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

Lead U.S. Principal Investigator and University
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Project Problem Statement and Justification
Agriculture in East Africa is characterized by women and men working in small scale, rainfed production, averaging 2 hectares per household (FAO 2006). Erratic bimodal rainfall patterns in recent years further challenge cropping results (ARB 2007). Farmers have very limited access to extension, training, inputs (quality seeds, fertilizers, etc.), improved agronomic practices, new technologies, and credit (KDA 2004; Nkonya et al. 2004). Producers are not well linked with profitable markets, especially to emerging sectors of domestic and regional markets (Ehui & Pender 2005). Private traders operate on a small scale with limited investment capability. Availability and use of processed products at present remain very modest. As a result of low production levels, hunger is widespread (WFP 2006) and the vast majority of the rural population lives in absolute poverty (KDA 2004).

Our recent efforts to introduce new agronomic practices and technologies demonstrate encouraging progress (Butler & Mazur 2007). Ongoing collaboration since 2004 of Iowa State University (ISU), Makerere University (MAK), and Volunteer Efforts for Development Concerns (VEDCO) in Uganda’s Kamuli District (Mazur et al. 2006; VEDCO 2006; Sseguya, Mazur & Masinde 2009) using a sustainable livelihoods approach has increased food security and market readiness from 9% to 77% among 800+ farm households in 2½ years (Sseguya 2007). The main crops grown in Kamuli district are maize, beans, sweet potatoes, cassava, bananas, rice and coffee (Sseguya & Masinde 2005). Most (90%) of participating households produce beans, but only 20% sold some in 2007. The SL approach focuses on understanding and supporting individual and community capabilities, assets (natural, physical, human, financial, social, cultural and political capital), goals, strategies and activities. Diversification of livelihood opportunities and activities is crucial to sustainability (Ellis 2000). In combination with SL approaches, scientific knowledge, improved technologies, financial assistance, and changes in government policies can have significant positive local impacts (Helmore & Singh 2001). Participatory research methods can generate knowledge that people can apply to improve their individual and collective well-being (Selener 1997).
Beans provide a strategic opportunity to help meet the Millennium Development Goal targets of reducing hunger and poverty. Improved beans production in Uganda and Rwanda offers unique opportunities to address the deteriorating food security situation there and elsewhere in sub-Saharan Africa. The short growth period and two growing seasons offers great opportunities to contribute to rural poverty alleviation - playing an essential role in sustainable livelihoods of small scale farmers and their families, providing food security and income to the most vulnerable group, the women and children. Testing whether various management practices and technologies result in higher bean yield and quality at harvest and after storage (Objective 1), and which varieties, processing methods, and food combinations can increase consumption and nutritional value (Objective 2) are important under-researched issues in this region. Improved farmers’ linkages to emerging markets and the food industry are also essential (Objective 3).

Central problems limiting production of quality beans and higher yields
- Declining soil fertility and inefficient cropping systems unable to utilize available resources effectively and efficiently
- Limited accessibility and affordability of quality seeds, non-seed inputs and other yield improving technologies
- Effects of drought and other weather related factors compromise productivity and quality
- Diseases (root rot, anthracnose, angular leaf spot, common bacterial blight, viruses, rust, ascochyta blight) and insect pests (aphids, thrips, bean stem maggots, weevils)

Central problems relating to nutritional value and processing of beans
Pre- and post-harvest losses for beans are very high throughout the value chain, mostly due to poor harvest and post-harvest practices and poor on-farm storage facilities. Poor pre- and post-harvest handling also results in the majority of beans on the market being characterized by mixed varieties and poor quality with high levels of foreign matter, rotten or shriveled beans, and infestation. The lack of value-added bean products having reduced preparation times makes bean preparation laborious with high fuel requirements; consumers also tire of monotonous flavor. As a result, an increasing number of people are abandoning or reducing their bean consumption despite its documented high nutrient content and health benefits.

