will maintain higher CD4 percentage than HIV infected, HAARV naïve, 2- to 15-year-old children and adolescents eating a fish–maize supplement.
Objective 2: Determine the relative costs of three dietary treatments compared to HAARV drug treatment (Note: this will complete the data gathering begun in FY10).
Objective 3: Determine if eating the bean-based and cowpea-based supplements improve the integrity of the mucosal barrier in the gut and leads to reduced gut permeability and release of pro-inflammatory cytokines.

Training Objectives:
Sharon Hooper (Jamaican), is conducting a PhD study in Food Science at MSU with Dr. Bennink
Pudensiana Kiwali (Tanzania) is conducting a PhD study in Agricultural Marketing at SUA
Nyangi Amos (Tanzania) is conducting a MS study in Nutrition at SUA
Sacred Jacob (Tanzania) is conducting a MS study in Nutrition at SUA

EET Observations and Recommendations:
The EET observed through its interactions with Dr. Bennink, that the main issue he deals with is the logistics and lack of ability to provide sustainable bean supplement to those in need. We concur with TMAC's report that —The research findings for this project are essential to the future of legume research in Tanzania and beyond. It is clear that under-nutrition contributes to increase morbidity and mortality among HIV+ children." In terms of objective three of this project, access is needed to the current data in order to assess the extent to which this objective has been met. The PI has acknowledged that the samples were to be sent to the U.S. for analyses. It would be helpful to know which cytokines are going to be measured.

It is not clear what other parameters, other than CD4 and albumin, are being assessed. Normally, CD4 counts should be followed by serum albumin and liver transaminases. However, the PI has indicated that they will look at cytokines. Some of the cytokines are sensitive to the storage time and the conditions in which they are kept, e.g. -20ºC or -70 º C temperatures. Therefore, it is important that these parameters be analyzed in a random fashion, e.g. baseline samples, final samples, and corresponding final samples be analyzed at the same time, albeit in batches. A dose-response study may also be conducted in various age group populations.

In the current project, the bean supplements are presented as a _medicine' for the HIV+ children. However, it is best to promote these supplements as adjunctive therapy rather than medicine. It is understood that the purpose of referring to the products as medicine was to help ensure that the target child received the food. An alternate approach would be to provide the beans directly to the caregivers and have the target child fed directly. Crop selection by rural farmers depends on multiple factors. Demonstrating improved nutrition by providing bean/cowpea based food to caregivers for the HIV+ children or households in general may encourage interest in growing cowpea or beans.

The EET recommends that the MSU-3 project be given a no-cost extension to complete its work plan, but that this project should not continue in its present form in the next phase of the Pulse CRSP. Rather, the results of this study should be published and distributed to the appropriate institutions and agencies with significantly scaled up capacity to expand the program. The EET recommends that the MO discuss the continuation of this work with the USAID missions in Africa within the FtF mandate.

MSU-4 ***Impact Assessment of Bean/Cowpea and Dry Grain pulses CRSP Investments in Research, Institutional Capacity Building and Technology Dissemination in Africa, Latin America and the U.S.***

Phases: III
U.S. Principal Investigators and Institutions:
Mywish Maredia, MSU, U.S.
Host Country Collaborators and Institutions:
Richard Bernsten, MSU, U.S.; Eric Crawford, MSU, U.S., Jim Beaver, UPR, Puerto Rico; Juan Carolos Rosas, EAP-Zamorano, Honduras; Eduadro Peralta, INAP, Ecuador; Emmanuel

Prophete, Haiti; Ndiaga Cisse, ISRA; Senegal; Issa Drabo, INERA, Burkina Faso; Phil Roberts, UC-Riverside, U.S.; Jeff Ehlers, UC-Riverside, U.S.
Total Activity Budget: $425,990

Background, Objectives, and Progress:
The overall goal of this Phase III project is to provide greater accountability and validation as a prerequisite for continued support of the Pulse CRSP and to improve the effectiveness of the projects by examining the _impact pathways' of the current projects. The ex-post impact analyses of Bean/Cowpea CRSP technology adoption and economic value are important to USAID, while ex-anti impact assessments and advisement to the MO are valuable in setting technical research priorities.

The objectives of the MSU-4 projects were:
Objective 1: To build an inventory of past documented outputs, outcomes and impacts of investments by the Bean/Cowpea CRSP and develop a trajectory of outputs and potential types of impacts of investments made by the Dry Grain Pulses CRSP
Objective 2: Conduct ex-post impact assessment of Bean/Cowpea and Dry Grain pulses CRSP investments in research, institutional capacity building and technology dissemination in Africa, Latin America and the U.S.
Objective 3: Investigate opportunities to integrate baseline data collection and impact evaluation strategies as part of the CRSP project design
Objective 4: Build institutional capacity and develop human resources it the area of impact assessment research

The MSU-4 team compiled two MS Access databases: 1) Database of improved varieties of beans and cowpeas in countries where the Bean/Cowpea CRSP has been historically involved in crop improvement research, and 2) the database of socio-economic studies and impact assessments conducted by the Pulse and Bean/Cowpea CRSP to date.

Field research and analysis for ex-post impact assessment studies were conducted on: 1) the adoption and impact of new bean varieties in Central America and Ecuador and cowpea varieties in Senegal, and 2) documentation of all the outputs, outcomes and impacts from the Bean/Cowpea and Pulse CRSP value addition, food science and human nutrition projects.

Four baseline data collection and impact evaluations were initiated in FY 12 in three Phase I/II projects, and an Impact Pathway Analysis was completed for the Phase II and III projects.

Training Objectives:
The activities planned under this project involved four graduate students in the planning and conduct of field research. These students were recruited from within the Department of Agricultural, Food and Resource Economics at MSU as research assistants (and not as participant trainees). They include:

- Byron Reyes (Ecuador)
- Nelissa Jamora (Philippines)
- Ben Megan (U.S.)
- David deYoung, (U.S.)

The MSU MS student Nelissa Jamora left MSU to pursue her Ph.D. at another institution and her research was not completed

EET Observations and Recommendations:
The Phase III MSU-4 project made significant progress in the compilation of two informative and useful databases since 2010: 1) Database of improved varieties of beans and cowpeas in countries were the Bean/Cowpea CRSP has been involved in bean improvement research, and 2) Database of socio-economic studies and impact assessments.

The first database provides a historical summary of bean improvement achievements that have been made through the Bean/Cowpea CRSP and collaborating institutions such as CIAT, Zamorano, and NARS. The initial analyses of the data on the adoption of new bean varieties and their economic impact for Central America estimates the Net Present Value of these varieties at close to US$170 million and the Internal Rate of Return at 22%. Further analysis of this data is planned.

The second database gives categories and provides citations and URL links to socio-economic studies and impact assessments and serves as a reference point for other studies conducted in the future. The MSU-4 analysis found a *~~"l~~ack of documented evidence of 'adoption', 'uptake' and utilization of outputs of food science research by participants in the bean and cowpea value chains in host countries (or even in the U.S.)*." The problem does not appear to be the quality of the scientific research underlying the CRSP supported projects as the food science/human nutrition research has generated many scholarly publications and articles. The question thus remains: What are the barriers (markets, government policy, appropriate technologies, etc.) to the adoption of food science, value-added local products, particularly in Africa? The EET believes a greater understanding of these barriers in the value chain is an important research question for the next phase of the Pulse CRSP. With the rapid growth of large urban populations in Africa, there is a great need for affordably priced and easy to prepare pulse food products.

It was less clear to the EET the value of the Impact Assessment Pathway on the Phase II and Phase III projects or exactly how this information would be used by the MO, especially projects deemed to have little or no potential direct impact within the next 5 years. As with the food science/human nutrition research, it can be difficult to predict ex-ante the potential impact of different research tracts. While plant breeding and variety release is fairly straight forward, impact assessment of upstream/basic research is much less so. The EET recognizes that impact assessments are important to USAID and that an Assessment Pathway Analysis would be a useful evaluation instrument for the MO *ex post facto*; however, we also recognize the limitations of this type of analysis when applied to the design, development, selection and evaluation of future projects.

The EET commends the work done by Dr. Mywish Maredia as the Lead PI of the MSU-4 Phase III project. We recommend that the impact analysis and assessment pathway work be continued in the next phase of the Pulse CRS, but instead of functioning as a separate project, that it become a responsibility of the MO on a 0.5 FTE basis. This will allow Dr. Maredia to interact more directly with the lead PIs in the development of the next phase of projects.

ISU-1 ***Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda***

Phases: I/II
U.S. Principal Investigators and Institutions:
Robert Mazur, Iowa State University
Host Country Collaborators and Institutions:
Dorothy Nakimbugwe, Makerere University; "Henry" Kitzo Musoke, Volunteer Efforts for Development Concerns (VEDCO); Michael Ugen, National Crops Resources Research Institute (NaCRRI)
Total Activity Budget: $913,236

Background, Objectives, and Progress:
In both Uganda and Rwanda beans are an integral food source for protein, elicit positive digestive benefits such as nutrient absorption and are a significant source of income for medium and small-holder farmers. In both countries dark red beans are the preferred varieties for cultural reasons even though they have lower yields and nutritional properties than lighter colored beans. As a result, bean based products for household consumption are essential to improving the nutritional status of Ugandans and Rwandans, especially that of women and children. Currently, there are very few products available utilizing local or improved varieties of beans such as bean flour or other flours and pastes made with beans as a major ingredient. Makerere University and the NGO VEDCO have been working to design new bean based products for commercial release. Further, VEDCO on its own has taken on the massive tasks of introducing improved bean varieties, educating rural farmers on management techniques to increase yields, increase farmer knowledge of bean markets and increase family income. To date VEDCO has educated over 800 farmers in the Kamuli district. Thus far two types of improved beans have been released by VEDCO, K-131 and K-132 with the help of NaCRRI, new management techniques have been introduced to rural farmers in many cases doubling their yields. Further, Makerere University has brought to commercial production one product combining bean, rice and Amaranth flours that can be used for cooking. Additional products for commercial production are expected in the near future.

The four main actors; ISU, Makerere University, VEDCO and NaCRRI are an impressive force with their combined efforts and resources. ISU has the technical expertise and equipment to aid Makerere University in bringing products to market and assisting NaCRRI in its breeding programs. VEDCO has the technical and on the ground experience to continue to assist farmers and has the strong potential to expand throughout Uganda and into Rwanda, while advancing management practices and products developed by Makerere University. This university has the nutritional and production background to continue designing new products for rural farmers and commercial production. Finally, NaCRRI is expecting to continue to release additional bean varieties that are more pest and drought tolerant and is expected to expand into climbing bean varieties.

The ISU-1 project has three main objectives:
Objective 1: To improve harvested bean yield and quality in Uganda and Rwanda.
Objective 2: Enhance the nutritional value and appeal of beans through appropriate handling and processing.
Objective 3: Identify solutions for constraints to increased marketing and consumption of beans and bean based products.

Scaling up of community based seed systems.
The ISU-1 program has made significant advances in the development and dissemination of two new bean varieties bred from the local Kanyebwa bean, known as K-131 and K-132 respectively. K-132 has proven to be more resistant to soil nutrition deficiencies, leaf and shoot pests and root rot. The yields using K-131 and K-132 have doubled on most farms and have allowed for additional income generation and increased food security. Makerere University staff, led by Dorothy Nakimbugwe, have developed cooking flours and snacks derived mainly from bean flour and have evaluated them for nutritional content, which is quite substantial. One product has successfully made it to commercial production and is available to the general public, while more are expected to follow after sensory and nutritional studies are conducted. VEDCO and NaCRRI have closely collaborated to disseminate the new seed varieties, management techniques and technologies, post-harvest handling and storage and bean market information through their vast network of extension agents. VEDCO has plans to move forward with NaCRRI and Makerere University into the fields of post-harvest management, including such techniques as triple bagging and storage. VEDCO has also expressed a desire to expand its operations beyond the current 800+ farmers into Northern and Western Uganda using CRSP funding. NaCRRI is looking to begin field trials of climbing beans so that new varieties can be bred and introduced to the areas of Uganda and Rwanda where they are already cultivated. The main goal of future progress however relies on the scaling up of community based seed systems to produce additional pure seeds for dissemination. BNF trials were also conducted along with limited phosphorus and pesticide trials.

Training Objectives:
Currently one PhD and three master degree seeking students were being trained at Makerere University through their association but not direct funding with this CRSP. In addition NaCRRI enlists students to work on its agricultural breeding programs while they pursue their various degrees, many of which end up working for NaCRRI.

Other non-degree training and extension activities occurred with over 800 rural farmers and extension workers in Kamuli, Uganda. These activities included seed multiplication, management training, seed harvesting techniques and some limited post-harvest and storage training.

EET Observations and Recommendations:
The ISU-1 project is a strong combination of different partners, who each have specific talents that have made this program a success. The connections and synergy between Makerere University, ISU, VEDCO and NaCRRI are well-established and successful in improving the bean yields and management practices of rural farmers in Uganda. These efforts have led to the

release of two new bean varieties K-131 and K-132 as well as products for the consumer market that utilize bean flour to make nutrient rich protein supplements for women and children, preventing malnutrition and stunting. It is extremely rewarding to see the positive impacts that the on farm management training as well as harvesting and post-harvest management have brought to the medium and small holder farmers. As such, the general consensus from the farmers was that they had doubled or tripled their income in a single growing season. This has allowed some farmers to pursue other career paths or send their children to better schools. VEDCO‘s utilization of CRSP funds is truly sensational as a few thousand dollars impact over 800 farmers. There is also a very heavy emphasis on gender equality in the program that ensures that women as well as men are able to access both quality seed and receive adequate training to better utilize space and increase productivity on their farms.

The program is in the beginning stages of post-harvest management studies and technology dissemination. Currently, ISU, VEDCO and NaCRRI have been instrumental in formulating best practices for handling and storing the K-131 and K-132 varieties. However, all parties have stated that there need to be additional studies and work done in the post-harvest management. At present, results of preliminary farm studies have seen declines in post-harvest losses from 60-70% down to 5-15% when utilizing sterile bean drying sheets and triple bagging. Further, the next logical step is studying the value chains from farm to market to ensure that the farmers are able to get their products to market for the best available price especially when utilizing post-harvest technologies. VEDCO also has a program by which they trained extension workers who went to visit the farms of those who received or were receiving management training or bean seeds on a weekly basis. This one on one interaction has helped to keep all of the advancements and progress in place where they would have in other cases fallen apart. Finally, while Makerere University has played an active role in seeking out producers of the products that they are inventing, this process needs to be sped up since they already have numerous products that are ready for commercial production.

The EET noted the TMAC‘s concern over a lack of soil fertility/improvement studies but found that there are currently too many biotic stresses such as pests and drought that would mask much of the effects produced by the addition of fertilizers or soil enhancement techniques. While there was strong evidence that Phosphorus was needed this aspect is not within the scope of this project but rather that of the ISU-2 program.

The EET recommends that the ISU-1 project be continued within the next phase of the Pulse CRSP with some further strengthening of efforts related to post-harvest management and market access for rural farmers.

The EET also recommends that the U.S. PI Robert Mazur along with the host country PIs publish more papers on the progress of their programs. In addition, the EET recommends that VEDCO receive additional funding through this program to enable continued expansion plans, which have been vital in the progress of this program to date.

ISU-2: ***Enhancing biological nitrogen fixation (BNF) of leguminous crops grown on degraded soils in Uganda, Rwanda, and Tanzania***

Phase: III
U.S. Principal Investigators and Institutions:
Mark E. Westgate, Iowa State University
Host Country Collaborators and Institutions:
Mateete Bekunda: Makerere University, Uganda; Lynne Carpenter-Boggs: Washington State University, USA; Karen Cichy: USDA-ARS, USA; James D. Kelly: Michigan State University, USA; Phillip Miklas: USDA-ARS, U.S.; Henry Kizito Musoke: Volunteer Efforts for Developmental Concerns, Uganda; Susan Mchimbi-Msolla: Sokoine University, Tanzania; Augustine Musoni: Institut des Sciences Agronomiques du Rwanda (ISAR), Rwanda; Eda Reinot: Becker Underwood, Inc., U.S.; Hamisi Tindwa: Sokoine University of Agriculture, Tanzania; Michael Ugen: National Crops Research Institute, Uganda; Peg Armstrong-Gustafson: Amson Technology L.C., U.S.
Total Activity Budget: $991,971

Background, Objectives, and Progress:
Common beans are the most important legume crop in Uganda, Rwanda and Tanzania occupying a very large proportion of land devoted to legumes. They are an important source of protein for low-income families in rural and urban areas providing about 38% of utilizable protein and 12-16% of daily caloric requirements. Improved bean production in Uganda, Rwanda, and Tanzania offers unique opportunities to address the deteriorating food security situation that exists in these countries and elsewhere in sub-Saharan Africa. Numerous studies have shown the potential of improving legume productivity by enhancing nodulation through proper use of a biological inoculant. Modern inoculant formulations designed to deliver a synergistic suite of biological and chemical enhancements for biological nitrogen fixation under stressful soil conditions have been made available to the collaborative research project by Becker Underwood, Inc. Becker Underwood‘s BioStacked® inoculant technologies for legume crops consist of well stabilized rhizobium bacteria, a biological fungicide, plant growth promoting rhizobacteria, and other biologically derived proprietary biostimulant technologies that are designed to promote plant growth and overall plant health. The project collaborators believe that this formulation will be particularly effective under degraded soil conditions encountered on small-landholder farms in Uganda, Rwanda, and Tanzania.

