P1-CU-1

Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya

Lead U.S. Principle Investigator and University:
Julie Lauren – Cornell

Collaboratoring Host Country and U.S. PIs and Institutions:
Beth Medvecky, Cornell, U.S.
John Duxbury, Cornell, U.S.
Rebecca Stoltzfus, Cornell, U.S.
John Ojiem, KARI, Kenya
Samuel Mwonga, Egerton, Kenya
John Nderitu, UNairobi, Kenya
Robin Buruchara, CIAT, Uganda
Alice Pell, Cornell, U.S.
Peter Hobbs, Cornell, U.S.
Christopher Barrett, Cornell, U.S.
Martins Odendo, KARI, Kenya
John Okalebo, MOI, Kenya
James Muthomi, UNairobi, Kenya

Project Problem Statement and Justification

Many rural households in the East African highlands are no longer self-sufficient in beans, a critical source of food and income. Farmers' inability to afford fertilizer inputs, coupled with continuous cropping on ever shrinking land holdings, has led to degraded and infertile soils and a concomitant decline in crop vigor, pest and disease tolerance and overall system productivity.

Low bean and maize productivity in Western Kenya is related to both soil fertility and biological constraints. Legumes can be important options for rebuilding soil fertility but poor utilization of applied P fertilizers, conflicts between soil renewal and immediate food and income needs and low fixed nitrogen returns from many grain legumes have limited expected returns. Additional production constraints and risks for beans in Western Kenya are presented by diseases and pests. We hypothesize that practices that promote vigorous establishment of pulse crops leads to increased pest/disease resistance, improved N fixation, and nutrient accumulation, which ultimately reduces risk, benefits system productivity, food security and human nutrition.

Consumption of pulses is essential for addressing iron deficiency, anemia and stunting caused by inadequate intakes of zinc. Recent national or regional level food composition data on the mineral nutrient content of staple food products, including iron and zinc, are often unavailable forcing researchers and policy makers to rely on international databases that do not adequately represent local environmental conditions, varieties, etc. Mineral nutrient contents of major foods grown under a representative range of smallholder farmer conditions are needed to develop local food composition tables and to determine food system nutrient outputs.

Determining how to effectively increase productivity of seriously degraded soils and to maintain the fertility of still productive lands is of paramount importance to all farmers living in the East African Highlands. To achieve this outcome, farmers and scientists need to form genuine learning partnerships. Providing opportunities for current and future scientific leaders to gain experience and expertise with participatory research and development approaches also are an essential part of the education process. These

experiences will help students and research scientists to understand that adoptable and sustainable technologies are those that reduce risk and effectively address farmer constraints and resource levels.

Planned Project Activities for October 1, 2009 - September 30, 2010

Objective 1: To develop and assess farmer capacity for improving vigor and growth of pulse crops on nutrient accumulation, pest/disease resistance and system productivity across a soil degradation gradient.

Collaborators:
Cornell - Beth Medvecky, Julie Lauren, Peter Hobbs, Alice Pell
KARI - John Ojiem, Martins Odendo, David Mbakaya, Isabella Ememwa
CIAT - Robin Buruchara

Approaches and Methods:
1. *In Community Farmers Meetings/Training Sessions* - KARI will organize and conduct additional meetings and trainings for farmers outside of the initial core group that we recruited and trained in FY09. Farmers invited to these meetings will be from surrounding communities in South Nandi, who have expressed an interest but were not able to participate in the FY09 program, and farmers working with new NGO partners located in Busia, Teso and Vihiga districts. Participatory approaches will be used to engage participants in understanding the rationale behind vigor-enhancing practices (root rot tolerant bean germplasm, seed priming, boma compost, combining/concentrating organic & inorganic fertilizers, multipurpose pulse crops lablab and cowpea), to facilitate exchange of farmer and scientific knowledge and to demonstrate boma compost making. A special effort will be made to create awareness with new farmers at the high fertility site in Koibem about soil fertility degradation and methods to reduce it.