The nutrition value of beans is negatively affected by anti-nutrients such as phytates, trypsin inhibitor, lectins, polyphenols, saponins, oligosaccharides and hemaglutinins (Kebede et al., 1995). However, treatments such as de-hulling, soaking, milling, fermentation and germination or malting and cooking enhance the digestibility and nutritional value (Matella 2005; Martín-Cabrejas 2006; Shimelis & Rakshit 2007; Nergiz & Gökgöz 2007; Cevdet & Gökgöz 2007).

Central problems inhibiting increased marketing of beans and derived food products
Prospects of marketing increased quantities of beans and new agro-processed bean products within the Ugandan and regional markets requires carefully examining production and marketing constraints (increased farm productivity, producer incentives, and access to better markets). Equally important is examining prospects for increasing demand for beans and agro-processed products (understanding consumers’ tastes and preferences, increased consumer awareness of benefits of consuming beans and other value-added products, increasing consumer choices of value-added products, etc.).
Planned Project Activities for October 1, 2011 - September 28, 2012

**Objective 1:** To Improve Harvested Bean Yield and Quality

**Collaborators**

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*Iowa State University* (Ames, Iowa)
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*Makerere University* (MAK-Kampala, Uganda)
- Dorothy Nakimbugwe, Dept. of Food Technology & Nutrition, dnakimbugwe@gmail.com, dnakimbugwe@agric.mak.ac.ug,

**Rationale**

Results of Phase 1 research activities prompted several adjustments in research and development activities in Phase 2.

On-farm field trials revealed significant local variation in soil conditions that resulted in large genotype x environment interactions for the priority varieties evaluated. Although management techniques and farmer interest contributed to some extent, variation was largely due to soil conditions and fertility. Bean production remained well below genetic potential and, in some cases, unresponsive to supplemental Nitrogen fertilizer. All soils in the test sites were depleted in phosphorous. Work under Objective 1a tests the hypothesis that incorporating varying amounts of inorganic phosphorous into the soil prior to planting will identify the level required to generate a profitable return on seed and N-fertilizer investment. Results of this objective will be compared to those of related studies to enhance Biological Nitrogen Fixation, in which phosphorous levels will be monitored as critical for profitable plant response.

Phase I results also confirmed the large potential for yield loss due to insect infestations during seed development. While chemical methods of insect control are available, their high cost and lack of information on effective and timely application renders chemical insecticides inaccessible for most small-landholder farmers. Entomologists at Uganda’s National Crops Resources Research Institute have identified the major insect pests in beans. Controlled field trials are being conducted to determine specificity and effectiveness of methods for controlling damaging pests.
Phase I analysis of farmer production levels and market requirements for consistent production levels and product quality required significant changes in seed management to effect a successful transition from household-based bean production to market-oriented production. A major priority has been to establish a system for community-based production of quality seed. We have trained and supported six farmer groups committed to large-scale bean production in accordance with established seed quality standards. This will subsequently enable many other farmers to utilize quality seed. We are also piloting triple bagging as a seed storage method suitable for long-term (3-6 months) storage without loss of product quality. We are using participatory methods to engage farmers in this process and establish viable and sustainable protocols for seed production, harvesting, and storage. We are in the process of monitoring success to date and individual and group level factors that account for variation in the success of community based seed production efforts to date. We hypothesize that certain elements of group leadership and dynamics have a major impact on the success and sustainability of the production groups.

Numerous factors are known to affect the quality of seed in storage. Phase I studies on typical storage techniques revealed the need to improve bean post-harvest handling and storage to prevent post-harvest losses and avoid excessive time expenditure involved in re-sunning. Re-sunning is commonly used to limit damage to stored seeds caused by infesting bruchid larvae. While the actual control mechanism is not known, the movement of the seed is thought to be the controlling factor. If correct, periodically moving the seed could limit adult damage, but would have little impact on eggs or larvae. We are continuing experiments that test the efficacy of air-tight bagging to eliminate living insects from the stored grain. The triple bagging technique has numerous advantages, including flexible storage volume, re-usability of bags, and manageable volume of individual bags (50-100 kg). This flexible storage approach is being evaluated as a means of meeting the emerging need for bulk storage on farm or at community collection sites for collective marketing to increase farmer access to emerging markets.