Although common bean has the potential for BNF, it is reported to have the lowest percent N derived from nitrogen fixation among legumes. Genetic variation for BNF has been reported within the primary gene pool, and lines with superior BNF have been identified; however, the screening of additional lines is warranted. Few breeding lines with improved BNF have been developed, thus marker-assisted selection (MAS) capabilities are desirable, as a means to facilitate breeding for traits like BNF with low to moderate heritability. Molecular mapping in combination with germplasm screening and MAS would be a powerful way to improve locally adapted germplasm for BNF in a host country. Recombinant inbred populations currently available are ideal for tagging and mapping genes that influence quantitative trait loci (QTLs). Few QTLs associated with BNF, however, have been identified to date, and those identified have

not been validated. Identifying and validating QTL, which condition enhanced BNF, would be a major contribution to the scientific community.

The ISU-2 project has four objectives:
Objective 1: To improve BNF and seed yields of common beans significantly using superior seed inoculants such as Becker Underwood's BioStacked® inoculant through farmer-based experimentation and adoption of innovative production techniques.
Objective 2: To examine the inheritance of genetic and environmental variation in BNF in common bean, and to identify molecular markers associated with QTL conditioning for enhanced BNF.
Objective 3: To improve the productivity, profitability, and sustainability of agricultural systems on degraded soils through effective dissemination of new information and technologies to small-landholder farmers.
Objective 4: Increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the bean and cowpea sectors in developing countries.

Training Objectives:
Seven (7) MS level graduate students and six (6) undergraduate students (five of which are from host countries) are being trained as part of this project. Two graduate students are being trained in the Soil Science Department at Makerere University under the direction of Dr. John S. Tenywa, Professor of Soil Science. Two graduate students are being trained at Sokoine University of Agriculture under the direction of Dr. Susan Nchimbi, Associate Professor of Plant Breeding and Genetics. One graduate student is being trained at Washington State University under the co-direction of Dr. Lynn Carpenter-Boggs, Assistant Professor of Soil Microbiology and Biochemistry, and Dr. Phillip Miklas, Legume Research Geneticist with USDA-ARS. One HC graduate student is being trained at Iowa State University under the direction of the program PI, Dr. Mark Westgate, Professor of Crop Production and Physiology. And one HC graduate student is being trained at Michigan State University under the co-direction of Dr. Jim Kelly, Professor of Crop Breeding and Genetics, and Dr. Karen Cichy, Research Geneticist with USDA-ARS.

Non-degree training has included formal internships for five (5) undergraduate students and training of HC laboratory technicians, field agronomists and extension staff, on the use and agricultural benefits of seed inoculants.

EET Observations and Recommendations:
The EET's review of this project made use of the various reports and workplans provided by the management unit (coming from the project team or the TMAC), a site visit to Iowa State, a site visit and discussions with some of the US partners at Michigan State, and site visits to Kampala, Uganda (Makerere University; VEDCO main office; NaCRRI facilities and field plots) and Kamuli, Uganda (VEDCO demonstration plots and farmer's fields). We did not have time to visit HC partners in Rwanda or Tanzania.

Several field trials have been conducted to evaluate genotype x inoculant x phosphorus treatment interactions. Protocols were established for quantifying biomass, total plant N, and petiole ureide content, as well as for sampling and analyzing root nodules. Soil samples and weather data were collected at various sites. Seeds of non-nodulating lines were obtained and distributed amongst some of the partners; further seed increases are underway. Grafting studies with non/non-nod lines, or bean/soybean combinations were conducted to assess aspects of the control of root nodule development. Genotyping of indigenous and trial inoculants was pursued. A large panel of genotypes was developed as part of a BNF diversity panel; seed increases are underway. Genetic diversity was documented as suitable for association mapping and physiological studies amongst bean lines selected for BNF capability. Putative BNF-responsive genes were identified to support future BNF diversity studies. A draft survey tool to assess farmer knowledge, practices, and attitudes about bean seed rhizobial inoculation was completed. Field staff were hired and trained to monitor and coordinate the extension work focused on farmer trainings on inoculant technologies.

The EET found the ISU-2 team to include a strong group of dedicated partners, but also recognized that the project being tackled is a rather difficult one. Our general impression, based on site visits as well as the project team‘s own reporting, was that the rhizobium field trials in Africa were not providing many definitive results. From a plant nutrition perspective, our assessment was that there were too many other overriding factors (nutrient stress, drought, insects, and other pathogens) that were complicating the rhizobial treatments/comparisons. Although we recognize that N is a limiting nutrient in the target soils of Uganda, Tanzania, and Rwanda, and BNF could potentially contribute to the N status of beans grown in these countries, we saw little benefit coming from the experimental studies conducted to date. It would appear that attention to issues of limited soil phosphorus (and possibly potassium and/or boron) or of low soil pH may need to be addressed before real progress can be made on BNF approaches. Some of these issues, along with other nutrient limitations, were being addressed with pot studies in screenhouses at NaCRRI and Makerere. We commend the team members for pursuing these more controlled studies and hope that they will yield useful information.

The EET also noted the questions being raised by project team members concerning the rhizobial inoculants being tested. Genetic analyses have raised concerns about whether the Makerere or Rwanda inoculants actually contain any rhizobia. This clearly needs to be sorted out before further field studies are pursued.

Certain aspects of this BNF project were focused heavily with US partners [e.g., Miklas (ARS-Washington State), Cichy and Kelly (ARS, MSU), and Carpenter-Boggs (WSU)]. This included much of the work to set up a BNF Diversity Panel, efforts to screen diverse genotypes for BNF efficiency, and efforts to genotype rhizobia and/or bean genotypes and RILs. This work seemed productive and moving in the right direction, but it was noted that we saw or heard of no connections between those activities and the field efforts currently being pursued in Uganda. Perhaps these US partner activities are still upstream of deployment/collaboration in the host countries.

Although definitive success with the BNF experiments was not achieved, the EET was pleased to see the cooperation that existed between ISU, Makerere, NaCRRI, and VEDCO, especially with

respect to outreach to farmers and the training of students and technicians. We were also encouraged by the progress made by VEDCO to develop a survey instrument to assess farmer's perceptions and knowledge about rhizobial technologies. However, we were also dismayed to learn that there were no local, commercial sources for rhizobial inoculum in the target regions in Africa. This would obviously diminish the potential success and impact of any BNF technology that might be targeted for dissemination.

Moving forward, the EET was unable to recommend that the ISU-2 project be continued in its current form in the next phase of the DGP CRSP. We do not believe there is much utility in continuing more of the field trials with rhizobium (or undefined inoculum), until various soil fertility and pathogen stress issues are resolved. Thus, we believe any continuation of activities by current partners on this project would need to be refocused, and probably re-competed. We do believe there was good synergy between the HC partners, such that future studies might be more productive if they were re-focused on non-BNF, soil fertility issues. Collaboration with investigators who are developing the NuMaSS (Nutrient Management Support System) software should be considered. Future emphasis could be placed on studies with varieties appropriate for western and northern regions of Uganda (and Tanzania and Rwanda, as well). Additional NaCRRI field stations would be needed; VEDCO extension agents might be able to help with access to farmer's fields. Some of the material to be tested could come from the BNF Diversity Panel being developed by US partners. These partners should be encouraged to continue developing materials suited for testing BNF traits, with the hope that the deployment and application of BNF technologies (in target regions of Africa) might be more realistic in future years. The EET also notes that there are no stable certified suppliers of rhizobium in Uganda (nor presumably in Rwanda or Tanzania); thus, the future promotion/dissemination of this technology would require some attention to the local commercialization of appropriate rhizobial cultures.

KSU-1 *Pulse Value Chain Initiative—Zambia*

Phases: III
U.S. Principal Investigators and Institutions:
Vincent Amanor-Boadu, Kansas State University
Host Country Collaborators and Institutions:
Dr. Gelson Tembo, University of Zambia
Total Activity Budget: $529,514

Background, Objectives, and Progress:
Two major sources of food and income in Zambia are beans and cowpeas. Beans and cowpeas constitute the greatest sources of protein available to people of all income levels, however relatively little is known on the value chains for pulses in Zambia, specifically how beans and especially cowpeas get from the farm to the market and what opportunities exist to make this process more efficient. Additionally, there are no previous studies on cowpea baseline data regarding market movements. Currently, Dr. Tembo has conducted over 1000 detailed household surveys (45 pages of questions in length) and is working with Dr. Amanor-Boadu at KSU to

clean up the data in preparation for data analysis. The focus of the surveys was cowpeas (both seeds and leaves), Lundazi beans and Mhala beans. Specifically, Dr. Tembo is looking to trace transactions from nine traders backwards to some 400 farmers and communicates with these nine traders on a weekly basis to further understand their weekly/seasonal movements in order to determine how to decrease transaction costs for both farmers and traders.

Drs. Tembo and Amanor-Boadu are also poised to conduct a case study on a large processor of beans and cowpeas named "Freshpikt" in order to understand how larger producers fit into the value chains. It was recently determined that demand studies should be added to the existing case study and household survey questionnaires to better understand the channels that exist for beans and cowpeas. This in turn would identify producer characteristics which leads to value created in the market.

The KSU-1 project has three main objectives:
Objective 1: conducting research to address the identified knowledge gaps about bean and cowpea value chains in Zambia.
Objective 2: determine the most efficacious value chains given producer and partner characteristics.
Objective 3: work with industry to develop and construct value chains that help increase producer incomes, improve food and nutrition security and improve efficiency along the supply chain.

Thus far objectives two and three remain uncompleted and objective one remains only partially completed. It must be stressed that this is not a major issue since in objective one the research has already been conducted and is currently being analyzed. Results for objective one are presumed to be released soon. Objective two remains incomplete because determining the most efficacious value chains can only occur once objective one has been analyzed at length.

Objective three is also not possible at this point due to current work being done on objectives one and two, which must be completed before objective three can be actively pursued. That being said Dr. Tembo is currently in constant contact with cowpea traders trying to understand limitations and flows of the value chains. Further understanding of food nutrition and security as well as increased producer incomes will come in time as this program progresses.

Training Objectives:
Currently, KSU is hosting three MAB students from Zambia. One student, Lydia, works for World Vision Zambia, which is a non-profit organization assisting farmers with sustainable development and is pursuing her MAB degree through long distance training at KSU and her thesis will be finalized in May 2013. Dr. Tembo is working with eight undergraduate students on the household survey and trader survey data, two of which have graduated. There are also two Masters students working with Dr. Tembo on his research, one is obtaining a degree in agricultural economics and the other is obtaining a degree in economics.

Other non-degree training and extension activities occurred with 1002 households who filled out 45 page questionnaires whom will receive the results of the surveys after the results have been cleaned and analyzed by both KSU and the University of Zambia. These households will gain

valuable information that will increase their productivity and market knowledge thereby making them more competitive in the cowpea production and trade.

EET Observations and Recommendations:
The KSU-1 project is one of the strongest projects in terms of both results and the implications of its surveys, which will shed light on bean and cowpea value chains that did not previously exist. Dr. Tembo has extensive help from his large pool of undergraduate and graduate students to both administer the surveys, stay in contact with the traders and to analyze the data. Additionally, Dr. Tembo seems to be working quite well with Dr. Amanor-Boadu at Kansas State University in cleaning up the data from the surveys as well as forging new and positive relationships with the private sector.

While it did take longer than expected to get the household surveys off the ground and to make good connections with bean and cowpea traders, significant progress has been made on both fronts with the KSU team in weekly contact with traders of seeds and the completion of the household surveys and the current analysis of the data. Additionally, Dr. Tembo told us that he would like to expand his surveys to different regions in Zambia and to further trace the movement of legumes between farmers and markets and eventually producers, in order to determine ways to lower trade barriers that currently exist.

One of the ongoing issues with this program which accounts for the late start of the survey administration to farmers and traders was that the University of Zambia took an inordinate amount of time to set up an account for the Pulse CRSP money for Dr. Tembo. This was due to legalistic tie-ups and additional bureaucratic holds that were placed on the funds. This program only gained access to its funding 18 months after the money had been awarded. However, despite these setbacks, the rapidity to which the survey data was collected and is being cleaned for final analysis has been most impressive. Another note of concern is that since Dr. Amanor-Boadu‘s focus is on private enterprise and private investments he would need to spend additional time in Zambia to ensure that he is giving the adequate care needed to the program as the focuses move from initial results to public and private engagements.

The EET recommends that the KSU-1 project be continued within the next phase of the Pulse CRSP with some further strengthening of efforts related to private sector engagement on the U.S. PI side and availability for assistance to the host country PI.

The EET also recommends that both Drs. Tembo and Amanor-Boadu publish results of their findings as soon as the data has been accurately assessed. These publications should take place in both Zambia and the United States, as the area of study is currently in uncharted territory. Further, the EET encourages Dr. Tembo to share the results of the survey analyses with the households surveyed as promised.

PSU-1: ***Improving Bean Production in Drought-Prone, Low Fertility Soils of Africa and Latin America – An Integrated Approach***

Phases: I/II
U.S. Principal Investigators and Institutions:
Jonathan Lynch, Pennsylvania State University, USA
Host Country Collaborators and Institutions:
Juan Carlos Rosas, EAP Zamorano, Honduras; Magalhães Miguel, IIAM, Mozambique; Kathleen Brown, Penn State, USA; Jill Findeis, Penn State, USA (now at University of Missouri); Celestina Jochua, IIAM, Mozambique; Soares Almeida Xerinda, IIAM, Mozambique; Roland Chirwa, CIAT, Malawi
Total Activity Budget: $831,406

Background, Objectives, and Progress:
Drought and low soil fertility are primary constraints to crop production throughout the developing world, and this is especially true of common bean, which in poor countries is typically a smallholder crop grown in marginal environments with few inputs. Phosphorus limitation is the most important nutrient constraint to bean production; unfortunately, fertilizer use is negligible in many developing countries, especially in sub-Saharan Africa, where farmers generally have the poorest soils. Research is needed to identify the sources of fertilizer phosphorus that could impact host country bean production and to help develop local markets for the fertilizer. Regarding drought issues, irrigation options are also very limited. Thus, there are needs for integrated nutrient management practices and improved germplasm, which could integrate fertilizer availability and use, with water conserving methods, and germplasm adapted for drought stress and low soil fertility. It is known that diversity exists amongst bean genotypes for root traits linked to drought tolerance and low soil fertility. Efforts to characterize these traits and to assess their utility in improving bean yields are needed. These traits could then be incorporated into breeding programs for cultivar improvement. Needs also exist for a better understanding of socioeconomic factors determining adoption of stress tolerant bean germplasm and the likely effects such adoption may have on household income and nutrition. Factors such as family structure (i.e., men versus women farmers) may play a role in determining whether the introduction of more productive germplasm is likely to have positive or negative effects on household income and nutrition.

The PSU-1 project has four objectives, which were consistent in Phases I and II:
Objective 1: Develop bean genotypes with improved tolerance to drought and low phosphorus.
Objective 2: Develop integrated crop management systems for stress tolerant bean genotypes.
Objective 3: Understand constraints to adoption of new bean technologies, income and nutrition potential, and intra-household effects and impacts.
Objective 4: Capacity building.

Training Objectives:
Two MS level graduate students have been trained as part of this project. An attempt was made to train additional students, but problems with English proficiency requirements (TOEFL test;

required for entrance to PSU) limited the number of students to two. Some limited involvement of undergraduate students and technician training was noted.

EET Observations and Recommendations:
The EET's review of this project made use of the various reports and workplans provided by the management unit (coming from the project team or the TMAC), a phone interview with Jonathon Lynch (US PI, PSU), and attendance at a bean meeting in Nicaragua that included discussions with some of the Latin American partners. We did not have time to visit HC partners in Mozambique, nor did we interview Jill Findeis regarding the socioeconomic components of this project.