2. *On Farm Verification Trials* - KARI will continue support for the initial core farmers in South Nandi to test selected vigor enhancing strategies for a second Short Rains-Long Rains cycle. In addition as funding resources allow, KARI will support verification by a limited number of new farmers in South Nandi, Busia, Teso and Vihiga districts. Treatments for the verification trials will be selected by the farmers according to their interest and resources. Based on FY09 results, we expect that farmers will streamline their testing in the second year to those treatments that have produced the greatest impacts. The project will supply sufficient quantities of bean (variety: KK8) and Lablab (variety: Rongai) seed and fertilizers (TSP, Minjingu Rock Phosphate, DAP) to plant the trials at new sites. Due to limited seed supply and to encourage farmer investment in developing their own seed supplies, we will not supply bean or lablab seed to the initial core farmers, but we will supply fertilizers. KARI personnel will provide technical backstopping and follow-up with the farmers.

Objective 2: To disseminate and evaluate through participatory approaches simple, low cost strategies for vigorous establishment/growth of pulse crops leading to increased system productivity and sustainability.

Collaborators:
Cornell - Beth Medvecky, Julie Lauren, Peter Hobbs, Chris Barrett
KARI - John Ojiem, Martins Odendo, David Mbakaya, Isabella Ememwa
NGO and farmer groups - REFSO, ARDAP, Avene

Approaches and Methods:
1. *Collaborations with NGO and farmer groups* - Support will be provided to 2 NGO's (REFSO, ARDAP) and a CBO (Avene Group) who will monitor their farmers' reaction and crop response to the vigor enhancing strategies in parts of Busia, Teso and Vihiga Districts of Western Province. The new partners are bulking bean and lablab seed this season and farmer testing will begin with the Short Rains season 2009-10. The results will help us to evaluate the performance of the vigor enhancing strategies in other parts of Kenya's Highlands and to confirm that these approaches are successful in different environments. In addition this initial collaboration builds the NGOs' capacity and provides a platform for scaling up in the future. REFSO and ARDAP currently serve ~ 1,800 and 5,000 households, respectively. Avene is a smaller organization, with < 50 clients, but it is part of a larger network established by Resource Kenya, a NGO focusing on soil fertility management strategies in Western Kenya.

2. *Crop performance evaluation and in season exchange visits* - New farmers will be trained to collect crop establishment and volumetric yield data (for maize, beans, lablab) from their verification trial plots. In addition, farmers will be shown how to assess and record the incidence and severity of pests and diseases (root rot, bean fly, others) with easily observed characteristic signs or symptoms.

The project will continue to support farmer-to-farmer exchange visits during Short and Long Rains seasons 2009-10 for South Nandi farmers and lead farmers from the NGO groups. These visits will raise farmers' awareness about maize and grain legume productivity under varying soil fertility conditions, while encouraging farmer-to-farmer knowledge sharing. Local input suppliers will be invited to learn about farmers' fertilizer and seed needs for grain legumes. Participant feedback after each group event will be solicited and reported.

Farmer feedback from all seasonal evaluations, exchange visits, the socioeconomic survey and participating NGO group monitoring will be compiled and used to document lessons learned from the participatory process. Key findings will be incorporated into extension materials (see below).
3. *Develop and distribute project-related training materials* - Extension materials on the vigor enhancing approaches will be prepared for farmers and development workers. These will focus on: (i) grain legumes and phosphorus use; (ii) growing and managing lablab; and (iii) alternative fertilizer strategies for maize (including boma compost, organic/inorganic fertilizer mixtures and the use of lablab as a soil amendment). The farmer-oriented instructional materials will utilize a combination of drawings and simple text, while the development workers materials will contain more text and explain points in greater detail. The materials will be made available to NGOs, CBOs, extension trainers in Kenya and through CIAT and ASARECA websites/ outreach programs.

4. *Complete socioeconomic survey and continue to monitor technology diffusion trends* - A Masters degree student at Moi University will initiate a socioeconomic survey towards the end of the Long Rains 2009 to document the initial core farmers' reaction to the tested vigor enhancement strategies including adoption trends (see FY09 Workplan). Data collection and analysis will be completed early in FY10. Farmers associated with newly recruited NGOs REFSO, ARDAP and Avene will be monitored through the end of FY10 to record perceived impacts, constraints, innovations and diffusion of the technologies to other farmers.