These Phase II activities for Objective 1 build on the great potential for promoting improved practices and disseminating technologies in Kamuli, in other districts in Uganda, and in Rwanda that have similar yield and seed quality limitations. Key activities for Objective 1 include:

- Data on variety performance, fertility response, and pest/disease management interventions will be analyzed.

- Exchange visits have been initiated to established seed production programs in central Uganda to facilitate learning and sharing of practices and technologies. These will be continued to central and western Uganda, as resources permit.

- Drying and storage techniques are being evaluated under various conditions and at various time intervals to determine their effectiveness in keeping out/killing pests and maintaining seed germination viability.

- Refinements in practices and technologies (land preparation, soil nutrient management, pest and disease control, harvest and storage) are being evaluated, documented, and incorporated into materials for dissemination.
Approaches and Methods

Obj. 1a. Improve Yield and Quality through Evaluation of Better Production and Management Practices

1. Evaluate existing bean varieties being promoted with selected traits (farmer selected varieties, high seed ferritin genotypes, early maturation, good yield, disease resistance) will be tested under farmers’ cropping system conditions - monocropping and intercropping with maize and/or bananas.

2. Evaluate practical methods to enhance nutrient management - organic fertilizers (adding compost and green manure to currently evaluated farm yard manure), adding phosphorous and nitrogen amendments.

3. Evaluate appropriate cultural/agronomic methods to control pests/diseases (intercropping, and crop rotation).

4. Promote adoption and use of key management practices and technologies.

Benchmarks

- Variety performance, fertility response, and agronomic/cultural controls analyzed

Apr. – Sept. 2012
- Assessment by farmers/farmer groups of new variety acceptability completed
- Report to bean breeders on variety performance and farmer acceptance completed

Obj. 1b. Support Community-Based Seed Production (CBSP) by Farmers Groups/Associations

1. Strengthen CBSP systems initiated in 2010 based on farmer group/stakeholder input

2. Document lessons learned in development of community based seed production systems

3. Scale up CBSP systems to other farmer groups in Kamuli District and explore approaches for doing so more widely

Benchmarks

- Strategies for profitability and sustainability of seed production assessed
- Extension guide for CBSP of beans finalized

Apr. – Sept. 2012
- Achievements and lessons learned from the CBSP documented and shared
- Assess impact of CBSP on seed systems within Kamuli district
- Successful strategies for seed production business promoted
Obj. 1c. Evaluate Adoption of Improved Post-Harvest Handling and Storage Methods

1. Evaluate parameters of ‘solarization’ method (bean seed size, seed coat thickness, color, length of time exposed, heat accumulated by time of day, etc.), to achieve optimal moisture content and viability of bean seeds.

2. Train farmers in improved drying methods to achieve optimal moisture content and viability of bean seeds, and identify and address barriers to farmers’ adoption.

3. Train farmers in improved threshing practices, identify and address barriers to farmers’ adoption.

4. Train farmers in improved storage methods (‘solarization’ and ‘triple bagging’), and identify and address barriers to farmers’ adoption.

5. Train farmers in technical, organizational, and financial management aspects of bulking facilities.

6. Assess adoption of drying, threshing, and storage techniques through interviews and focus group discussions.

**Benchmarks**


- Extension materials for drying, threshing, and storage finalized
- Barriers to adoption of storage techniques identified and addressed
- Follow up training on solarization and new storage techniques carried out

Apr. – Sept. 2012

- Farmers’ long-term adoption of new drying, threshing, and storage techniques assessed

Obj. 1d. Strengthen Learning and Sharing of Innovative Practices

1. Share and disseminate information through farmer field days at research/demonstration sites and regional/national agricultural shows, and develop materials and methods to promote improved management practices and technologies.