The EET recognizes the following progress made in Phases I and II of this project:
Root architecture traits were characterized in a large number of diverse bean germplasm and recombinant inbred populations. Data were shared with cooperators and others through Pulse CRSP reports; several scientific publications arose from these studies. Field trials with potential phosphorus-efficient and/or drought-tolerant bean genotypes were conducted in HC and US to assess various yield-related components, root architecture parameters, and soil erosion outcomes. Host country cooperators were trained in root trait analyses. Intercropping studies were conducted to assess the possibility for using phosphorus-efficient varieties in a maize-bean-squash or maize-bean cropping system. Studies were conducted with different rock phosphate sources, to assess the availability of phosphorus in these materials for plants, relative to highly available superphosphate. A survey instrument (Mozambique Vulnerable Soil Vulnerable Household) was developed and used in a face-to-face survey format. Information was collected on acceptance of phosphorus-efficient bean seeds, bean preferences for planting/marketing by male and female farmers, and access to improved seeds.

The EET recognized the high scientific quality of the root trait investigations, and understood the theoretical basis for the root architecture approach. We were surprised, however, that the adoption of characterized germplasm (with specific root architecture traits) was so low by bean breeders. Some testing has gone on and continues to go on with cooperators in Honduras (Juan Carlos Rosas) and Mozambique (Celestina Jochua), but there appears to be little appreciation or acceptance of the root traits for improving phosphorus-efficiency or drought tolerance by the broader bean community. Some of this may be due to the fact that bean seed yield data are limited with this material. Much of the _yield' analyses conducted as part of this project have been shoot biomass measurements done in Pennsylvania; photoperiod constraints have precluded true seed yield determinations in these field trials. More comparative studies are probably needed in target environments in Latin America and Africa to assess the utility of altered root traits on nutrient uptake parameters, water use, erosion, seed yield, and seed quality, in order for bean breeders to take notice of root traits in their breeding programs.

The EET also recognized the strong scientific quality of the socioeconomic studies. These results should lead to a better understanding of farmer acceptance of new varieties and management technologies in the study regions, but hopefully will inform Pulse CRSP partners in other HC regions. The results should also point the way towards more market opportunities for farmers – especially women farmers.

Moving forward, the EET was unable to recommend that the PSU-1 project be continued in its current form in the next phase of the Pulse CRSP. We acknowledge the extreme importance of addressing soil fertility, phosphorus-efficiency, and seed/management acceptability or access issues for small-landholder farmers. However, we believe it would make more sense to refocus and integrate several of the objectives of this project into one or more broader projects in the next Pulse CRSP. Sufficient work seems to have been done already in Phases I and II on the characterization of several root architecture parameters, but until the bean breeding community takes note of and begins to utilize these traits, there seems no need to launch into additional root trait investigations at this time. We believe the current, extensive database on characterized genotypes, provided by the US PI, needs to be mined by the breeders before additional phenotypic studies are contemplated. We do hope that some benefit will come of the extensive work that has gone in to the last five years of this project. The EET does recognize the unique expertise of Lynch, and the importance that root traits will play in solving the soil fertility and drought problems facing Latin American and African farmers; thus, it is hoped that he might continue to be involved in a future Pulse CRSP Project, although perhaps more as a cooperator and/or consultant on a separate breeding-specific project. The current HC cooperators might also be considered for inclusion in a future project that pertains to their specific country. Regarding the socioeconomic objectives of the PSU-1 project, as noted elsewhere in this report, we are strongly in favor of including survey instruments and other methods that provide information on farmer-marketing-value chain interactions in all of the Pulse CRSP projects. Thus, we also would hope that Jill Findeis (now at the University of Missouri) might be brought in as a partner on one or more of the future Pulse CRSP projects.

TAMU-1 *Increasing utilization of cowpeas to promote health and food security in Africa*

Phase: III
U.S. Principal Investigators and Institutions:
Joseph Awika, Susanne Talcott, Bir Bahadur Singh, Texas A&M University, USA
Lead US PI: Joseph Awika, Texas A&M University, USA
Host Country Collaborators and Institutions:
John Shindano, University of Zambia, Zambia
Kalaluka Lwanga Munyinda, University of Zambia, Zambia
Kennedy Muimui, Zambia Agriculture Research Institute (ZARI), Zambia
Abdul Faraj, Egerton University, Kenya
Prisca Tuitoek, Egerton University, Kenya
Amanda Minnaar, University of Pretoria, South Africa
Gyebi Duodu, University of Pretoria, South Africa
Total Activity Budget: U$627,190.00

Background, Objectives, and Progress:
Poor families, especially children in Sub Saharan Africa, suffer high rates of malnutrition which may lead to increased risk of chronic diseases. In particular, this encompasses the diseases linked to chronic malnutrition, including cardiovascular disease, cancer, and osteoporosis in adulthood. Nutrition-related chronic diseases are becoming increasingly common in Africa, especially in

urban areas. Not only do they produce an immense economic burden in countries with limited health infrastructure, but they also contribute significantly to morbidity and mortality. Consumption of beans, including dry grain pulses, in general have been shown to enhance gut micro-flora, boost immunity and promote cardiovascular health. Beans‘ health benefits are not only due to the fact they are rich in macronutrients (low in fat) but also have high levels of soluble dietary fiber known to increase the production of short chain fatty acids in the gut resulting in better immune function and overall health. Additionally, the components of beans including cowpeas such as their antioxidant and anti-inflammatory properties may contribute to their health benefits. Therefore, the extent to which cowpeas and their constituents impact human health through up regulation of these molecules needs to be further investigated. Some cowpea varieties are amongst the most drought tolerant crops and have a great potential as a food security crop for many poor African subsistence farmers.

The objectives of the TAMU-1 study were:
Objective 1: Identify cowpea lines with high content of health enhancing compounds and their relationship to seed color and other seed traits.
Objective 2: Establish how the phytochemical profiles of cowpeas affect bioactivity by measuring key markers/predictors of protection against chronic diseases
Objective 3: Elucidate the mode of inheritance (heritability) of selected bioactive traits in cowpea and genetic association between physical and bioactive traits.
Objective 4: Establish strong linkages with HC policymakers and other stakeholders, and develop outreach strategies that will lead to long term increase in cowpea consumption for health and food security.
Objective 5: Strengthen cowpea nutrition research in Kenya and Zambia

Training Objectives:
Twambo Hachibamba (Zambia) is conducting a PhD study in Food Science at the University of Pretoria. She also spent 6 months in Dr. Awika‘s lab in Texas A&M University.
Alice Nderitu (Kenya) is conducting a PhD study in Food Science at the University of Pretoria
Leonard Ojwang (Kenya) conducted a PhD study in Nutrition and Food Science at Texas A&M University
Archana Gawde (U.S.) is conducting a PhD study in Molecular and Environmental Plant Science at Texas A&M University
Billy Kiprop (Kenya) is conducting a MS study in Biochemistry at Egerton University in Kenay

Short term training was also conducted for NGO representatives, academic and extension staff of Egerton and KARI in Nairobi and at Egerton University in Kenya. Another short term training of HC personnel and stakeholders was conducted in Zambia on phytochemical methods analysis.

EET Observations and Recommendations:
From host country side, this project is very weak with little perceived productivity. Resources at University of Zambia are not in place. The current PI, Dr. John Shindano, is new to the project with only one other staff member present at the University of Zambia. The other three faculty members have gone to South Africa to earn their PhD degrees. Turnover of previous host country (HC) participants has not helped this project. The Fluorescence/luminescence instrument (purchased with Pulse CRSP funds) is available, but currently out of service due to a

software problem. The HC team was to conduct ORAC assays on ten local varieties but did not complete the surveys due to instrument problems. A technician is apparently available (trained in ORAC methods and fluorescence methods), but expertise may be weak, especially based on the poorly demonstrated productivity. As a result, several HC objectives and sub-objectives have been turned over to Texas A&M University, but the numbers analyzed (e.g. reps, genotypes, environments) still seem low.

The current HC PI is also one of two current faculty members in Food Science Department at the University of Zambia. Three are away working on PhDs and positions are being filled with temporary hires. Hence, Dr. Shindano had had an increase in his teaching and administrative workload due to circumstances beyond his control.

The EET recommends that the nutrition efficacy studies be moved to animal models with less emphasis on cell culture, but that this work would have to be done at Texas A&M University as the host country investigators located at the University of Zambia do not appear to have the infrastructure in place to do such studies.

It is not clear to the EET how the U.S. and HC activities are interrelated and we suggest that this project be redirected. Breeding work by Dr. Munyinda, of the Agronomy Department, using radiation mutagenesis is producing some interesting cowpea breeding lines with new traits including seed size, yield, early maturity, and seed coat color, i.e. different phenolic and antioxidant profiles. Although he is not funded through Pulse CRSP, his work is highly complementary to the project objectives and fills the breeding work mentioned in the work plan.

Because there is a strong HC stakeholder interest, including government and NGOs, in the nutritional and health benefit aspects of this project, it is imperative that the U.S. and HC PIs seek out appropriate collaborators in order to build a team to carry out the nutritional studies required in order to influence government ministries to argue for new policies that would help expand cowpea markets. The EET recommends that this TAMU-1 not continue as a separate study, but be incorporated into the broader value-chain project for Zambia

UCR-1 *Modern Cowpea Breeding to Overcome Critical Production Constraints in Africa and the U.S.*

Phases: I/II
U.S. Principal Investigators and Institutions:
Philip Roberts, UC-Riverside; Jeffrey Ehlers, UC-Riverside
Host Country Collaborators and Institutions:
Ndiaga Cisse, ISRA, Senegal; Issa Drabo, INERA, Burkina Faso; Antonio Chicapa Dovala, IIA, Angola
Total Activity Budget: $993,555 (including $130,000 Technology Dissemination Award for seed of improved cowpea varieties in West Africa)
Background, Objectives, and Progress:
Cowpea is an important food legume in sub-Saharan Africa, particularly in West Africa, and an important pulse crop in California. In Africa, cowpea yields are typically low due to production

constraints of poor soils, drought, pests and diseases, and low to no inputs by the farmers, many being women who lack access to the most productive lands The UC-Riverside cowpea breeding program has successfully released improved high yielding, disease and insect resistant blackeye cowpea lines for the U.S. A pigeonpea selection is also being tested for fast-track release. During the previous Bean/Cowpea CRSP, several breeding lines were developed by INERA in Burkina Faso, ISRA in Senegal, and IITA are in the final stages of testing for varietal release.

The objectives of the UCR-1 project are:
Objective 1: Develop improved, pest resistant and drought tolerant cowpea varieties for target regions in sub-Saharan Africa and the U.S. using modern plant breeding tools.
Objective 2: Strengthen cowpea seed production and delivery systems in Angola, Burkina Faso and Senegal to ensure delivery of improved varieties.
Objective 3: Technology dissemination (seed of improved cowpea varieties in West Africa).
Objective 4: Capacity building for host country NARS

The UCR-1 project targets yield and quality enhancement through the genetic improvement of cowpea varieties using genomics and modern breeding approaches. On-farm trials of six lines were being conducted in Burkina Faso. Breeder seed of advanced lines is currently being produced in Senegal. In Angola, cowpeas field evaluations were conducted in three locations. Work in Angola has been slow due to problems in the Phase I field evaluations. In California several white and blackeye cowpea breeding lines were being tested in large-scale field trials. The UC Riverside breeding programs is targeting lygus, nematode, aphid and drought resistance. In West Africa, Striga, Macrophomina, and thrip resistance are being targeted in the breeding program, as well as grain quality, cooking time and yield stability.

Molecular SNP markers for root-knot nematode, fusairum wilt and aphids are being used to evaluate breeding populations. Work is underway to identify a SNP marker for lygus resistance. The EET was happy to see that leaf samples from the Host Countries and California trials are being sent to KBioscience for DNA extraction and genotyping with custom sets of SNP markers to aid in progeny selection.

Breeder, Foundation and Certified seed of the newly released varieties and existing varieties are being increased in Burkina Faso and Senegal at the research stations and by trained farmers.

Training Objectives:
Antonio David (Angola) completed his MS training in plant breeding and genetics at the University of Puerto Rico in collaboration with Dr. J. Beaver
Mame Penda Sarr (Senegal) is doing a PhD in Plant Pathology at the University of Dakar
Arsenio Ndeve (Mozambique) is doing PhD in Plant Breeding/Plant Pathology at UC-Riverside with Drs. P. Roberts, J. Ehlers and R. Chiulele
Mouhamadour Moussa Diangar (Senegal) is completing a MS degree in Plant Breeding/Genetics at the University of Ouagadougou with Dr. N. Cisse

EET Observations and Recommendations:
The UCR-1 program has a strong international team of cowpea breeders and partner institutions. Excellent work has been made in the development of disease and insect resistant breeding

populations and lines. The EET found strong evidence of research productivity through new variety releases in California and host countries and through scientific publications, and recommends that this project be continued in the next phase.

Continuing support to seed production and dissemination efforts will be critical for the new varieties to make on-farm impact. The EET recommends that socio-economic studies be included in the next phase to understand farmer decision-making in the adoption (or not) of the new releases and to work with agronomists to develop crop management practices that are compatible with farmer needs and constraints.

The UC-Riverside has successfully leveraged significant funding through the CGIAR Generation Challenge Program (GCP) Tropical Legumes for West Africa to develop and apply cowpea genomic resources, including CDNAs, BACs, ESTs and NSP genotyping for genetic and physical mapping and the development of high-through marker genotyping for major traits including insect and disease resistance and drought and heat tolerance. The EET supports and encourages this type of collaboration and leveraging of funds as the results of this work will be used by UCR-1 in the applied breeding programs and for greater efficiency and effectiveness in selection by both the HC and U.S. cowpea breeding programs. Other funds have also been leveraged, including funds for ISRA to begin a marker assisted Striga resistance backcrossing breeding program.

Senegal, a FtF focus country, and Burkina Faso are strategic for impacting the Sudano-Sahelian region of West Africa. Ghana is another country that could also be engaged in the next phase. The impact of the UCR-1 program in Angola has not been as effective; nor does it appear that there is a strong national program effort to increase their research capacity in cowpea. However, the continued partnership with the University of Puerto Rico for graduate training is needed to build capacity in Angola for pulse research.

In the next phase of UCR-1, changes in the project‘s technical leadership will need to be addressed with the future retirement of the UC-Riverside cowpea breeder and the imminent retirement of the HC PI Issa Drabo, though he has a very capable mentee who will take over his position. As with other projects, it will be important to seek new research partners and to encourage the U.S. and HC institutions to support these critical positions.

UIUC-1 ***Biological Foundations for Management of Field Insect Pests of Cowpea in Africa and Implementation of a Comprehensive Bio-Control Program for the Management of Economically Important Insect Pests on Cowpea in West Africa***

Phases: II/III
U.S. Principal Investigators and Institutions:
Barry Pittendrigh, University of Illinois at Urbana Champaign, Julia Bello-Bravo.
Host Country Collaborators and Institutions:
Dr. Clementine Debire and Dr. Malik Ba, INERA
Total Activity Budget: $1,217,927
Background, Objectives, and Progress:

Cowpeas remain one of the most important legumes in West Africa with Burkina Faso being the third largest producer of cowpeas behind Nigeria and Niger. The soil in Burkina Faso is such that the top soil is only 50-70 cm in depth and can be quite acidic, which makes the only cowpea varieties available very susceptible to drought and pests. Fertilizers and pesticides are beyond the reach of almost all farmers leading to depleted soils and insect infestations. Currently, Burkina Faso is poised to become a net exporter of cowpeas but major insect pests like legume pod borer, bruchids, and pod sucking bugs have lowered productivity and yield levels to such low levels that exportation of cowpeas to the other two aforementioned countries is not possible. As a result, the only logical option is to provide farmers with easily available ~~"n~~atural" pest control as well as the introduction of bio-control agents to help stem the effects of the insects that are devastating cowpea yields.

At present, studies led by both INERA and UIUC have found some profound results about the most destructive of the pests to the cowpea plant, an insect, *Maruca vitrata*. Maruca lay their eggs on cowpea plants. The larvae eat into the shoots of the cowpea plant, eventually killing it. Previously, it was believed that Maruca only bred below the southern border of Burkina Faso and that the Maruca would then migrate northward during the monsoon season into most of Burkina Faso. The studies that were performed on Maruca populations and movements using light traps in fields across the country for a year determined that Maruca were actually breeding much further north than previously thought, thereby affecting where bio-control agents should be released. The other great result that came out of studying the Maruca was that a local tree in Burkina Faso produces neem oil which contains a virus called the Mavi virus which is a natural pesticide that can be used against Maruca larva, killing it in the initial stages of pupal life in the plant. A combination of a liquid formulation of neem oil containing the virus doubled the cowpea grain yield and was more effective in controlling the pests of cowpeas than the use of most traditional pesticide sprays. Additionally, neem is readily available to grow, buy or purchase and is easily sprayed on cowpea plants. Further studies have indicated that the active virus in neem can be collected from the dead Maruca larvae, squished into a liquid and then reapplied with the same effects on cowpea plants for Maruca control.