Objective 3: To research factors (nutrients, pest/diseases and their interactions) affecting pulse productivity across a soil degradation gradient

Collaborators:

Cornell - Julie Lauren, Beth Medvecky, John Duxbury, Peter Hobbs
KARI - John Ojiem, David Mbakaya, Maurice Mudeheri
CIAT - Robin Buruchara
Egerton Univ. - Samuel Mwonga
Moi Univ.- Robert Okalebo
Univ. Nairobi- James Muthomi, John Nderitu

Approaches and Methods:

1. *Implement replicated experimental trials* - The replicated Main Experiment (lablab and bean in Short Rains; maize-bean intercrop in Long Rains) at 4 sites across the soil fertility gradient will be repeated in FY10 in order to obtain a second year of data. KARI will establish and oversee the management of the replicated experiments.

2. *Data collection and evaluation* - Emergence, early seedling growth, pest/disease and agronomic data will continue to be collected from the replicated experiments during FY10. Results will be shared among all collaborators at the end of each cropping season.

3. *In-season field visits and annual meeting review of results* - Site visits will be made to the replicated trials by project collaborators to assess the effectiveness and impacts of the tested vigor enhancing strategies and to interact with farmers. Observations and comments will be reported. A second annual meeting will be held after the Long Rains 2010 to review and summarize results from the farmer and replicated experiments.

4. *Germplasm testing* - A student at Moi University will compare the agronomic, pest/disease response and phosphorus efficiency of cowpea lines obtained from the University of California Riverside at 4 sites across the soil fertility gradient during Short Rains 2009-2010. The student's Masters thesis will utilize these results combined with a similar evaluation of local cowpea germplasm during the Long Rains 2009.

Fifty lines of nutrient efficient common beans obtained from the Pennsylvania State University (PSU) project will be evaluated on the KARI Kakamega station for adaptation to Western Kenya conditions during the Long Rains 2009 season, Early vigor, growth habit, impact of diseases (root rot, mosaic virus, angular leaf spot, etc.) and pests (bean stem maggot, aphids), flowering, maturity and yield data will be recorded. Selections will be made for cultivar release purposes or as breeding parents.

5. *Nutrient analysis of grain and edible leaf samples* - Additional grain and leaf subsamples will be collected from replicated trials for mineral nutrient analysis at Cornell University. Focus will be on cowpea materials being tested by the Moi University student in the Short Rains 2009-2010.

6. *Publication preparation* - Data from the 4 replicated experiments collected over the 2 years of the project will be summarized and prepared for publication in peer reviewed journals. Preparation of these publications will occur after the end of the Long Rains 2010 season; and we expect manuscripts to be ready for submission within 6-9 months of the end of FY10.

Objective 4: To facilitate and support on-farm participatory research opportunities for Kenyan agricultural scientists and graduate students

Collaborators:
Cornell - Julie Lauren, Beth Medvecky, John Duxbury
KARI - John Ojiem, Martins Odendo, Maurice Mudeheri
Egerton Univ. - Samuel Mwonga
Moi Univ. - Robert Okalebo
Univ. Nairobi - James Muthomi, John Nderitu

Approaches and Methods:
1. *Implementation of student research projects* - All of the students will have finished data collection by the end of the Short Rains season (February 2010). Two students will be collecting data from additional satellite experiments established on 4 farmer fields across the soil fertility gradient - Expmt I: to evaluate the performance of cowpea germplasm; Expmt II: to assess the impact phosphorus additions in seed priming water on growth and performance of bean, cowpea and lablab. A third student will collect additional pest and disease data from the established replicated Main Experiment.

2. *Masters theses* - Five students will complete Masters theses during FY10: 3 at Moi University, 1 at University of Nairobi and 1 at Egerton. Project and HC Capacity Building program funds have been used to support these students.