2. Review training materials by project farmers and RDEs/CNHWs, adapt, and translate.

3. Develop materials for new farmer groups to utilize in adopting and utilizing new management practices and technologies (germination, moisture content, etc.).

4. Explore approaches to disseminate and promote management practices and technologies in other districts, and quantify the resource requirements.

**Benchmarks**


- Training of trainers in bean production initiated
- Training modules (production, drying, storage, and management of bulked bean grains and seeds) compiled into a comprehensive document and published
Apr. – Sept. 2012

- Final training of all trainers conducted – including farmers from other districts for scaling up and scaling out
- Two farmer field days held (one in each sub-county)
- Project findings shared with stakeholders through workshop and publications
- Status of bean production, constraints faced and resources needed for scaling up determined

Target Outputs and Developmental Outcomes

We will document and publicize the contributions of production factors to increased yield, reduced loss due to pests and diseases, and improved quality after drying and storage, as well as successful strategies for profitable and sustainable community-based seed production. Farmers’ indigenous knowledge combined with emerging research results and ‘lessons learned’ will be incorporated into revised training procedures and materials, and promotion protocols for use in VEDCO operations and NaCRRI demonstration projects in other areas of Uganda. The project will facilitate access to improved drying and storage techniques, and farmers’ central roles in field days conducted for the public (farmers, farmer groups and associations, NGOs, researchers). We anticipate that dissemination of these technologies, management practices, and CBSP programs will benefit – directly and indirectly - more than 2,000 VEDCO-assisted farmers and other farmers in Kamuli. Project researchers will actively explore the bases for dissemination of improved technologies and practices to other districts in Uganda and in Rwanda.

Objective 2: To Enhance Nutritional Value and Appeal of Beans through Appropriate Handling and Processing.

Collaborators

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Rationale

Phase I results indicate the need to promote increased bean consumption among farming communities and urban consumers to realize the nutritional and health benefits and address prevalent diet and nutritional imbalances, as well as the need to reduce cooking time and monotony in the diet. Doing so involves three core elements. The first element involves understanding and communicating consumer preferences regarding culinary properties and sensory characteristics of existing and improved bean varieties to national bean breeding programs and the private business sector. This leads to the second element - engaging the private business sector in value addition and commercialization of bean products to open up new markets for bean producers. Third, in order to enhance children’s daily nutrient intake through increased consumption of beans and bean products, our emphasis will be on products that are practical, useful in school settings, and acceptable to students. Thus, institutional buyers such as schools, hospitals, and humanitarian agencies have been identified as potential markets for beans and bean products.

While beans have the potential to positively contribute to the nutritional and health status of both farming and urban communities, a number of constraints to consumption remain, including long cooking times, monotony of cooking methods and limited dietary complementation. During phase I, pre-processing methods that reduce cooking times to about 15 minutes, using a pre-processed bean flour were developed. Recipes utilizing the fast-cooking bean flour were developed in a participatory, community based competition and field day in 2010.

We hypothesize that availability of acceptable alternative ways of preparing beans will result in increased bean consumption. The central hypothesis regarding farmers’ adoption, adaptation and sustained use is that a coordinated strategy of technological innovation to facilitate ease of utilization of bean-based foods and ongoing evidence of nutritional and economic benefits of beans are likely to create sustainable increased consumption of beans within communities.

Phase I results indicate that new high yielding bean varieties were not necessarily of optimal nutrition and consumer acceptability. This clearly indicated a disparity between breeding for agronomic hardiness versus end user requirements. Thus, Phase II of this project is bridging the gap between breeders and consumers by clearly defining consumers’ sensory, culinary and processing requirements and informing national breeding programs. It is hypothesized that interfacing with bean breeders and providing critical information on expectations of end users (consumers and processors) will lead to development of sustainable and consumer acceptable varieties.