To date, the project has also created some farmer training through two programs one of which is called Scientific Animations without Borders (SAWBO) that enables farmers who have low levels of literacy to learn farming techniques and pest management through online tutorials that are broadcast in 3D. These videos can be transferred from phone to phone or accessed over the internet and have voice-overs in native languages and or dialects. This program is completely funded by the World Bank and administered by Julia Bello-Bravo and the UIUC staff. Another extension building program that has been in place for about a year is called SUSDeViki, which is an online tool that allows extension agents to locate education materials appropriate for various levels of training from low level literacy to high levels of literacy depending on the audience. This is also funded by the World Bank and is available for free. A further extension training aspect of this program are the farmer training schools that train and educate farmers once a week for the entire cowpea growing cycle to help farmers with any problems that they may encounter during the farming season.

The UIUC-1 project has three main objectives:
Objective 1: In-depth understanding of the biology of the pest insects and how they interact with their environment.
Objective 2: Cost-effective and ecologically sound management approaches.
Objective 3: Cost-effective educational programs to train farmers in the use of some of these control strategies when and where active participation of farmers is needed.

UIUC has completed all of its objectives, however they wish to expand on each point and further move their studies into surrounding countries, specifically Niger. Thus far there have been extensive studies undertaken especially by Dr. Malik Ba on Maruca, Pod Sucking Bugs, Aphids, and Thrips among other plant pests. These studies have looked at the physiology, morphology, eating and mating habits, habitats and migration. These studies have been instrumental in designing natural means by which to devise pest control strategies for small holder producers of cowpeas.

The development of the neem oil containing the Mavi virus has been a significant point of progress in making cost effective and ecologically friendly management practices that can be utilized by all levels of farmers. This in combination with the extensive education tools found in SAWBO, SUSDeViki and the on-site farmer trainings have made this project a huge success. Further areas identified for study are Aphids, Thrips and post-harvest losses to further aid farmers in their battle against cowpea pests in Burkina Faso.

Training Objectives:
Through the training programs such as SAWBO and SUSDeViki the UIUC project has opened up the ability to train numerous farmers through the transfer of animations and document dissemination via cell phones for low literate farmers to use. In addition to the technology dissemination of farming management and pest control techniques, UIUC has demonstrated that it is highly engaged via extension training where INERA and UIUC employed staff go out into the field to give the local farmers hands on training for cowpeas on integrated pest management techniques.

Unfortunately, it is not known how many people have been trained through these activities because information can be shared from farmer to farmer without needing to access the data through their own cellphones. Additionally these training methods can be sent via email, played via DVD or projector which makes the ability to quantify true numbers of those trained extremely difficult. However, as new documents and videos are posted to SUSDeViki and SAWBO emails are sent out to current users and this number is expected to drastically expand in the near future leading to additional technology disseminations.

EET Observations and Recommendations:
The UIUC-1 project is an extremely strong project and the EET was highly impressed with the progress that the program has made in the short period of time during which it has been in operation. It is clear that Drs. Dabire, Ba and Pittendrigh work extremely well with each other and there is a great synergy between the various trainings such as farmer field training, SUSDeViki and SAWBO along with the work being done by INERA on bio-control agents and insect life-cycle studies. In addition to debunking previous assumptions regarding pests affecting

cowpeas the program has an extremely robust extension agent and training programs as evidenced by the two programs SUSDeViki and SAWBO.

The work currently being done using neem by INERA is extremely impressive such that it's neem oil with Mavi virus is roughly 93% effective against Maruca, which is almost as effective as the leading pesticide. This ability to utilize a local tree fruit in the fight to protect cowpea from the most destructive pests means that almost all farmers have access to this pest control method. Additionally, farmer groups are starting to form that are beginning to produce neem in large quantities for sale to farmers who do not have direct access to neem. While Bt Cowpea is relatively close to commercial production and dissemination to local farmers, it is still expected to be about 7 years away, making neem a good organic alternative to more costly and dangerous pesticides.

Finally, and most importantly, is the work being done to study the lifecycles of major pests such as Maruca, pod sucking bugs, thrips and aphids. Continued studies into these pests will help this program and farmers to better protect cowpeas against such attacks and it will also potentially lead to additional bio controls being found and then disseminated.

The EET recommends that the UIUC-1 project be continued within the next phase of the Pulse CRSP.

The EET is concerned that more needs to be done to ensure equal gender access to training in SUSDeViki, SAWBO and farmer trainings.

UPR-1 *Development, Testing and Dissemination of Genetically Improved Bean Cultivars for Central America, the Caribbean and Angola*

Phases: I/II
U.S. Principal Investigators and Institutions: J. Beaver, University of Puerto Rico
U.S. Collaborators: Consuelo Estevez de Jensen, University of Puerto Rico;
Timothy Porch, USDA-ARS Tropical Agriculture Research Station, Mayaguez
Host Country Collaborators and Institutions: Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras; António Chicapa Dovala, António Francisco Castame, Instituto de Investigacão Agronómica (IIA), Angola; Emmanuel Prophete, National Seed Program, Ministry of Agriculture (CRDA) Haiti,
Total Activity Budget: $931,500

Background, Objectives, and Progress: The common bean (*Phaseolus vulgaris* L.) is an important source of protein for low income families in Central America, the Caribbean and Angola. Increased or more stable bean yield can improve the diet and provide a reliable source of income for small-scale farm families in these countries. The development of improved bean varieties has proven to be an effective strategy to address biotic and abiotic factors that limit bean production in Central America and the Caribbean. During the past 10 years, however, only a limited number of black bean cultivars have been released in Latin America and the Caribbean. This is the result of a lower level of investment in black bean breeding and less emphasis in

Central America on the testing and on-farm evaluation of advanced black bean breeding lines by national programs. As a consequence, black bean cultivars tend to have lower seed yield potential and less disease resistance than the most recently released small red bean cultivars. The most promising small red bean cultivars developed at Zamorano can be readily used to improve black beans.

Improved bean breeding lines developed by the Dry Grain Pulse CRSP bean breeding program in Central America and the Caribbean may be useful in some bean production regions of Africa, given the similarity in agro-ecological zones and production constraints. Results from the exchange of breeding lines during Phase I of the project identified a few red mottled beans from the Caribbean that were well adapted to Rwanda. Some small red bean cultivars and breeding lines developed in Central America have resistance to diseases (BCNM, rust, angular leaf spot, and anthracnose) and tolerance to abiotic stresses (low soil fertility, drought and high temperature) that are important constraints to bean production in Africa. Although black beans are estimated to account for < 5% of bean production in Africa, this seed type is often a component of mixtures grown in low fertility soils. The lowland bean breeding team has developed Andean (red mottled and light red kidney) bean breeding lines with virus and rust resistance that may be useful in Southern Africa.

The UPR-1 project has five objectives
Objective 1: Development, release and dissemination of improved common bean cultivars for Central America, the Caribbean and Angola.
Objective 2: Selection of beans for adaptation to low N soils
Objective 3: Develop and test molecular markers for disease and pest resistance
Objective 4: Evaluation of other dry pulse crops for Central America and the Caribbean
Objective 5: Capacity Building

The UPR-1 program has made significant progress during Phase I and Phase II of the present funding cycle. During the project period, a number of new cultivars have been released for Central America and for Haiti. In addition breeding lines have been identified for the development of cultivars for Angola, for enhanced nitrogen fixation, and for disease resistance. Breeding lines have also been identified for other pulses - specifically, lima beans, cowpeas and tepary beans. The principal investigator and his collaborators list a large number of presentations of their work at national and international meetings as well as publications in peer reviewed journals.

Training Objectives:
Two master‘s degree students completed training at the University of Puerto Rico, with CRSP support.
Monica Mbui Martins from Angola completed a MS degree program in Plant breeding and Genetics in 2011.
Ronald Dorcinvil from Haiti completed a MS degree program in Soil Sciences in 2009.

In addition four students received partial support to complete B.S. degrees at the Escuela Agrícola Panamericana-Zamorano (EAP), Honduras
Paola Alvarado from Honduras received a degree in Plant Science in 2009
Ruth Valladares from Honduras received a degree in Plant Science in 2009
Jorge Ronny Diaz from Honduras (Peru) received a degree in Crop Science in 2011
Luís Patricio Moncaño from Honduras (Ecuador) received a degree in Crop Science in 2011

The UPR-1 project also supported a variety of short term training and extension activities designed for students, researchers, technical personnel as well as for farmers.

EET Observations and Recommendations:
This is a stellar project with a proven record of continuing success in an area which addresses the core objectives of the CRSP program. The most notable successes of the project concerns the release of improved cultivars as well as the identification of breeding lines that should pay ample dividends in the future for disease resistance in yet-to-be released new Angola varieties, and for pulses other than the common bean. The EET does note, however, that progress has not been outstanding across all the five objectives listed. Thus, the work on improved nitrogen fixation (new cultivars for low N soils) has not progressed as fast as may have been hoped, and few new molecular markers have been identified to aid the breeding programs. Furthermore, all of the new varieties released have been for Central America and Haiti, and none for Angola, but this may simply reflect the recent addition of Angola to the project. The EET recognizes that the breeding programs have a cycle time that is significantly longer than five years. Such criticisms are minor and do not detract from the overall quality of the project. The EET enthusiastically recommends continuation of the UPR-1 project.

One issue that must be taken into consideration however is succession planning for the project to maintain its vigor and thereby ensure its continuing success. The EET notes that the Principal Investigator and his key collaborator in Honduras have reached or are approaching retirement age. The EET considers that the project could benefit in the future by including one or more junior and younger investigators who could carry the project forward in the longer term and thus consolidate the legacies of Drs. Beaver and Rosas.

BTD *Strategic Investment in Rapid Technology Dissemination: Commercialization of Disease Resistant Bean Varieties in Guatemala, Nicaragua, Honduras and Haiti*

Phase: III (Associate Award)
U.S. Principal Investigators and Institutions: Luis Flores, Michigan State University
U.S. Collaborators: Jim Beaver, University of Puerto Rico
Host Country Collaborators and Institutions: Juan Carlos Rosas, Escuela Agrícola Panamericana-Zamorano (EAP), Honduras; Narcizo Meza Linares, Dirección de Ciencia y Tecnología Agropecuaria (DICTA), Ing. Misael Espinoza, DICTA; Alfredo Mena, Inter American Institute for Cooperation in Agriculture (IICA), Pétion Ville, Haiti, Emmanuel Prophete, National Seed Program, Ministry of Agriculture (CRDA) Haiti; Ing. Aurelio Llano, Instituto Nicaragüense de Tecnología Agropecuaria (INTA) Nicaragua; Ing. Julio Cesar Villatoro, Instituto de Ciencia y Tecnología Agrícolas (ICTA) Guatemala; José Angel Dávila

Estrada Fundación para la Innovación Tecnológica, Agropecuaria y Forestal (FUNDIT), Guatemala.
Total Activity Budget: $3,365,011

Background, Objectives, and Progress: The project seeks to contribute to the achievement of four central goals: *i)* to increase agriculture productivity, profitability and income of farm families; *ii)* to disseminate outputs of agriculture research so as to reduce risk/vulnerability and to increase productivity gains of staple crops; *iii)* to increase market access in an improved policy environment with greater private sector investment; and *iv)* to increase nutritional interventions so as to reduce child mortality and improve nutritional outcomes. Specifically, the project addresses the shortage of high-quality bean seed of improved varieties available to resource-poor farmers in countries in Central America and the Caribbean; Haiti, Guatemala, Honduras and Nicaragua. Specific aims of the project are to establish a network of community seed banks (CSBs) for beans in the five bean producing regions in Nicaragua, and to export this alternative model for sustainable seed production to two other countries in Central America, Guatemala and Honduras as well as to Haiti.

The concept of CSB‘s first originated in Nicaragua at the Nicaraguan Institute for Agricultural Technology (INTA). In this model each CSB has an identified leader farmer, a *Promotor*, with whom technical staff interacts. The *Promotor* receives regular training on seed production and handling. The bank is ―capitalized" each year by INTA through the provision of ―registered" seed of improved varieties, plus a package of inputs (such as fertilizer, silos, Rhizobium inoculum etc.). Each CSB commits to provide 20 pounds of the quality-declared seed to 50 farmers in their community or neighboring communities. The recipient farmers commit to pay back the CSB with seed or with quality grain in order to maintain a reserve of improved genetic material. CSBs vary in the number of members, bylaws of the bank and, geographic extension of their member base. In this model, the quality of seed produced is constantly assessed by end-users, the cost of the seed is considerably lower as compared to ―certified" seed available in commercial agriculture depots, and the seed is available within a short distance from the farmers.

This project has made significant progress since it was initiated in October 2010. During the first half of the first year of the project, activities focused on identifying appropriate partners and establishing sub-contracts for implementation of project activities both at the regional and at the country levels. Efforts during the second half of the first year focused more on providing leadership in project implementation; developing Scopes of Work for each partner institution and setting target dissemination goals in each country. During this first year 200 Community Bean Seed Banks were established in Nicaragua, and seven each in Guatemala and Honduras, disseminating 11 varieties adapted for differing microclimate and environmental regimes. During the second year, due to end in September 30 2012, further substantial progress is being made in all four countries in establishing more CSB‘s, and strengthening those already in existence. Progress however has not been uniform across all countries. The most success has been achieved in Nicaragua where the concept of CSB was established before the initiation of this project, and where CSB‘s have previously existed for other crops. The least progress has been made in Haiti, where the project has encountered substantial challenges and setbacks.

Training Objectives: Since this associate award is not, by definition, a research project, it may be expected that no specific graduate training activities are reported. Nevertheless, one U.S. graduate student, David Young, is receiving training in monitoring and evaluation (M&E), under the direction of Dr. M. Maredia, who has the lead in this project for M&E.

As may be expected for such a project, a number of technical training activities are reported for the three Central American countries, for farmers, extension workers and *Promotores*.

EET Observations and Recommendations:
The EET considers that this project has already in its short existence (less than two years at the time of writing this report) had an outstanding record of success due in no small part to the leadership of the PI at MSU, Dr. Flores, and his team of dedicated collaborators in all four countries. The team has well recognized that the Nicaragua CSB model must be adapted and modified (in the case of Haiti substantially) to take into account the different policies, quality of the infrastructure, and state of development of the extension services in each country, as well as the differing cultural and political environments in each country. In this regard, the experience of the BTD project in modifying and adapting the Nicaraguan CSB model for Haiti, Guatemala and Honduras has provided and will continue to provide much valuable information, should USAID or other donors decide to support the establishment of CSBs in other parts of the world.

The BTD project has been quite candid and honest about the relative lack of success of the project in Haiti. However, the EET is well aware of the extraordinary difficulties of working in that country, which were greatly exacerbated by the recent earthquake, devastating the infrastructure in large parts of the country. Thus, this lack of success should not, in any way be construed as criticism of Dr. Flores, or Dr. Prophete, or their other collaborators in that country. If, at the end of three years, no significant achievements are reported for the BTD project in Haiti, the EET considers that no other organization or group of individuals could have done any better.

In summary, the EET considers that during its short existence – less than two years – the BTD project has achieved spectacular results. They have also generated much useful information and insights which could prove to be extremely important in the successful implementation of CSB projects in other countries in other continents. Accordingly, the EET enthusiastically recommends continuation and even expansion to other Pulse CRSP countries, hopefully, through USAID Mission awards and buy-ins.

C. Research Activities

1. **Describe whether the depth, breadth, and rigor of the research and development activities have been sufficient to allow the CRSP to achieve its stated goals and objectives.**
   A significant strength of the Pulse CRSP is its multi-disciplinary portfolio of research activities that include molecular genetics, breeding, integrated crop management, BNF, root architecture , IPM, plant pathology, food science and chemistry, human nutrition/feeding

studies, socio-economic, marketing and value chain development. Overall, the Pulse CRSP projects have achieved most of their stated goals and objectives.