3. *Sharing results at annual meeting* - Students will present results from their research projects for discussion and suggestions during the FY10 annual meeting. Results will be incorporated into the project annual report as they become available.

4. *Publications/Conference presentations* - Results from the students' research projects will be disseminated either at local conferences or submitted for publication in refereed journals. At least one journal manuscript submitted for publication or one conference presentation will have been given by each of the universities by the end of FY10.

Objective 5: Capacity Building

1. Crispus Mugambi Njeru - Masters; Moi University; Full CRSP support;Course work complete, research ongoing
2. Jane Francisca Nafula Lusweti - Masters; Univ. of Nairobi; Partial CRSP support; Course work complete, research ongoing

3. Belinda Akinyi Weya - Masters; Egerton University; Full CRSP support; Course work ongoing
4. Silvester Odundo - Masters; Moi University; Partial CRSP support; Course work complete, research ongoing
5. Eunice Onyango Odero - Masters; Moi University; Partial CRSP support; Course work complete, research ongoing
6. Caren Oloo - Masters; Univ. of Nairobi; Partial CRSP support; Course work ongoing

Degree Training:

Trainee #1

First and Other Given Names: Crispus Mugambi

Last Name: Njeru

Citizenship: Kenyan

Gender: Male

Degree: M.S.

Discipline: Soil Science

Host Country Institution
to Benefit from Training: Kenya Agricultural Research Institute Kakamega

Training Location: Moi University

Supervising CRSP PI: Okalebo, John

Start Date: 02/08

Project Completion Date: 02/10

Training Status: Active

Type of CRSP Support (full, partial or indirect): Full (Category 2a)

Trainee #2

First and Other Given Names: Belinda Akinyi

Last Name: Weya

Citizenship: Kenyan

Gender: Female

Degree: M.S.

Discipline: Soil Science

Host Country Institution
to Benefit from Training: Kenya Ministry of Agriculture Extension - Kisii

Training Location: Egerton University

Supervising CRSP PI: Mwonga, Samuel

Start Date: 08/08

Project Completion Date: 08/10

Training Status: Active

Type of CRSP Support (full, partial or indirect): Full (Category 2a)

Trainee #3
First and Other Given Names: Jane Francisca
Last Name: Lusweti
Citizenship: Kenyan
Gender: Female
Degree: M.S.
Discipline: Plant pathology & Entomology
Host Country Institution
to Benefit from Training: Kenyan Ministry of Agriculture Extension
Training Location: University of Nairobi
Supervising CRSP PI: Muthomi, James
Start Date: 10/07
Project Completion Date: 10/09
Training Status: Active
Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #4
First and Other Given Names: Silvester Navuana
Last Name: Odundo
Citizenship: Kenyan
Gender: Male
Degree: M.S.
Discipline: Soil Science
Host Country Institution
to Benefit from Training:
Training Location: Moi University
Supervising CRSP PI: Okalebo, John
Start Date: 09/07
Project Completion Date: 09/10
Training Status: Active
Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #5
First and Other Given Names: Eunice Onyango
Last Name: Odero
Citizenship: Kenyan
Gender: Female

Degree: M.S.
Discipline: Socioeconomics
Host Country Institution
to Benefit from Training: KARI Kakamega
Training Location: Moi University
Supervising CRSP PI: Odendo, Martins
Start Date: 10/07
Project Completion Date: 10/09
Training Status: Pending
Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #6
First and Other Given Names: Caren
Last Name: Oloo
Citizenship: Kenyan
Gender: Female
Degree: M.S.
Discipline: Plant pathology & Entomology
Host Country Institution
to Benefit from Training: Ministry of Agriculture-Extension
Training Location: University of Nairobi
Supervising CRSP PI: Muthomi, James
Start Date: 10/08
Project Completion Date: 10/10
Training Status: Pending
Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Contribution of Project to Target USAID Performance Indicators

See Performance Indicators worksheet for FY10

Target Outputs

1) Identification of biophysical environments in the East African Highlands where vigor enhancing strategies will have the most impact for addressing pests and diseases of pulse crops. Target domains will be based on pest/disease incidence and severity of pulse crops across a soil degradation gradient and assessments of vigor enhancing strategies (root rot tolerant bean varieties, seed priming, phosphorus fertilizers, combining organic-inorganic fertilizers, boma compost) in providing tolerance to identified pest and disease pressures.