Besides utilization by communities, the project will continue to partner with the private business sector to promote adoption of value addition to beans as a way of increasing consumption and creating market outlets. Bean varieties that are high yielding and stress resistant but have low consumer acceptability and are prone to being hard-to-cook were selected for value addition and product development in phase I. In phase II, processing protocols developed in phase I are being refined and up-scaled through the Technology Business Incubator (TBI) model, as a vehicle to promote technology transfer to the private sector. TBIs are effective frameworks for fostering industrial uptake of new technologies by providing entrepreneurs with a supportive environment
to help establish and develop their projects (Lalkaka 1996). It is hypothesized that by providing services (product refinement/optimization, up scaling, test marketing, access to funding/loans) on a ‘one-stop-center’ basis and enabling overhead costs to be reduced by sharing facilities, the TBI model will significantly improve the establishment and growth prospects of bean processing enterprises in their early stages of development. Private sector partners will be linked to farmer organizations for maximum trickle down effect of value addition returns. We will also test two additional hypotheses: (1) processing of beans significantly improves its acceptability and market potential; and (2) there is no significant difference between the organoleptic property of bean based products made from hard-to-cook bean varieties and the varieties less prone to that phenomenon.

Initial publication outlets for this research include the Journal of Agricultural and Food Chemistry, and the Journal of Food Science.

Approaches and Methods

Obj. 2a. Address Nutritional and Health Problems among Vulnerable Individuals through Increased Consumption of Beans, Bean Products, and Complementary Foods

1. Train rural populations (Rwanda, then Uganda) to process bean flour and utilize simple ‘cold extrusion’ technology (using hand-operated presses) at community level with processed (sprouted, fermented) beans and maize.

2. Develop and implement appropriate extension information education and communication (IEC) approaches (nutrition, processing of bean based products) for rural community nutrition and health workers to accelerate and multiply positive rural development impacts.

Benchmarks


- IEC materials translated into local languages

Apr. – Sept. 2012

- Extension information, education, and communication approaches for popularization of bean products finalized

- Community-based dissemination field days held in Uganda and Rwanda

Obj. 2b. Analyze Culinary Properties, Sensory Characteristics, and Consumer Acceptability of Improved Varieties of Beans

1. Analyze culinary properties of improved bean varieties in Uganda (NaCRRI) and Rwanda (ISAR)

2. Analyze sensory characteristics (color, texture, taste, flavor, etc.) and consumer acceptability of improved bean varieties in Uganda (NaCRRI) and in Rwanda (ISAR)

3. Liaise with national bean breeding programs to match consumer requirements with culinary and sensory characteristics of new varieties
Benchmarks


• Culinary traits and sensory characteristics of improved bean varieties documented
• Communicate culinary traits and sensory characteristics results to national breeding programs

Apr. – Sept. 2012

• Strategy to promote current and improved varieties developed with national breeding programs
• Strategy to promote improved bean varieties initiated

Obj. 2c. Incorporate Insights from Analysis of Private Food Processing Industry regarding Development and Commercialization of Bean-based Products

1. Identify approaches and methods that enable farmers’ associations to establish and strengthen links with the private food processing industry in Uganda, taking lessons from experiences in the U.S.

2. Engage private sector actors in developing protocols for value-added bean products (including utilizing the semi-processed bean flour for including the weaning food/school feeding product).

3. Develop and evaluate marketing strategies regarding consumers’ nutritional awareness and utilization, and work with private sector processors, distributors and retailers to promote bean products for purchase.

4. Support commercialization of bean products through technology and business incubation in the Makerere University, Department of Food Science, Technology and Business Incubation Centre.