2. **In what ways are the research activities strategically sequenced to ensure targeted development outcomes within a known period?**
The Pulse CRSP was designed to be implemented in two discrete phases (I and II). Each phase required that the projects contain a workplan and budget corresponding to the funding period and a defined set of objectives, outputs, and capacity building efforts. The Phase I workplans were discussed and prepared in concert with the Host Country collaborators at a Pulse CRSP "All Researchers Meeting" held in Barcelona, Spain in February, 2009, and subsequently reviewed and approved by the MO and the USAID Cognizant Technical Officer. At the end of Phase I, each project submitted a Technical Progress Report, which were reviewed by the TMAC and MO. One project was not refunded and the remaining PIs were asked to submit revised Phase II workplans based on feedback from the TMAC.

   When USAID increased the Pulse CRSP funding in 2009, funds were set aside and specifically designated for dissemination of outputs (technologies) that resulted from Pulse CRSP research and three projects (UPR-1, UCR-1 and UIUC) received supplemental funding to support bean and cowpea seed multiplication activities in Central America and West Africa (Senegal and Burkina Faso) and dissemination of IPM messages for cowpea in West Africa.

   Several projects integrated outreach activities into their respective projects. ISU-1 partnered with an NGO in Uganda, Volunteer Efforts for Development Concerns (VEDCO), to link with communities and farmers and extension training services. ISU-2 partnered with VEDCO to educate and disseminate Rhizobium inoculants to farmers in Uganda. UIUC-1 undertook the development of animation videos to communicate IPM messages to farmers and extension agents in West Africa, done concurrently with their research on monitoring of insect pest movements and assessment of biological control strategies.

3. **How relevant are the research activities to USAID's current FTF research strategy? Are the Missions or other operating units (i.e., other Washington-based offices) aware of and have they sought to access the CRSP's technical, training and outreach expertise? Give examples.**

   The EET believes that the Pulse CRSP is very relevant to FtF and well positioned to contribute significantly to the overall FtF research strategy. Eight USAID Missions have identified "beans"/grain legumes as a "strategic value chain".

   The Pulse CRSP participated in two "Sustainable Intensification of Cropping Systems" meetings funded by USAID under FtF and convened by IITA (the lead contractor): Ghana for the Sudano-Sahelian cropping system of West Africa, and Tanzania for maize-based cropping systems or Eastern and Southern Africa. As a result, three "Quick Wins" short term projects have been awarded which involve the Pulse CRSP.

Relative to engagement with USAID Missions, the MO has only been approached by the Nicaraguan and Guatemalan Missions because of their awareness of the effectiveness and benefits to smallholder farmers of the Bean Technology Dissemination Associate Award. Other USAID Missions who have expressed interest in the Pulse CRSP include Zambia, Mozambique, and Angola. In the next phase of the Pulse CRSP, the EET recommends that the MO be proactive and deliberate in contacting and linking with USAID Missions as potential partners in the implementation of their country's FtF agriculture development strategy.

4. **Which projects are likely to make the most progress towards fruition if another five years is granted? Are they scalable for greater impact?**

   UIUC-1
   UPR-1
   MSU-1
   UCR-1
   ISU-1
   KSU-1
   MSU-4
   BTD

   The EET believes that dissemination of outputs from the majority of these projects can be scaled up to achieve broader impact.

5. **Do the results achieved to date and the expected outputs justify greater emphasis (effort and investment) on outreach and scaling-up for impact if another five year renewal is granted? Why or why not?**

   The EET believes that some of the project outputs could be scaled up if another Pulse CRSP is renewed for another 5 years. However, we question whether this would be the best use of the core Pulse CRSP research and capacity building/training activities. Rather, investing in more up-stream research (i.e., development of molecular markers; understanding complex interactions low soil fertility/root rot pathogen complexes) would better utilize the U.S. universities comparative strengths and capacities, coupled with the HC's abilities to conduct complementary on-site, on-farm research depending on the study.

   However, as seen in some international research/development projects of the past, significant resources (time and money) can be misdirected if the research being conducted is not based on farmer needs and constraints, and evaluated on-farm. This is equally true whether the new technology/practice is for technology-intensive U.S. farms or resource-poor farms in Africa or Latin America. Because of the complex nature of farming systems in most Pulse CRSP host countries, especially in Africa, the EET recommends that socio-economic analysis be an integral part of most HC activities and that participatory research be integrated into these projects.

   The EET recommends that large-scale outreach and technology dissemination activities be supported by USAID Missions through associate awards and buy-in. The challenge is how to engage Missions so that they take interest and appreciate the value of technologies, practices

and knowledge being generated by CRSP projects, and take the initiative to support associate award activities.

6. **If another five years is granted, how should the program focus its efforts to achieve a greater level of effort or extend farther towards impact? Should there be a focus on fewer high performing activities? Should there be a different mix of activities along the research continuum? Which ones need to be refocused or discontinued? Among the projects making significant progress, which ones are scalable for a greater impact?**
The EET recommends that in the next phase of the Pulse CRSP that there should be greater focus on a fewer high performing, multidisciplinary projects, and that within those projects there should be a mix of activities along a research continuum that takes advantage of the comparative strengths of the U.S. and HC PIs and associated partners and institutions.

   Some areas of research focus to be considered are:
   a) Phenomics for physiological traits associated with legume yield, adaptation to abiotic and edaphic constraints, and some focused work on target pests and disease constraints.
   b) Identify and use of molecular markers to improve bean and cowpea yield potential and adaptation to strategic agro-ecologies in West Africa, Eastern and Southern Africa and Central America.
   c) Develop IPM strategies, utilizing _omics' tools, for the effective deployment of biologicals to control insect pests in West Africa.
   d) Develop agro-ecological strategies to improve soil fertility, increase natural BNF capacity, and reduce soil-borne diseases of beans in Eastern and Southern Africa and Andean Latin America.
   e) Enhance nutritional quality of diets
      - Understand potential contribution to grain legumes in diets to the nutrition and health to children up to 3 years old (the first 1000 days) and women of child bearing age.
      - Understand role of grain legumes in gut health and function as related to nutrition
   f) Transform pulse value chains through socio-economic research which seeks to understand constraints, especially those in marketing, and interventions to lower transaction costs while improving access/participation by women in income generation, including better understanding of urban and rural consumer demand for grain legumes.
   g) Conduct research to assess impacts of past research outputs, monitor performance and outcomes of new projects, and assist PIs in the design and development of new projects to both learn from past experiences and to promote CRSP achievements.

Research on BNF (ISU-2), root architecture (PSU-1), and cowpea antioxidant properties (TAMU-1) should be incorporated into other projects. Other projects such as MSU-2 and MSU-3 should be given no-cost extensions to complete on-going research and training activities and then discontinued.

E. <u>Program Focus</u>

1. **In general, comment on the depth versus breadth of the program.**
The Pulse CRSP encompasses a wide range of projects of different depths and breadths. Some of the projects that continued from the Bean/Cowpea CRSP into the current Pulse

CRSP brought with them a wealth of knowledge, experience, and a track record of impact. A few of the new Pulse CRSP projects, some established in Phase III, did not have the same depth of experience working with dry grain pulses and HC partners, and this was reflected in some initial startup delays and problems in the design of their experiments. However, overall the EET found that all the Pulse CRSP projects were able to successfully complete most of their stated objectives with notable outcomes.

2. **What are the synergies across research activities that warrant the number of research activities in the portfolio? Have the activities been of sufficient depth to make an impact on the state-of-the-art or to apply existing knowledge to real life problems? Give examples**.
   It is vitally important in a CRSP program that there be clearly defined connections, research interactions, and coordination of research activities with common HC partners to achieve such synergies. A CRSP program is more than the summation of the component projects.

   Synergies exist between the breeding project activities, with those working on integrated crop and pest management (as varieties with agronomically important traits including disease and insect resistances are important in ICM and IPM), value addition (cooking, processing and culinary traits), nutrition and with marketing and consumption studies.

   In the future, linking the phenotyping research with the genotyping platforms, marker identification and ultimately with NARS breeding efforts (which use MAS) will be critical to making gains in yield potential.

3. **Please comment on the quality and depth of the research and the relevance of the work to provide solutions to the pulse sector development problems? How could the major themes or topics be refined to increase impact?**
   The quality of the programs that the EET has recommended for continuing funding is exceptional in both the nature of the work as well as the substance. Much of the research is filling vital gaps in the value chains, as well as providing research on a variety of topics such as bio-control agents, nutrition, and plant physiological traits and plant varieties. As a result the depth of the research stretches from the basic (cowpea value chain) to the extremely complex (breeding for drought tolerance). Further, this research provides a base for additional work in Africa and Latin America that will enable farmers to be more productive, efficient and profitable in an age of increasing food insecurity.

   The aspect of gender equity is paramount in the CRSP-targeted countries in Africa and Latin America where women do not receive equal treatment, training, and access to resources as their male counterparts. This undermines the food security of families, and especially that of women and children who see less of the profits from farm production. Although the Pulse CRSP has done an excellent job in training women graduate students, some projects need to make a more concerted to ensure that women and children are the foci of their HC training and extension activities. A positive example is ISU-1 which currently makes a very concerted effort to ensure that women are receiving the same assistance as men.

4. **How well has the ME balanced the research and implementation activities given the amount of funding provided? Please provide some direction or focus on how much emphasis should occur within the Pulse CRSP portfolio on basic research, applied research, and implementation**.
   Overall, the ME has a well balanced approach in the funding provided to the research and outreach activities within the portfolio of projects. In the next phase, the EET recommends that the overall strategy of the Pulse CRSP should be to invest in a portfolio of fewer high priority, multidisciplinary projects in priority technical areas and to adequately support these efforts so that the projects have a better opportunity to achieve their target objects and goals. Larger-scale outreach and technology dissemination activities should be supported by USAID Missions through associate awards.

5. **How does the Pulse CRSP respond to Title XII's objectives?**
   The EET met with representatives of the U.S. Dry Bean Council. They are very supportive of the Pulse CRSP and its activities. They emphasized the importance of U.S. breeders having access to improved breeding lines, sources of disease resistance, and other germplasm through their interaction with Pulse CRSP breeders.

   In recent years, marketing of the nutritional and health-promoting value of grain legumes has been the number one priority of the US —bean" industry. Grain legumes are being promoted in the U.S. for their health and nutritional value, especially as related to reducing the risk of chronic diseases (type 2 diabetes, cardiovascular disease and cancers).

   The Pulse CRSP is recognized by the U.S. industry as providing leadership to the industry on nutrition research. The Pulse CRSP MO administered the research program of the Beans for Health Alliance. The current research of Maurice Bennink is being closely monitored by the industry because of its focus on child nutrition. Going forward, research focusing on gut health and function as related to nutrition and reduction of risk of chronic diseases would be highly supported by US industry groups.

D. Collaboration, Capacity Building and Outreach

1. **What are some examples of partnerships and collaboration between host country and the U.S. PIs? How have they been effective at building the capacity of local researchers, policy makers and practitioners?**
   The EET observed that all the Pulse CRSP projects required effective collaboration and partnership between U.S. and HC scientists to achieve the project's research and developmental outcomes. Greater than 50% of all project funds go to HC institutions. This has two advantages: 1) it stimulates greater collaboration, interactions, and technical capacity building with the HC institutions and scientists; and 2) invests in the development of capacity within the host country to sustainably address challenges facing the pulse sector.

   A study on the impact of U.S. graduate degree training on capacity building was conducted by Jamora, Bernsten and Maredia (2011, http://purl.umn.edu/105037). The study found that over 86% of host country trainees returned to their home country. In their enhanced capacity, trainees made contributions to the advancement of pulse and other crop research that can be

attributed to their graduate degree training. Trainees reported that their graduate degree training was necessary for their professional development and was highly relevant to their current job responsibility.

2. **Compared to the research activities of the CRSP, what has been the level of effort and investment in training and institutional capacity building? Has it been effective? How can impact of capacity building be captured (and measured) more effectively?**
   The institutional capacity building needs identified by the HC institutions are integrated into each Phase I, II and III project. A minimum of 30% of project funds must be in support of degree and/or short term training. As described in the answer to the previous question, 86% of the host country graduate degree trainees returned to their home countries. In some cases, recent PhD (and some) MS graduates were quickly advanced into administrative positions which has limited their ability to manage active research programs. The EET recognizes many countries, especially in Africa, do not have enough trained agricultural researchers to meet the needs of their country and that continued capacity building is needed. Graduate level training and non-degree/short term training are a major strength and program activity of the Pulse CRSP that should be continued in the next phase. Current monitoring and evaluation techniques of such training through the annual training reports are more than adequate and need no further enhancement.

   In-country capacity building for technicians, NGO staff, and others support personnel has been supported to a lesser degree in some projects and hampered by the poor conditions of many of the facilities, including lack of instruments, technicians and access to stable electricity levels. Some of the program sites visited in Africa had stated specifically that they wish they could receive technical training on specific laboratory instruments and on breeding techniques, or for their technicians to receive such training. This aspect could be greatly strengthened should U.S. PIs themselves provide training in the host country or send qualified technicians to do so. This is the only feasible way to increase institutional capacity in regions where there is simply no means by which to do so from local sources.

3. **What outreach strategies have been integrated into project design to increase likelihood of uptake and utilization of research results? What have been the most effective strategies for outreach at the country level?**
   The involvement of national extension programs, local and international NGOs, and farmer groups into the project design helps to increase the likelihood of uptake and utilization of research results. The EET founds a number of examples of effective strategies for outreach at the country level. These are described in the individual project reports above.

4. **What have been the outreach efforts at the regional or "global" level?**
   The Pulse CRSP has a strong regional outreach effort. The Bean Technology Dissemination (BTD) associate award is an example of an effective outreach effort at the regional level (Nicaragua, Honduras, Guatemala and Haiti). Not only is the project facilitating the dissemination of quality seed of improved varieties generated through CRSP investment, but it is also bringing NARS together in Central America to promote a common sustainable seed systems model: the community seed banks.

Similarly, the IPO-omics work on cowpea through UIUC-1 is regional in West Africa (Mali, Burkina Faso, Niger, Nigeria Benin and more recently Ghana). The cowpea seed multiplication activity of UCR-1 is also partially regional (Senegal and Burkina Faso).

All these initiatives could easily be expanded and extended to other countries. The limiting factor is resources. One could make a strong case however that this type of activity should best be carried out with USAID country or regional mission support (through the associate award and buy-in mechanisms).

5. **How has the ME communicated its activities to the global community through:**
   - **b. Hosted events, peer-reviewed journals and published work?**
   - **c. USAID Missions and other operating units?**
   - **d. Other donors and partners (other bilateral development agencies, etc.) How might the management entity better capture "impact" of their efforts at this level?**

     Examples of Outreach Activities by the Pulse CRSP MO:
     - Global Pulse Researchers Meetings in Ecuador 2010 and Rwanda 2012
     - Pulse CRSP sponsorship of World Cowpea Conference in Senegal in 2011
     - PI and Director participation in Bean Improvement Cooperative (BIC) meetings
     - PI and Director participation in the PCCMCA meetings (Mesa de Frijol)
     - Publication and distribution of annual Technical Highlights Reports
     - Pulse CRSP Website
     - Publications by PIs

III. ADMINISTRATIVE REVIEW

1. **What have been the roles/functions of the advisory committees and the administrative leadership? How cost effective has each been? Could they be more efficient? How?**
   The External Evaluation Panel (EAP) of the 2002-06 Bean/Cowpea CRSP recommended that the Board, Technical Committee, and Regional Planning Teams be replaced with the Technical Management Advisory Committee (TMAC) in the Pulse CRSP. The TMAC combines both administrative advisory and technical performance monitoring functions. The role, composition and responsibilities of the TMAC are described in the Operations and Policy Manual of the Pulse CRSP.

   The TMAC is comprised of three PIs who are elected by their peers, an external internationally recognized pulse scientist, two representatives from CGIAR centers (CIAT and IITA), an industry representative (appointed by the US Dry Bean Council), and the USAID Agreement Officer Representative (AOR) for the Pulse CRSP. The members include:

   External: Dr. Douglas Maxwell, University of Wisconsin
   Dr. Ousmane Coulibaly, IITA-Benin

IACR:	Dr. Steve Beebe, CIAT
Industry:	Greg Varner, Michigan Bean Commission
PIs:	Dr. Barry Pittendrigh, University of Illinois at Urbana-Champaign
	Dr. Amanda Minnaar, University of Pretoria, South Africa
	Dr. Mywish Maredia, Michigan State University
AOR:	Larry Beach, Bureau of Food Security

The EET has been very impressed with the role, composition, and performance of the TMAC. The committee has been very effective in evaluating the projects' annual work plans and technical progress reports and advising the MO. The TMAC performed an important function in assessing the performance of Phase I projects, including field visits to specific projects, and recommending extensions of selected projects as Phase II projects (with some redirection and refocusing). They also evaluated all Phase II and III projects for performance, potential and relevance, and formulated recommendations regarding the future status of these projects should the Pulse CRSP program be extended for five years.