2) Identification of socio-ecological niches in the East African Highlands where lablab (variety Rongai) can be used most successfully for food, income generation, livestock feed and/or replenishing soil fertility for enhancing crop vigor. Niches will be based on

the agronomic performance of lablab, smallholder farmers' choices for utilizing lablab grain/biomass and its impacts on vigor and growth of subsequent maize production across a soil fertility degradation gradient.

3) Multipurpose cowpea varieties identified for production of both grain and biomass for food, income and rebuilding soil fertility; that perform well under the biophysical conditions of Western Kenya and are acceptable to smallholder farmers.

4) Locally relevant nutrient composition database developed for lablab, cowpea and common bean (grain, leaf) grown under Western Kenya's varying soil fertility conditions to aid policy decision-making for meeting human nutrition goals through the food system.

5) Project-related extension materials developed and disseminated to promote adoption and aid scaling up of vigor enhancing strategies for Highland mixed farming systems based on lessons learned from participatory activities including farmer preferences, constraints, innovations, technology impacts and adoption trends.

6) Increased capacity of mid-career professionals from the Kenya Agricultural Research Institute and Ministry of Agriculture to address technical pulse crop production issues using participatory research approaches.

Engagement of USAID Field Mission(s)

- 1-2 courtesy visits to Agriculture Office during FY10
- Invite Agriculture Officer for a project site visit

Networking Activities with Stakeholders

- Collaborations with NGO/farmer groups REFSO, ARDEP and Avene were developed in FY09. Trainings, facilitation and technical backstopping on the improved pulse productivity strategies will continue in FY10 in an effort to build capacity in these NGOs and provide a platform for scaling up.
- As a result of the project, farmers are expressing interest in TSP fertilizers for their pulse crops. During FY10, stockists (local input suppliers) will be invited to attend exchange visits to create awareness and exchange ideas about vigor enhancing strategies, thereby stimulating opportunities for increased sales and expanded inventory in response to farmers demands.

Leveraging of CRSP Resources

Existing projects lead by co-PIs of this project will allow us to leverage travel funds during the project period. The projects are the SANREM CRSP (Sponsor: USAID, through Sept 2009); Global Livestock CRSP (Sponsor: USAID, through Dec 2011); and Building Farmer's Capacity and Marketing Skills (Sponsor: Anonymous dor and Catholic Relief Services through August 2009).

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

PERFORMANCE INDICATORS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)

Project Title: Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya

Lead U.S. PI and University: Julie G. Lauren, Cornell University

Host Country(s): Kenya

Output Indicators	2010 Target (October 1 2009-Sept 30, 2010)	2010 Actual (October 1 2009-Sept 30, 2010)
Degree Training: Number of individuals enrolled in degree training		
Number of women	4	
Number of men	2	
Short-term Training: Number of individuals who received short-term training		
Number of women	100	
Number of men	50	
Technologies and Policies		
Number of technologies and management practices under research	2	
Number of technologies and management practices under field testing	9	
Number of technologies and management practices made available for transfer	9	
Number of policy studies undertaken	0	
Beneficiaries:		
Number of rural households benefiting directly	150	
Number of agricultural firms/enterprises benefiting	1	
Number of producer and/or community-based organizations receiving technical assistance	4	
Number of women organizations receiving technical assistance	1	
Number of HC partner organizations/institutions benefiting	4	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	20	

Dry Grain Pulses CRSP (10/1/09-9/30/10)

Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya

	Third period (12 months) 10/01/09 - 09/30/10					
	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)
Institution Name	**Cornell**		**KARI**			
a. Personnel Cost						
Salaries	$28,327.62		$3,419.52			
Fringe Benefit	$13,483.95		$0.00			
b. Travel	$13,800.00		$18,458.50			
c. Equipment ($5000 Plus)	$0.00		$0.00			
d. Supplies	$400.00		$6,013.28			
e. Training						
Degree			$16,071.97			
Non-Degree			$0.00			
f. Other	$5,040.00		$0.00			
g. Total Direct Cost	**$61,051.57**	**$0.00**	**$43,963.27**	**$0.00**	**$0.00**	**$0.00**
h. Indirect Cost	$32,967.85		$4,396.33			
i. Indirect Cost on Subcontracts (First $25000)	$0.00					
j. Total Indirect Cost	$32,967.85	$0.00	$4,396.33	$0.00	$0.00	$0.00
Total	**$94,019.42**	**$0.00**	**$48,359.60**	**$0.00**	**$0.00**	**$0.00**
Grand Total	**$142,379.02**					

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	**$61,052.57**	**58.14%**
Total direct cost budgeted for H.C institution(s)	**$43,963.27**	**41.86%**

Cost Share	U.S. Institution	U.S. for Host Country	HC or U.S. Institution (1)	HC or U.S. Institution (2)	HC or U.S. Institution (3)	HC or U.S. Institution (4)	Total
In-kind			$22,340.00				$ 22,340.00
Cash	$16,217.00		$10,634.00				$ 26,851.00
Total	$ 16,217.00	$ -	$ 32,974.00	$ -	$ -	$ -	$ 49,191.00
Attribution to IEHA Objectives							
Percentage of effort	60.00%		49.89%				56.57%
Amount corresponding to effort	$56,411.65	$0.00	$24,126.60	$0.00	$0.00	$0.00	$80,538.26
Attribution to Capacity Building (Theme "D")							
Percentage of effort	40.00%		50.11%				43.43%
Amount corresponding to effort	$37,607.77	$0.00	$24,233.00	$0.00	$0.00	$0.00	$61,840.76

Name of PI and Institution affiliation: Dr. Julie G. Lauren, Cornell University

REPLACE THIS SEMI ANNUAL INDICATORS WITH ATTACHED REVISED FILE

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2009 -- September 30, 2010)

SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

Project Title: **Using Improved Pulse Crop Productivity to Reinvigorate Smallholder Mixed Farming Systems in Western Kenya**

	Abbreviated name of institutions											
Identify Benchmark Indicators by Objectives	**Cornell**		**KARI**									
	4/1/10	**9/30/10**	**4/1/10**	**9/30/10**	**4/1/10**	**9/30/10**	**4/1/10**	**9/30/10**	**4/1/10**	**9/30/10**	**4/1/10**	**9/30/10**
Objective 1	To develop and assess farmer capacity for improving vigor and growth of pulse crops on nutrient accumulation, pest/disease resistance and system productivity across a soil degradation gradient.											
Reports on in-community trainings and meetings			x									
Farmer trials established			x									
Objective 2	To disseminate and evaluate through participatory approaches simple, low cost strategies for vigorous establishment/growth of pulse crops leading to increased system productivity and sustainability.											
NGO partner monitoring reports received			x	x								
Farmer data collected			x	x								
Exchange visits conducted & technologies evaluated			x	x								
Extension materials developed & distributed		x		x								
Objective 3	To research factors (nutrients, pest/diseases and their interactions) affecting pulse productivity across a soil degradation gradient											
Research experiments established for 2nd year			x									
Seasonal research results reported	x	x	x	x								
Site visit trip reports	x	x	x	x								
Germplasm testing reports received			x									
Annual meeting report		x		x								
Nutrient analysis report	x											
Publications in preparation		x		x								
Objective 4	To facilitate and support on-farm participatory research opportunities for Kenyan agricultural scientists and graduate students											
Faculty progress reports			x	x								
Student research reports at annual meeting				x								
Masters degrees completed		x		x								
Publications submitted or presentations given at conference		x		x								
Name of the PI responsible fo reporting on benchmarks	J.G. Lauren		J.O. Ojiem									

Signature/Initials: _____

Date: _____