Benchmarks


• Infrastructure to support commercialization of bean products at Makerere University developed
• Developed protocols for value-added bean products up-scaled in partnership with private sector
• Marketing strategies for processed bean products developed and evaluated

Apr. – Sept. 2012

• Process to document industrial adoption and market performance of bean based value added products initiated
• Process to evaluate impact of industrial adoption of value added bean products on farmers’ livelihoods initiated
**Target Outputs and Developmental Outcomes**

Documentation and analysis of culinary properties and sensory characteristics of current and new bean varieties will be of great value to national bean breeding programs. We will document and publicize nutritional analysis of harvested beans and effects of processing methods, including the rural-based cold extrusion method. In rural communities, we will conduct follow-up training and evaluation regarding adoption of promoted food preparation practices and use of complementary foods. Information on shelf-stability and consumer acceptability of the developed bean flour-based products and extruded products will be of interest to processors and retailers. Private sector processors will gain from the bean processing protocols that will be finalized and disseminated. Rural farmers will gain through project activities which will enable farmers’ associations to establish and strengthen links with the private food processing industry.

**Objective 3: To Identify Solutions for Constraints to Increased Marketing & Consumption.**

**Collaborators**

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- Robert Mazur, Department of Sociology, rmazur@iastate.edu

**Rationale**

Although there has been an increase in bean market participation among households, bean production has tended to be for domestic consumption rather than for commercial purposes (currently 42%). Improved crop management practices and technologies stimulate market participation, as they effectively increase the quantity available for sale. Basic value addition activities such as proper drying, sorting, grading, storage, the absence damage or insect infestation, help improve quality and price. When farmers can obtain good prices, they increase marketing. Further, when farmers add value, they can achieve even higher prices. The local village markets have been important concentration/assembly and dispersion points for beans, and where market prices become formalized. Still, most (79%) farmers who sell beans do so at farm gate rather than directly in markets. Transaction costs, costs associated with gathering information, travel, making sales or purchases, can impede the development of markets and marketing activities. Market participation by smallholder farmers is affected by transaction costs, especially distance and access to useful market information. Since households headed by women
tend to market smaller quantities of beans, there is value in increasing program and policy support for women to add value to product and for their marketing efforts. Our results to date suggest the value of increasing access to market information systems that are reliable and timely, improving transportation networks for marketing, strengthening farmer groups, and establishing associations that can effectively engage in collective marketing with various types of buyers, including industry.

To foster successful collective marketing activities as production increases, our Phase 2 activities focus on strengthening farmer groups and associations, and supporting development of value chain partnerships, and addressing the requirements of women who may market in small quantities or specialize in small-scale, value added services. These strategies reduce the costs of marketing transactions, including acquisition of market information. It is expected that these efforts will increase the number of farmers engaged in commercialization of beans, increase the quantity of beans sold, and increase the income and associated livelihoods benefits that small scale farmers derive from production and sale of beans. We expect that farmers participating in this project, as well as other VEDCO assisted farmers, will play important leadership roles in emerging associations.

**Approaches and Methods**

**Obj. 3a. Assess capabilities and needs of farmer groups and associations**

1. Assess institutional status of existing farmer groups and associations
2. Design strategies to build strong farmers’ marketing associations

**Benchmarks**

- n/a (being completed during FY11)

Apr. – Sept. 2011
- n/a (being completed during FY11)

**Obj. 3b. Strengthen Farmers’ Successful Engagement in Value Chain Development**

1. Convene periodic value chain platform meetings
2. Establish product portfolio appropriate for target markets
3. Improve market information systems
4. Training farmers’ associations in agri-business management skills

**Benchmarks**

- Farmers trained in developing business plans, pricing, packaging and record keeping
- Market information system enhancements initiated
Apr. – Sept. 2012

- Progress of farmer groups in collective marketing evaluated
- Comprehensive business plans developed
- Strategic value chain partnerships established

Target Outputs and Developmental Outcomes
Farmers will benefit significantly from improved market information systems, establishing small scale bulking centers, processing and extrusion as value addition income earning activities, and increased capabilities to engage with value chain actors regarding production, bulking, price negotiation, and targeting production. Consumer awareness and interest in bean products is expected to increase among households, students, and others. The private business sector will benefit by through product development, commercialization, and access to new markets.