The Pulse CRSP continues to maintain "Institutional Representatives" who are, at times, called on to address contractual or personnel issues at partner universities.

2. What has been the substantial involvement and contribution of the USAID AOR?
The program has had three AORs during the course of the current Pulse CRSP program: Jeryis Oweis, Bahiru Daguma, and Larry Beach.

The MO was very complementary of the positive and productive working relationship he has had with all three AORs, each with different project management style, skill sets, and understandings of pulse research. Each of the AORs contributed significantly to the implementation and oversight of the Pulse CRSP.

The EET recommends that the AORs work proactively with the MO to cultivate stronger linkages with USAID missions.

3. What was the process for sub-award selection? How effectively did the process yield a high quality, relevant portfolio of activities? How consistent was it with the requirements of the cooperative agreement?
The MO issued two RFPs; one in 2007 to initiate the new Pulse CRSP, and one in 2009 when USAID increased the project ceiling for the Pulse CRSP. The 2007 RFP resulted in the selection and awarding of eight Phase I projects. The 2009 RFP resulted in the awarding of four Phase III projects. Both selection processes were fully open and competitive. Evaluation was based on clearly defined and publicly known selection criteria.

For the selection of the 2007 proposals, the MO convened an expert External Advisory Panel (EAP) for four days to oversee the review process and advise both USAID and the MO on which projects should be awarded. Some of their recommendations were contingent upon specific changes being made to the projects for more clearly defined objectives, outputs, and HC partners. The members of the EAP included:

- Gerry Combs, Nutritionist, Director, USDA/ARS Grand Forks Human Nutrition Research Center, North Dakota
- Ratan Lal, Soil Management and Fertility, Ohio State
- Greg Traxler, Economist, Auburn University (currently with the Bill and Melida Gates Foundation)
- Lorna Butler, Sociologist, previous director of the Sustainable Agriculture Center, Iowa State University
- Bert Vanderberg, Bean breeder, Saskatchewan

For selection of 2009 Phase III proposals, the MO sought three peer reviewers for each area where a project would likely be funded (BNF, nutrition, value chain research). The reviewers prepared written evaluations and recommendations of the proposals which were reviewed by the Pulse CRSP Director, Deputy Director, and USAID AOR. The peer reviewers also requested that a number of proposals be resubmitted with significant changes before the final decision was made. In certain cases, multiple iterations of resubmissions of revised proposals occurred before settling on one that was acceptable for subcontracting as a project in the Pulse CRSP.

When subcontracting, the approved proposals became part of the "Technical and Cost Applications" for the subcontracts with the "Lead" U.S. universities. These also then became the basis for the development of annual technical workplans and budgets by all the PIs and collaborators (US and HC) in a project. The TMAC made further modification to the workplans based on the results presented in the technical progress reports and site visits.

The EET finds that the processes used to evaluate the Phase I/II and Phase III proposals was fair, based on expert peer evaluations and recommendations, and, overall, resulted in a high quality, relevant portfolio of projects, consistent with the requirements of the cooperative agreement.

A. Program Management

1. What have been the challenges for the ME and how have they responded?

The MO was initially understaffed for a program of this magnitude. It also had to respond to a number of staff changes.

In 2008, the MO had only 2.40 FTE of staff time, plus a student to provide clerical services (Director, 0.9 FTE; Deputy Director, 0.50 FTE; Administrative Officer, 1.0 FTE). Funding was inadequate to afford a clerical staff person and a communications specialist. For two years, a student was hired to provide clerical services. When she left, Gloria Bateman was hired as a Clerical Assistant in 2011.

In 2009, Mywish Maredia stepped down as the Deputy Director of the Pulse CRSP and returned to her academic faculty position in the Department of Agriculture, Food and Resource Development. After an open search by a committee appointed by the Dean, Dr. Johan Brink was hired as the Deputy Director. About the same time, he was concurrently

appointed as Interim Director of the Institute of International Agriculture. In April 2011, Dr. Brink's stepped down as the Deputy Director and the Dean appointed and commissioned another Search Committee to conduct an open search for a new Deputy Director which resulted in the appointment of Dr. Cynthia Donovan. Dr. Donovan brought complementary disciplinary expertise (as an agricultural economist), extensive field research experience from Latin America and Africa, experience with USAID country Missions, and knowledge of the Pulse CRSP as a Co-PI. She was also an elected member of the TMAC for two years.

The lower initial funding authorization ($9 million) of the Pulse CRSP, followed by a $5 million increase at the start of the third fiscal year (FY 2010), afforded an opportunity to address technical gaps areas in the Pulse CRSP program, support impact assessment research, invest in technology dissemination, and hire a Communications Specialist in the MO. The technical gaps that existed in the program were considered to be in the areas of BNF, nutrition research, and socio-economic research.

Subcontracting new projects in the third year of a five-year program presented challenges for achieving research and training output goals. Three years was not sufficient time to issue an RFP, review proposals, negotiate subcontracts with lead US universities, for these US universities to establish sub-subcontract with Host Country institutions, recruit students for degree training, and ultimately to implement the projects.

Based upon the annual technical progress reports, most of the Phase III projects were not able to effectively initiate research activities until the second year (FY 2011). Considering the time limitations of the Phase III projects, the PIs of these projects were clearly at a disadvantage compared to the Phase I/II projects. The EET took this difference into consideration when we evaluated each project.

2. **How has the ME promoted and maximized values such as collaboration, capacity building, and outreach among sub-awardees?**
The EET believes that the MO has consistently promoted values such as collaboration, capacity building, and outreach in the Pulse CRSP, and U.S. and HC scientists are expected to mutually commit to joint research planning and development of workplans; establishment of distinct roles and responsibilities among PIs and institutions to complete research, training and outreach activities; shared responsibility and accountability for project performance; partnership in seeking to leverage additional grant funds; and joint annual reporting of technical progress.

One of the strengths of the Pulse CRSP is its commitment to institutional capacity building. As of September 30, 2011, 53 students were either fully or partially supported in graduate or undergraduate degree programs through the CRSP. The EET was pleased to see that 33 of the 53 degree students were enrolled in universities in either Host Countries or in academically renowned institution in other countries (e.g. South Africa, Brazil). By supporting graduate training at partner HC universities, HC PIs are able to assume a greater role in the advising and monitoring of the academic formation and

research activities of the trainees, and the Pulse CRSP is able to contribute to the ongoing strengthening of graduate programs at these institutions.

In addition to degree training, the Pulse CRSP also supports short term training of HC collaborators and technical staff in research methods, instrumentation, and new areas of science (e.g., marker assisted selection, preparation of rhizobium inoculum, etc.). In some cases, HC scientists have also been able to take research sabbaticals and short term training in the laboratories of US universities. Networking and collaboration with peer scientists within the region is encouraged and expected at the Pulse CRSP All Researchers Meetings and other conferences.

Apart from the funding that is expected to be budgeted annually for institutional capacity building each year (>30% for training), the Pulse CRSP program sets aside $150,000 - $200,000 each year which it competitively awards to partner Host Country institutions for capacity building. To receive funds, HC institutions submit proposals which are reviewed by the TMAC. The MO awards the funds in accord with the recommendations of the TMAC. These funds have been greatly appreciated by the HC partners and enabled the project teams to address capacity needs that became evident as the projects were being implemented.

The success of Pulse CRSP projects should be measured not only against their research output, but also against development outcomes that benefit the pulse sector. The MUS-4 Phase III project was developed to collaborate with Phase II project PIs to strategize and determine ~~"i~~mpact pathways" for important research outputs. It is expected that each project will link with appropriate private and public sector groups (NGOs, government programs, etc.) to inform/educate them of the improved technologies and to discuss tangible steps to ensure their dissemination (e.g., multiplication of foundation seed, development of animation video messages, etc.).

3. How have activities been reviewed?

The TMAC conducts annual reviews of workplans and technical progress reports for all Phase I, II and III projects. As part of these reviews, the TMAC prepares a written summary of each annual project evaluation plus recommendations for improvement or change going forward. The MO shares the TMAC evaluations/recommendations with the Lead PIs of each project, with the expectation that the PIs will make the appropriate adjustments in their projects and future workplans or technical progress reports. The TMAC assesses PI and project response to their comments and recommendations during subsequent reviews of annual workplans and technical reports. In addition, the TMAC and the MO carry out site visits to U.S. and HC institutions, meet with the project teams during the global Pulse CRSP meetings (Barcelona, Quito and Kigali) and conduct periodic phone conversations with PIs.

In 2012, the TMAC made a final evaluation of projects at the global Pulse CRSP meeting in Kigali. Each committee member rated the projects for performance, potential, and relevance and a recommendation was made on whether the project should be: extended with funding; no-cost extension, but not refunded; no extension of project; and

opportunity to compete for new project awards. The TMAC recommended that four projects be extended with funding, one for a no-cost extension, and the remaining should be re-competed. This report was shared with the MO and AOR only.

4. **What systems are in place to keep research activity on track according to the CRSP's goals?**
   The Pulse CRSP was designed for the award of short term Phase I projects (FY 2007-2010) that could be extended for an additional two years as Phase II projects (FY 2010-2012) based up acceptable progress toward project objectives. This new program management strategy was implemented to ensure project performance accountability by empowering the MO to make mid-course programmatic changes, if necessary.

   The TMAC met early in 2010 to formally review the performance of all Phase I projects by evaluating FY 2009 technical progress reports, site visit reports and the requests by PIs for project extensions. This resulted in recommendations for the extension of seven of the Phase I projects as Phase II projects (the ISU-1 project with substantial changes in objectives) and the discontinuation of one project (CU-1).

   Based on the TMAC's written evaluations and recommendations, the continuing project PIs were asked to prepare FY 2011 and 2012 workplans which reacted to the TMAC's guidance. The TMAC then reviewed these workplans before they were approved and the sub-contracts were amended for FY 2011.

   The EET is supportive of this program management strategy and recommend that a two-phase system of subcontracting of project be extended if the next phase of the Pulse CRSP is extended for an additional 5 years.

5. **In general, what has been the management style of the ME regarding PIs and sub-awardees? How could it be improved?**
   The management and operation of the Pulse CRSP is based on well documented and clear expectations as laid out in the Pulse CRSP Operations and Policy Manual. Annual project performance reviews conducted by the TMAC are used by the MO to adjust underperforming or delayed projects.

   The U.S. PIs expressed appreciation for the straight forward, direct management style of the Pulse CRSP Director and Deputy Director and overall welcomed their suggestions on how to improve or strengthen their projects. Commonly heard comments were ~~–t~~he MO is responsive to our inquiries; the MO gives frank feedback and recommendations, which has been helpful".

   Some HC researchers had only limited access to the MO as it is the responsibility of the Lead U.S. PIs to keep their collaborators informed about the projects. In a few cases, lack of effective communication and interactions between the U.S. and HC PIs was evident.

   To encourage greater communication and collaboration among all the Pulse CRSP participants, the EET recommends that the Global Pulse CRSP Meetings be held annually

instead of biennially. This will ensure that all researchers receive timely information from the MO and project collaborators and will encourage interaction and the exchange of ideas.

6. **How have management problems been addressed?**
   The Pulse CRSP has an Operations and Policy Manual which explains the structure and guidelines for the implementation of the program. When issues arise (e.g., change in PI, etc.), the manual describes the process to be followed for resolution. The EET was extremely impressed with the Operations and Policy Manual and recommends other USAID CRSPs adopt this type of administrative service.

B. Financial Management

1. **Have there been any problems regarding financial issues as perceived by CRSP participants at various levels (ME, Principal Investigators, Researchers, & in-country Collaborators)? How have problems been resolved?**
   Overall, the EET received very few reports about financial transaction concerns from any of the U.S. PIs or HC collaborators, with the exception of TAMU-1 which had difficulties in opening a banking account in Zambia. Once the ME allocates project funding to the Lead U.S. universities, it is the responsibility of that institution to allocate funding to the HC collaborators. If there are problems with new Lead U.S. institutions getting this process implemented, the MO and, if necessary, a member of the ―Institutional Representatives" will work with that university's contracts and grants office to resolve problems.

2. **Have vouchers been processed in a timely way so as to minimize pipeline issues or payment lags?**
   Yes, overall the EET found that the vouchers have been processed in a timely way to minimize pipeline issues and payment lags.

C. Monitoring and Evaluation (M&E)

1. **What types of M&E have been undertaken by the ME?**
   The Pulse CRSP uses ―Fixed Price" contracts as the contractual mechanism with all HC institutions for research, outreach and training activities. An advantage of Fixed Price contracts is that payment of funds is based on performance (technical progress) rather than submission of invoices of expenditures.

   For a HC institution to receive installments of funding throughout the course of a fiscal year, a Semi-Annual Indictors of Technical Progress report must be submitted to the Lead U.S. university for the respective project identifying the activities competed during the past six month period, which must be signed off by the Lead U.S. PI. This is considered as a ―deliverable" which triggers a payment. The EET found that the Fix Price contract is a good mechanism for both U.S. Lead PIs and the MO to monitor technical progress by project team members.

Since 2010, each project must submit an annual report of Actual Performance Indicators achieved by the project. This information is required by USAID for CRSP reporting of annual contributions to FTF metrics. Deviations of ―actuals" from ―targets" greater than 10% (whether above or below) necessitate the submission of a written explanation to the MO. The Actual Performance Indicators are another mechanism by which the MO can monitor project performance in addition to a review of the Annual Technical Progress Reports.

The MO shared with the EET that the Actual Performance Indicators for the entire Pulse CRSP program consistently exceeded Targets for all metrics.

2. **Are the indicators used effective at capturing and communicating the outcomes and impacts of research activities? Are there appropriate indicators for the stage in the "research continuum"?**
   Performance indicators do not provide the kinds of detailed information which can be used to evaluate ―outcomes" and potential impacts of research projects. Many times, the indicators established by USAID under FTF are ―macro" level metrics which reveal little about the outcome of an individual technology. To provide greater precision and accountability, the MSU-4 project PI Dr. Mywish Maredia conducts impact assessments of Pulse CRSP research activities and works with each PI to set up impact assessment pathways.

3. **Have baselines, if necessary, been established? When?**
   At this time, Pulse CRSP funding has not allowed for baseline data to be collected in all but a few target countries to assess possible future adoption and impact of technologies and practices generated by Pulse CRSP projects. Baseline data is being collected in a few countries where value chain studies have been initiated. However, it is anticipated that if the Pulse CRSP is extended for another 5 years, baseline data collection should be expanded within certain projects.

4. **Are data collected valid and of proper quality for reporting?**
   The baseline data collected thus far has been limited to specific countries and activities and the EET was not able to fully evaluate the data sets.

5. **Have indicators capturing impacts and outcomes on higher levels been developed?**
   The EET is not clear on what is meant by ―higher levels" in this question.

RECOMMENDATIONS

1. The EET commends the Dry Grain Pulses CRSP for the significant achievements it has made in bean and cowpea research, outreach, dissemination, capacity building and impact, through a successful model of U.S. and Host Country collaborative research and development projects.

2. The EET recommends that the Dry Grains Pulses CRSP be funded for another phase. We recommend that funding for the next phase, at minimum, be equal to or greater than the total funding for Phases I, II, and III.

3. The EET commends the ME and MO for their professional and proactive leadership of this complex international program, and for their wholehearted commitment to the mission and goals of the Pulse CRSP and the Feed the Future (FTF) mandate of USAID.

4. The TMAC is to be commended for their dedication, professionalism, and hard work in the review of annual workplans, evaluation of annual technical project reports, and participation in various site visits. In particular, the EET would like to thank Dr. Robert Maxwell, TMAC Chair, who has given generously of his time and expertise, without compensation for his efforts.

    - Although we would like to think that the Pulse CRSP would be so fortunate in the future to find another TMAC Chair with this same dedication to service, we recommend that in the next phase, some level of compensation, perhaps as an honorarium, be considered for the Chair and non-Pulse CRSP TMAC members.

    - Also to be considered is whether additional expertise on the TMAC committee is necessary (i.e., soil science) or should experts be asked to serve on the committee on an ad hoc basis when needed.

    - The EET believes that there is no need to establish a separate pre-award committee to evaluate and rank new projects in the next phase. Rather, the TMAC is best suited to carry out this function as it is knowledgeable of what has been done in the past, and can ensure that future priority areas are addressed.

5. The EET supports the two phase model for project management as it empowers the MO to make timely adjustments to some project objectives and methodologies, and to end unproductive projects.