Objective 4: Capacity Building
To Increase the Capacity, Effectiveness and Sustainability of Agriculture Research Institutions that Serve the Bean Sector in Uganda and Rwanda

Collaborators

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- Helen Jensen, Department of Economics, hhjensen@iastate.edu
Approaches and Methods

- Engage students in learning appropriate theories and methods in discipline and multidisciplinary format, and applying them in their research activities
- Integrate students into research projects and research program development
- Guide development of students’ research proposals and supervise their research

Benchmarks

- Inter-organizational learning fostered

Apr. – Sept. 2012
- Training M.S. students at Makerere University completed
- Training M.S. student in Food Science & Technology from Rwanda on-going
- Training Ph.D. at Iowa State University completed
- Inter-organizational learning fostered
- Preliminary results disseminated (conferences, publications, websites)

Degree Training

Trainee #1
First and Other Given Names: Gerald
Last Name: Sebuwufu
Citizenship: Ugandan
Gender: Male
Degree Program for training: Ph.D.
Program Areas or Discipline: Agronomy
Host Country Institution to Benefit from Training: National Crops Resources Research Institute, Uganda
University to provide training: Iowa State University
If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? Yes
Supervising CRSP PI: Mark Westgate
Start Date: August 2008
Projected Completion Date: August 2012
Type of CRSP Support (full, partial or indirect): Partial
If providing Indirect Support, identify source(s) of leveraged funds: Iowa State University
Amount Budgeted in Workplan, if providing full or partial support: $19,033
Direct cost: $15,715
Indirect cost: $3,318
U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University
**Trainee #2**  
First and Other Given Names: Martin  
Last Name: Mutambuka  
Citizenship: Ugandan  
Gender: Male  
Degree Program for training: Ph.D.  
Program Areas or Discipline: Food Science and Human Nutrition  
Host Country Institution to Benefit from Training: Makerere University, Uganda  
University to provide training: Iowa State University  
If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? Yes  
Supervising CRSP PI: Manju Reddy and Suzanne Hendrich  
Start Date: January 2009  
Projected Completion Date: May 2012  
Type of CRSP Support (full, partial or indirect): Partial  
If providing Indirect Support, identify source(s) of leveraged funds: Iowa State University  
Amount Budgeted in Workplan, if providing full or partial support: $14,658  
Direct cost: $12,019  
Indirect cost: $2,639  
U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University

**Trainee #3**  
First and Other Given Names: Joseph Deng  
Last Name: Malual  
Citizenship: U.S.  
Gender: Male  
Degree Program for training: Ph.D.  
Program Areas or Discipline: Sociology  
Host Country Institution to Benefit from Training: VEDCO  
University to provide training: Iowa State University  
If enrolled at a US university, will Trainee be a “Participant Trainee” as defined by USAID? No  
Supervising CRSP PI: Robert Mazur  
Start Date: July 2011  
Projected Completion Date: May 2012  
Type of CRSP Support (full, partial or indirect): Partial  
If providing Indirect Support, identify source(s) of leveraged funds: Iowa State University  
Amount Budgeted in Workplan, if providing full or partial support: $19,263  
Direct cost: $15,674  
Indirect cost: $3,589  
U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University

**Trainee #4**  
First and Other Given Names: Grace  
Last Name: Nkundabombi  
Citizenship: Rwanda  
Gender: Female  
Degree: M.Sc.  
Discipline: Food Science & Technology  
Host Country Institution to Benefit from Training: Kigali Institute of Science and Technology - Rwanda  
University to provide training: Makerere University
Supervising CRSP PI:  Dorothy Nakimbugwe  
Start Date: August 2011
Project Completion Date: August 2013
Training Status: Active
Type of CRSP Support (full, partial or indirect): Partial (Category 2b)