6. There is a critical need for impact assessment across all projects. With the additional expectation that all projects develop ―impact assessment pathways" within the design of their projects, we recommend that Dr. Mywish Mareda be brought in as a 0.5 FTE member of the MO staff to coordinate this effort.

7. We recommend that the Global Pulse CRSP Meetings be held annually, rather than every two years. To offset the additional travel expenses, these meetings, when and where possible, could be held in tandem with other meetings that many Pulse CRSP researchers would be attending (e.g. Bean Improvement Cooperative Meeting, Crop Science Society of America Annual Meeting).

8. A significant concern is how the Pulse CRSP is going to contend with and prepare for the upcoming retirements of a number of senior bean/cowpea scientists in U.S. and Host

Country institutions that have been the backbone of the Bean/Cowpea and Pulse CRSPs. This is, of course, a concern of many institutions as the baby boomers begin to retire.

- The EET was encouraged to see some new early and mid-career scientists participating as U.S. PIs and HC partners in a number of projects. We recommend that the three plant breeding projects (MSU-1, UPR-1 and UCR-1) also include new plant breeder PIs to work closely with the current Lead PIs before they retire. The ME may need to call on their "Institutional Representative" and stakeholders to encourage the institutions where the Lead PIs are located to refill these positions once the senior PI retires.
- The Pulse CRSP should establish a mentoring program so that new PIs with less experience working with dry grain pulses or with resource poor farmers in Africa and Latin America consult and interact with more experienced PIs in the design and operation of their projects. These PIs should be encouraged to attend the Bean Improvement Cooperative (BIC) meetings to be current in bean research and to become part of the larger bean/cowpea research community.
- To encourage new U.S. university scientist participation, the MO should consider providing 2-3 months of salary support for faculty who are on 9-month appointments.

9. One of the primary constraints to increasing bean and cowpea productivity in Africa is low soil fertility. Greater effort to understand soil fertility constraints and their complex interactions with native rhizobia and root rots is critical to sustain increased yields.

10. The EET would like to see the incorporation of transgenic work into some of the breeding initiatives during the next funding period. It is noted that Brazil has recently released a transgenic virus resistant bean. World trends in transgenic crop technology development indicate that they will continue to increase in importance and in the number of hectares planted worldwide.

11. The EET also recommends that socio-economic studies be incorporated into all projects with applied research components. These projects should include the collaboration of economists, social scientists, and anthropologists. This is especially important for any projects involving technology dissemination.

12. New, high yielding climbing bean varieties have been widely adopted in Rwanda and crop management practices have been developed to provide staking materials. Yield increases are two to four times that of traditional varieties. The EET recommends that further breeding, evaluation and testing of climbing beans and associated management practices be extended to other targeted Pulse CRSP countries in Africa.

13. Based on the success of the BTD Seed Technology Dissemination Associate Award in Central America, the EET recommends that this project be continued in Central America and expanded to other countries.

14. Considering the limited impact that numerous food science and value-added products studies have had in past Bean/Cowpea CRSPs, the EET recommends that low priority be given to these types of studies in the next CRSP. Rather, specific nutritional studies, such as the impact of bean/cowpea-based diets on children (up to 1,000 days) and gut health, be given higher priority.

15. Breeders should continue to evaluate and select for quick cooking time in beans as this appears to be a heritable trait that is valued by consumers.

16. The EET commends the Pulse CRSP on their capacity building efforts, particularly graduate student training, which should be continued with the same level of emphasis in the next phase. Short term training for HC technicians and NGO project leaders is also needed in many countries. Advances in Distance Education techniques should be more extensively utilized to develop specific training models in various languages.

17. The above recommendations, to a great extent, envision the next phase of the Pulse CRSP with total greater funding than at present. If funding is reduced below that of the present Phase I, II and III levels, then the MO and TMAC will have to make hard decisions about their future priorities.

18. The EET recommends that renewed efforts be made to secure funding (Associate Awards and buy-ins) from USAID Missions in the Host Countries as well as the Regional Missions in order to leverage funding. The EET notes that in some case the local missions were not aware of the ongoing Pulse CRSP projects in their country/countries of focus. The MO is encouraged to make regular visits to the USAID Missions in order to highlight successes of the Pulse CRSP projects in the recent past, and to solicit support for programs in their countries of focus. Similarly, the U.S.-based PI‘s are encouraged to make courtesy calls to the Missions whenever they are in the HC‘s.

APPENDICES

Appendix A. External Evaluation Team

Dr. Julian Adams
Professor
Department of Molecular, Cellular and Developmental Biology, and Ecology and Evolutional Biology
University of Michigan
Ann Arbor, MI

Dr. Bahram Arjmandi
Chair and Margaret A. Sitton Professor
Department of Nutrition, Food & Exercise Sciences
Florida State University
Tallahassee, FL

Dr. Michael A. Grusak
Plant Physiologist and Professor of Pediatrics
USDA-ARS Children's Nutrition Research Center
Department of Pediatrics
Baylor College of Medicine
Houston, TX

Dr. Julia Kornegay (Chair)
Professor and Director of the Graduate Program
Department of Horticultural Science
NC State University
Raleigh, NC

With support from:
Mr. Steven Long
International Affairs Program Analyst
Bureau for Food Security (BFS), Policy and Research Division (ARP-R)
USAID
Washington, DC

Appendix B. Scope of Work

Dry Grain Pulses Collaborative Research Support Program (CRSP)
Award Number: EDH-A-00-07-0005-00
(2007-2012)

Technical and Administrative Performance Evaluation
SCOPE OF WORK

Purpose

The purpose of this evaluation of the Dry Grain Pulses Collaborative Research Support Program ("Pulse CRSP") is to assess program performance, to identify program successes and areas of concern, to help program implementers improve program effectiveness, to provide recommendations, and to inform the U.S. Agency for International Development (USAID) on future programming and support of the Pulse CRSP. As the program has now been ongoing for five years, this evaluation will serve to inform USAID on whether to extend the Pulse CRSP as it currently exists, to suggest significant modifications to the program, or to not continue funding.

Background of the Dry Grain Pulses CRSP

USAID established an agreement with Michigan State University (MSU) in September 2007 to serve as the Management Entity for the Dry Grain Pulses CRSP and to administer the program for the five-year period of October 1, 2007 through September 28, 2012. This Cooperative Agreement- Leader with Associate award (# EDH-A-00-07-0005-00) was the result of an open and competitive competition to identify a university with predominant technical capacity in grain legumes to manage this new CRSP on "pulses". Michigan State University submitted Technical and Cost Applications for the Dry Grain Pulses CRSP in response to a Request for Assistance (RFA) issued by USAID in early 2007. The approved Technical Application and a slightly modified Cost Application (both Budget and Narrative) then became an integral part of USAID's contract with MSU.

The Dry Grain Pulses CRSP is a new award that follows the Bean and Cowpea CRSP which had been managed by MSU from 1980 to September 28, 2007. The Bean and Cowpea CRSP received numerous three and five-year extensions, each accompanied by an external evaluation of program performance by an External Evaluation Panel and the submission of new technical and multi-year budget proposals.

The Dry Grain Pulses CRSP is distinct from the Bean/Cowpea CRSP in numerous ways including: (1) a broader research agenda involving diverse grain legume crops (common bean, cowpea, pigeon pea, lima bean, lablab, etc., (2) a global program vision aligned with the priorities of the Presidential "Initiative to End Hunger in Africa", (3) four new "Technical Themes" which provided the conceptual framework for the subcontracted research projects, and (4) a new more efficient and cost-effective program evaluation and advisory mechanism, the Technical Management Advisory Committee (TMAC). The TMAC replaced the Board (comprised of Institutional Representatives from partner U.S. universities and Host Country institutions), the Technical Committee, and three Regional Project Committees.

The Technical Themes for the Dry Grain Pulses CRSP for the period Oct. 1, 2007 – September 28, 2012 are to seek to:

- Reduce production costs and risks for enhanced profitability and competitiveness of bean, cowpea and grain-legume farmers;
- Increase the utilization of bean and cowpea grain and food products so as to expand market opportunities and improve community health and nutrition;
- Improve the performance and sustainability of bean and cowpea value-chains, especially for the benefit of women, and
- Increase the capacity, effectiveness and sustainability of agriculture research institutions which serve the pulse sectors and developing country agriculture in Sub-Saharan Africa and Latin America.

Through a competitive process in which an RFP was issued and proposals received and peer-reviewed, the Management Office selected in consultation with USAID eight Phase I projects (FY08-10) that were subcontracted to seven U.S. "Lead" universities. Each project involved collaborative research, technology transfer, and degree and short term training (capacity building) activities by scientists at a Lead U.S. university with Principal Investigators at agriculture research institutions (NARS and universities) and NGOs in strategic countries in Sub-Saharan Africa, Latin America and the U.S.

In summer 2009, USAID informed MSU that it would consider increasing the "authorization ceiling" for the Dry Grain Pulses CRSP from $9 million to $14,014,000 contingent on the submission and approval of a modified Technical Application that addressed key areas for strengthening the program plus a revised Cost Application for the final three years of the program, Fiscal Years 2010 through 2012. The approved Technical Application called for the awarding of several additional projects to address technical gaps in the program (e.g., nutrition, biological nitrogen fixation, and value chains), to strengthen technology dissemination activities, to assess both ex-post and ex-ante impact of research investments through both the Bean/Cowpea and Dry Grain Pulses CRSPs, and to improve communications and promotion of CRSP technical achievements and development impacts.

In early FY 10, through the issuance of a new RFP, four new projects were competitively selected and subcontracted to achieve the objectives identified in the modified Technical Application. As these were new projects of two to three-year duration (FY10-12). The Management Office called these "Phase III" projects to distinguish them from ongoing research and capacity building contractual commitments.

Also in FY 10, the Technical Management Advisory Committee (TMAC) reviewed the technical progress and potential for development impact of the eight "Phase I" projects and recommended to the Management Office that seven projects be extended for an additional two years, FY 2011 and 2012, with technical adjustments. The MO followed up by requesting that Lead U.S. PIs submit FY 11 and 12 Workplans and Budgets which responded to the TMAC's recommendations for technical changes in each project. These documents then became the basis for amendments to subcontracts. The projects receiving a two-year extension were thus called "Phase II" projects.

In late 2009, the Bureau for Food Security, USAID/Washington, presented to the CRSP Directors a "Strategic Response to the Global Food Price and Insecurity Crisis". Following the establishment of the Presidential Initiative "Feed the Future", the federal government developed a "Research Strategy for Global Food Security" which proposed a new research approach with alignment to the Feed the Future program. Within the past year, the Pulse CRSP Management Office has been seeking to respond to USAID's guidance so as to effectively support and contribute to the Feed the Future research strategy. This response is evidenced by changes in Performance Indicators of projects, reaching out to strengthen partnerships and better coordinate activities with CGIAR centers through the CRP3.5 process, and convening consultations with international communities of grain legume scientists. Outputs from these consultations included recommendations on future research priorities to "substantively" increase pulse

productivity by small-holder farmers, and to improve the nutritional quality of diets and the nutritional/health status of the poor in developing countries, especially women and young children.

Scope of Work

The Dry Grain Pulses CRSP ―Pulse CRSP" is a five-year Cooperative Agreement/ Leader with Associates award to Michigan State University for administration of a global program for the period October 2007 through September 2012. As stated in the contract, there is "some assumption" that USAID will award a five-year extension contingent on a record of good performance during the first five-year period, continued relevance of the CRSP to the overall Agency portfolio and development priorities, and the availability of funds. In the present 2012 context, this means that the Pulse CRSP should also fit well with USAID's Feed the Future (FTF) development goals and agriculture research agenda.

An ―External Evaluation" will provide USAID and the Management Entity (ME) with constructive feedback on the past performance and management of the Pulse CRSP, but equally important review the program's current ―technical relevance" and make recommendations regarding a five-year extension of the CRSP, including the identification of research, extension and capacity building activities that should be considered when developing a Technical Application of the program for 2012 – 2017.

This External Evaluation will focus on progress the Pulse CRSP is making towards achieving its Technical Vision as stated in the 2007 and 2009 Technical Applications approved by USAID. In addition, the program evaluation will also assess the administration and implementation of the Pulse CRSP by Michigan State University as a ―partner" with the Office of Agriculture Research and Policy, Bureau of Food Security, USAID in terms of its technical leadership and management of the contractual and financial aspects of this complex multi-institutional global program.

Criteria for Assessment: The EET will evaluate the CRSP in the following areas by responding to the questions below.

I. Technical Review
   A. Technical Leadership
      1. What are examples of technical leadership displayed by the ME?
      2. What are examples of technical leadership displayed by the individual project Principle Investigators (PIs)?
      3. How are the separate research activities integrated into a broader strategy or thematic programming areas including Feed the Future?
      4. How and with what results has gender been taken into consideration in research design, training and outreach strategies at the research activity level?
      5. How does the ME facilitate engagement of the research activities or themes to other development programs in regions where the CRSP is active?
      6. How well has the ME facilitated the participation of new partners? Give examples of how program RFPs are designed and how opportunities are advertised and made available for new PIs.
      7. Are the levels of effort, award size and research project duration sufficiently balanced to allow the CRSP to achieve program goals and objectives?
      8. What have been the significant accomplishments in terms of research, outreach, and dissemination?
      9. How has the ME built on earlier investments?
      10. What can be done to capitalize on these - to broaden or accelerate progress?

11. How does the ME continue to be forward thinking about research ideas and plans associated with the CRSP?

B. Research activities
    1. Please describe whether the depth, breadth, and rigor of the research and development activities have been sufficient to allow the CRSP to achieve its stated goals and objectives.
    2. In what ways are the research activities strategically sequenced to ensure targeted development outcomes with in a known period?
    3. How relevant are the research activities to USAID's current FTF research strategy? Are the Missions or other operating units (i.e., other Washington-based offices) aware of and have they sought to access the CRSP's technical, training and outreach expertise? Give examples.
    4. Which projects are likely to make the most progress towards fruition if another five years is granted? Are they scalable for greater impact?
    5. Do the results achieved to date and the expected outputs justify greater emphasis (effort and investment) on outreach and scaling-up for impact if another five year renewal is granted? Why or why not?
    6. If another five years is granted, how should the program focus its efforts to achieve a greater level of effort or extend farther towards impact? Should there be a focus on fewer high performing activities? Should there be a different mix of activities along the research continuum? Which ones need to be refocused or discontinued? Among the projects making significant progress, which ones are scalable for a greater impact?

C. Program Focus
    1. In general, comment on the depth versus breadth of the program.
    2. What are the synergies across research activities that warrant the number of research activities in the portfolio? Have the activities been of sufficient depth to make an impact on the state-of-the-art or to apply existing knowledge to real life problems? Give examples.
    3. Please comment on the quality and depth of the research and the relevance of the work to provide solutions to the pulse sector development problems? How could the major themes or topics be refined to increase impact?
    4. How well has the ME balanced the research and implementation activities given the amount of funding provided? Please provide some direction or focus on how much emphasis should occur within the Pulse CRSP portfolio on basic research, applied research, and implementation.
    5. How does the Pulse CRSP respond to Title XII's objectives?

D. Collaboration, capacity building and outreach
    1. What are some examples of partnerships and collaboration between host country and the U.S. PIs? How have they been effective at building the capacity of local researchers, policy makers and practitioners?
    2. Compared to the research activities of the CRSP, what has been the level of effort and investment in training and institutional capacity building? Has it been effective? How can impact of capacity building be captured (and measured) more effectively?
    3. What outreach strategies have been integrated into project design to increase likelihood of uptake and utilization of research results? What have been the most effective strategies for outreach at the country level?
    4. What have been the outreach efforts at the regional or ~~"g~~lobal" level?

5. How has the ME communicated its activities to the global community through:
    a. Hosted events, peer-reviewed journals and published work?
    b. USAID Missions and other operating units?
    c. Other donors and partners (other bilateral development agencies, etc.) How might the management entity better capture ―impact" of their efforts at this level?

II. Administrative Review

A. What have been the roles/functions of the advisory committees and the administrative leadership? How cost effective has each been? Could they be more efficient? How?

B. What has been the substantial involvement and contribution of the USAID AOTR?

C. What was the process for sub-award selection? How effectively did the process yield a high quality, relevant portfolio of activities? How consistent was it with the requirements of the cooperative agreement?

D. Program Management:
    1. What have been the challenges for the ME and how have they responded?
    2. How has the ME promoted and maximized values such as collaboration, capacity building, and outreach among sub-awardees?
    3. How have activities been reviewed?
    4. What systems are in place to keep research activity on track according to the CRSP's goals?
    5. In general, what has been the management style of the ME regarding PIs and sub-awardees? How could it be improved?
    6. How have management problems been addressed?

E. Financial Management:
    1. Have there been any problems regarding financial issues as perceived by CRSP participants at various levels (ME, Principal Investigator, Researchers, & in-country Collaborators)? How have problems been resolved?
    2. Have vouchers been processed in a timely way so as to minimize pipeline issues or payment lags?

F. Monitoring and Evaluation (M&E):
    1. What types of M&E have been undertaken by the ME?
    2. Are the indicators used effective at capturing and communicating the outcomes and impacts of research activities? Are there appropriate indicators for the stage in the ―research continuum"?
    3. Have baselines, if necessary, been established? When?
    4. Are data collected valid and of proper quality for reporting?
    5. Have indicators capturing impacts and outcomes on higher levels been developed?

Evaluation Methodology: The evaluation will be based on a review of project documents, meetings, interviews and attendance at a CRSP meeting, held in Kigali, Rwanda from February 13 – 17, 2012. The EET members will interact with the ME, program leaders and host-country stakeholders, as well as other relevant regional or global development and research communities. The evaluation will consist of the following steps:

A. The EET will schedule an internal team planning meeting via phone with the USAID Agreement Officer's Representative (AOR) and other USAID staff as needed. In this meeting and in a desk review the evaluators will ascertain the relevance of all the individual projects to the overall objectives of the CRSP. Evaluators will be familiar with a number of documents before the meeting, including the CRSP agreement, program operations and other documents, annual reports; original research activity proposals and work plans for Years 1-5. All of these, as well as other CRSP documents will be provided by the CRSP ME, and will constitute materials necessary for the Desktop Review. During this phase, the EET will review documentation relevant to the Areas of Evaluation, may conduct phone interviews with the ME, Principal Investigators and other stakeholders. The purpose of the Desktop Review is to provide background and determine the necessary and reasonable travel, site visits and in-person and virtual interviews required to properly execute the evaluation.
B. The EET will then discuss with the evaluation manager and the AOR an Evaluation Work Plan outlining the necessary interviews, travel to visit the ME and U.S. universities, and to attend a CRSP meeting, held in Kigali, Rwanda from February 13 – 17, 2012, and time required to successfully complete the evaluation.
C. Conduct the evaluation.
D. Upon completion of the evaluation, the EET will submit a draft evaluation report to the AOR. The report should include recommendations for enhancing the performance and impact of the CRSP. It shall also make recommendation regarding a possible five-year extension of the CRSP as follows:
    a. Refinement of program themes or topics covered by the CRSP;
    b. Number and depth of activities in the CRSP's portfolio;
    c. Type of activities relative to the research and development continuum;
    d. Improving/expanding impact;
    e. Major organizational or procedural changes.

Evaluation Report: The EET will submit its draft report on or about April 15 after the field work is completed. This report will address the specific items mentioned in this SOW and any other relevant issues the EET feels should be addressed. The draft will be submitted electronically in MS Word format to the CRSP AOR and the manager of the review. USAID will then return comments and suggestions for consideration to the EET within 15 days. The final revised report should be submitted to USAID no more than 15 days after the return of the comments and suggestion from USAID. All comments should be sufficiently addressed. The report should be submitted in MS Word format to the USAID CRSP AOR and manager of the review. An oral presentation of the final report will also be made to USAID and the ME via an arranged phone call. The following is a suggested outline for the report:

I Title Page
II Table of contents
III List of Acronyms
IV List of Tables
V List of Figures
VI Executive Summary
VII Findings and conclusions
    A. Responses to each item in the SOW
VIII Recommendations
IX Appendices
    A. Statement of work
    B. Itinerary
    C. List of Persons Contacted

Level of Effort and Time Frame: The level of effort for the entirety of this scope of work will consist of no more than 20 person days for the Team Leader and up to 12 days for the other EET members over a period not to exceed 44 days. The USAID AOR and review manager will be available to the team as a resource person but will not contribute directly to preparation of the report.

Team Composition and Qualifications

The technical areas of focus of the CRSP require that expertise on the panel will be appropriate for the CRSP being evaluated. Team members must have the expertise necessary to evaluate the program and to address the evaluation questions. The team members must familiarize themselves with USAID's priorities and objectives in the economic growth sector, and particularly the USG Feed the Future research strategy. USAID will designate one team member as team leader.

Administrative/management review member (1): A senior administrator with a minimum of ten years' experience managing multifaceted international development research and/or university-based programs. The preferred candidate will be familiar with both university-based programs and USAID (or other donor) funded programs. A background in agricultural or rural development is preferred. The candidate would also have (1) demonstrated capacity to conduct program evaluation; (2) an understanding of USAID's foreign assistance goals, and its particular objectives related to collaborative research, agricultural development and food security; and (3) the ability to analyze issues and formulate concrete recommendations orally and in writing.

Technical team members (2): Must be recognized experts on international development related to agriculture and/or rural development with expertise in the focus area of the Pulse CRSP. Team members will be chosen from those who have experience in such areas as agricultural production/ agronomy, human and livestock health and/or agricultural economics. Technical team member candidates will also have demonstrated (1) capacity to conduct program evaluation; (2) thorough understanding of research methodology; (3) experience in effectively conducting outreach and dissemination to policymakers, development practitioners and/or the private sector; (4) the ability to analyze issues and formulate concrete recommendations orally and in writing.

Appendix C. Itinerary of Events/Meetings and People Contacted

5/21/12
-Meet with Irv Widders (Director) and Cynthia Donovan (Deputy Director) for an introduction to the DGP CRSP
-Meet with Derek Byerlee of the BIFAD Review to discuss the CRSP MO
-Michigan Bean commission (Bob Green and Greg Varner) to get an understanding of what is needed by the bean community in Michigan and their interest in the CRSP.
-Meet with Karen Cichy (USDA/ARS – MSU) regarding PIII-ISU-2 project on BNF in common bean
-Meet again with with Irv Widders and Cynthia Donovan on the Pulse CRSP.

5/22/12
-Meet with the TMAC (Doug Maxwell, Barry Pittendrigh and Mywish Maredia) to discuss program as a whole and the role and composition of the TMAC.
-Meet with John Kelly, Siglinda Snapp and Adam Cichy regarding PII-MSU-2 project and common bean breeding program at MSU. Students of Kelly and Snapp also attended
-Dinner with MO staff (Widders, Donovan, Hassankhani, Halverson, Bateman) and Doug and Martha Maxwell

5/23/12
-Meet with Cynthia Donovan and Eric Crawford regarding PII-MSU-2 project and socio-economic research in Pulse CRSP
-Meet with Mywish Maredia, Eric Crawford, and Byron Reyes regarding Impact Assessment, PIII-MSU-4 project
-Meet with Maurice Bennink regarding PIII-MSU-3 project and role of CRSP in health field
-Lunch with Graduate Students affiliated with the Pulse CRSP (9 students; 3PhD, 6 MS)
-Meet with Wayne Loescher, Jeffrey Cruz, and Lorelei Davis to discuss capacity and opportunities for Phenomics Research for Photosynthetic Traits at MSU
-Meet with Dr. Gretchen Neisler, Director, Institute for International Agriculture at MSU

5/24/12
-Meet with Marguerite Halverson and Irv Widders regarding communications and promotion activities by the CRSP.
-Meet with Ben Hassankhani and Irv Widders regarding contractual and financial management of the CRSP.
-Meet with MSU Office of Contract and Grant Administration (Dan Evon, Evonne Pedawi, Diane Cox)
-Lunch with Rick Bernsten, PI of PII-MSU-2 project
-Meet with Doug Buhler, Dean of the College of Agriculture and Natural Resources, and Steve Hanson
-Meet with Jeff Riedinger, Dean of International Studies and Programs
-Wrap up meeting with Irv Widders

Nicaragua: Julian Adams
6/2/12-6/5/12
-Bean Technology Dissemination Second Regional meeting: Montelimar, Nicaragua.
Discussions with:
-Cynthia Donovan: MSU
-Mywish Maredia: MSU
-David de Young: MSU
-Luis Flores: MSU
-Julio Ceasar Villatoro: ICTA Guatemala
-Pedro Rosado Pol: ICTA Guatemala
-Juan Carlos Rosas: CIAT, Zamorano, Honduras
-Ann Vargas: CIAT Zamorano, Honduras
-Jose Virgilio Garcia Aldana: DICTA-Honduras
-Ana Dunnaway: DICTA-Hondruas
-Emmanuel Prophete: NSS-Haiti

-James Beaver: UPR
-Consuelo Estevez de Jensen: UPR
-Aurelio Llano: INTA-Nicaragua
-Francisco Pavon: INTA-Nicaragua
-Aldo Rojas: INTA: Nicaragua

6/4/12
KSU-1 teleconference with Vincent Amanor-Baodu (Julia Kornegay, Bahram Arjmandi and Steven Long)

6/6/12
-EET conference call

6/8/12
-PSU-1 Teleconference with Jonathan Lynch (Julian Adams, Mike Grusak, Steven Long)

6/13/12
-Julian Adams meet with Luis Flores, Ann Arbor
-TAMU-1 phone conference with Joseph Awika (Bahram Arjmandi and Julia Kornegay)

6/24-6/25
Julia Kornegay visit to ISU
-met with ISU-1 Bob Mazur
-met with ISU-2 Mark Westgate

Country Visits (Uganda, Burkina Faso and Zambia (Bahram Arjmandi, Mike Grusak, Steven Long)

6/25/12
-Meet with KSU-1 and TAMU-1 teams to get project overviews
-John Shindano-TAMU-1 HC PI
-Gelson Tembo-KSU-1 HC PI
-Meet with Dean of the School of Ag. Sciences
-Meet with Judith Lungu: former dean of School of Ag. Sciences

6/26/12
-Meet with John Munyinda: plant breeder, University of Zambia
-view laboratories of TAMU-1 and field trials on campus
-Presentations by TAMU-1 and KSU-1 students/research assistants
-KSU-1 has roughly 8 students working for it
-TAMU-1 has 3 students currently studying overseas

6/27/12
-Discussion with KSU-1 stakeholders
-Geoffery Kayama: South Farmers Africa Link – Africa Bean Network (ABN)
-Rochester Kasamu: Stewards Globe
-Discussion with TAMU-1 stakeholders
-Nancy Sakhala: Ministry of Ag and Animal Health
-Musando Mofu: National Health Institute
-Muketoi Owamunyima: PELUM-organization that looks at marketing strategies of grains
-Visit Soweto Market to understand how beans are bought and sold/understand constraints farmers face
-Wrap up meeting with Drs. Tembo and Shindano.

6/29/12
-Visit Makerere University, meet with:
-John Muyonga: Dean for School of Food Technology, Nutrition, and Bioengineering
-Samuel Kyamanywa: professor of pest management
-Dorothy Nakimbugwe: Senior Lecturer of food technology and Nutrition/ISU-1 PI

-John Tenywa: Senior Lecturer of Agricultural Sciences/ ISU-2 PI
-Meet with VEDCO employees:
-Naboth Bwambale: estension specialist
-Nancy Rapando: Programs Director
-Meet with PhD and MS Students
-4MS
-2PhD: Peter B.—ISU-2 soil scientist
-Saw presentations on food nutritional testing, extension and capacity building and BNF trials
-Go to NaCRRI site visits in Jinja to observe BNF and soil nutrition

6/30/12
-Visit field sites of ISU-1 & ISU-2 in Kimuli district
-meet with extension partners, VEDCO staff, and local farmers
-meet at VEDCO nutritional center to observe bean food product entrepreneurs

7/1/12
-return to Kampala
-talk with Naboth Bwambale on ride back

7/2/12
-Go to NaCRRI site at Namulonge-look at BNF trials and plant breeding ISU1&2
-Meet with:
-Michael Ugen: NaCRRI Director of Bean Research Program (part of ISU-1)
-Michael Otim: NaCRRI Crop Entemologist
-John Tenywa: Senior Lecturer of Agricultural Sciences/ ISU-2 PI
-Pamela Parapu: NaCRRI plant physiologist
-Stanley Nkalubo: ACCI graduate, NaCRRI Plant Breeder
-Meet with VEDCO Management staff to discuss roles and future work (ISU-1):
-Henry Musoke: VEDCO Director
-Nancy Rapando: VEDCO Program Director
-Naboth Bwambale: VEDCO Extension specialist

7/3/12
-Wrap up meeting with ISU1 and ISU-2 Staff
-discuss the future of both programs
-discuss generalized findings/suggestions
-Meet with:
-Dorothy Nakimbugwe, John Tenywa, Naboth Bwambale.

7/5/12
-Meet with UIUC-1
-Clementine Debire: INERA Scientist UIUC-1 co-host PI
-Malick Ba: INERA Scientist UIUC-1 co-host PI
-Barry Pittendrigh- UIUC-1 US PI
-Julia Bello-Bravo-UIUC-1 Assistant Director of Illinois Strategic International Partnerships
-discussed the overall project, met with extension builders, scientists/researchers, farmers, and technicians
-talked about SAWBO and SuSDEViKI
-labrotory visits and observing live bio-control agents

7/6/12
Visit UCR-1 field site-SARIA Station
-Meet with Dr. Issa Drabo: UCR-1 host PI
-discussed future plans of UCR-1
-explanation of breeding plan and cycle
-looked at small cowpea plots
-observed seed storage methods and bean breeding lab.

Appendix D. List of Materials Reviewed

Technical Management

1. Alignment of Dry Grain Pulses CRSP with FtF Research Strategy

2. Technical and Cost Applications (2007, 2009)
   - Technical Application - Dry Grain Pulses CRSP Proposal (10-1-07 through 9-30-09 Original Proposal)
   - Cost Application – Dry Grain Pulses CRSP (10-1-07through 9-30-09 Original proposal)
   - USAID Memo Re Increased Ceiling
   - Amendment Technical Application Dry Grain Pulses CRSP (10-1-07 to 9-29-12)
   - 5) Revised Five-Year Budget for DGP CRSP (Additional funds 10-1-07 to 9-29-12)
   - Budget Narrative (Additional funds 10-1-07 to 9-29-12)

3. Annual Technical Progress Reports
   - FY 2008-09 Annual Project Technical Progress Reports and Actual Performance Indicators (Phase I)
   - FY 2010 Annual Project Technical Progress Reports and Actual Performance Indicators (Phase I and III)
   - FY 2011 Annual Project Technical Progress Reports and Actual Performance Indicators (Phase II and III)
   - FY 2011 Strategic Investment in Rapid Technology Dissemination: Commercialization of Disease Resistant Bean Varieties in Guatemala, Nicaragua, Honduras and Haiti

4. Pulse CRSP Technical Highlights
   - FY 2009 Technical Highlights
   - FY 2010 Technical Highlights

5. Pulse CRSP Impact Pathway, All Projects

6. Operations and Policy Manual for the Pulse CRSP

7. Research Publications
   - Genetic Improvement
   - Integrated Crop Management
   - Nutrition and Health
   - Value Chain
   - Impact Assessment

8. Brochures
   - Pulse CRSP Brochure 2011
   - Pulse CRSP Trifold Brochure

9. Programs for Global Meetings of the Pulse CRSP
   - 2008 Program for Global Meeting of the Pulse CRSP: Barcelona
   - 2010 Program for Global Meeting of the Pulse CRSP: Quito
   - 2012 Program for Global Meeting of the Pulse CRSP: Kigali

10. Executive Reports of Workshops and Consultations
    - PSU
    - MSU

11. Pulse CRSP Director's Presentations to BIFAD External Review Team, April 2012
    - Core Traits and Comparative Strengths of CRSPs Afforded by U.S. University Technical Leadership and Innovation in Research Contributing to International Agriculture Development Presenter: Irvin Widders, DGP CRSP, Michigan State University

Administrative Management

1. Financial Reports
    - Dry Grain Pulses CRSP Financial Report (10-1-07 to 3-31-12)

2. TMAC Evaluations of Annual Workplans and Technical Progress Reports, plus recommendations
    - TMAC Meeting Agendas
        - Agenda TMAC Meeting Feb 12-18 2012
        - Agenda TMAC Meeting Sept 9-12 2010

3. RFP Related Documents
    - RFP, Dry Grain Pulses CRSP
    - Invitation to Complete ~~–~~Expression of Host Country Institutional Needs and Interests"
    - REQUEST FOR EXPRESSIONS OF INTEREST (REI) FROM U.S. UNIVERSITIES To Participate in the Dry Grain Pulses Collaborative Research Support Program (CRSP) (Award No. EDH-A-00-07-00005-00)