Trainee #5  
First and given names:  Catherine Tamale  
Last name:  Ndagire  
Citizenship:  Ugandan  
Gender:  Female  
Degree program for training:  M.Sc.  
Program areas / Discipline:  Food Science & Technology  
Host Country Institution to benefit from training:  Makerere University, Uganda  
University to provide training:  Makerere University  
Supervising CRSP PI:  Dorothy Nakimbugwe  
Start date:  August 2010  
Project completion date:  May 2012  
Type of CRSP Support (full, partial or indirect):  Partial

Trainee #6  
First and given names:  George  
Last name:  Jjagwe  
Citizenship:  Ugandan  
Gender:  Male  
Degree program for training:  M.Sc.  
Program areas / Discipline:  Extension & Innovation Studies  
Host Country Institution to benefit from training:  Makerere University, Uganda  
University to provide training:  Makerere University  
Supervising CRSP PI:  Dorothy Nakimbugwe  
Start date:  August 2010  
Project completion date:  August 2012  
Type of CRSP Support (full, partial or indirect):  Partial

Trainee #7  
First and given names:  Doreen  
Last name:  Alupo  
Citizenship:  Ugandan  
Gender:  Female  
Degree program for training:  M.Sc.  
Program areas / Discipline:  Food Science & Technology  
Host Country Institution to benefit from training:  Makerere University, Uganda  
University to provide training:  Makerere University  
Supervising CRSP PI:  Dorothy Nakimbugwe  
Start date:  August 2011  
Project completion date:  May 2013  
Type of CRSP Support (full, partial or indirect):  Partial
Contribution of Project to Target USAID Performance Indicators

- Seven scientists will undergo degree training (three female, four male) during this period at Makerere University (four M.S.) and Iowa State University (three Ph.D.).
- We expect 400 farmers (300 female) to participate in training regarding production, harvesting, and post-harvest methods in Uganda.
- Important technologies and management practices under research and field testing are:
  - Protocols for matching bean varieties with agro-ecological regions and growing conditions (soil nutrients, amendments, and moisture) for optimum physiology (plant growth and development) and yield (seed number, size, and nutrient composition)
  - Post-harvest handling and storage training techniques being adapted and further developed, incorporating results of project research
  - Protocols for producing bean flour, extruded bean snack and extruded instant bean flour
  - Recipes utilizing bean flour
  - Protocols for bean flour-based products
  - Improved market information system
  - Marketing information and protocols for farmers and farmer organizations
- We expect these approaches to be at or near readiness for transfer for use by Host Country farmers or researchers during this phase of the project. We plan to demonstrate and disseminate these management practices and technologies to wider audiences.
- We expect that 400 households will benefit directly from our training and support program. The train-of-trainer approach utilized will ultimately benefit many more farm households.
- Two agricultural enterprises will benefit from the increased volume of product marketed and available for processing.
- We expect that all six participating producer organizations, two marketing associations, and an additional six producer organizations will receive useful and actionable technical assistance. All of these organizations have a significant or majority of women members.
- We expect that four Host Country partner organizations/institutions will benefit from these activities (two universities, one NARO, and one NGO).
- We anticipate that an additional 100 acres will be cultivated using improved technologies during this phase of the project.

Target Outputs

- Reports regarding recommended practices for crop production, and both pre- and post-harvest management procedures to improve quality of harvested beans and increase yields
- Training manuals (for VEDCO’s Community Based Trainers, farm group members, etc.)
- Stronger links between farmers groups and associations to diverse types of buyers, including the food processing industry
- Reports of superior processing methods to protect protein and carbohydrate digestibility
- Recipes for widespread use, including for nutritionally vulnerable people
- Protocol for bean flour processing promoted for commercialization
- New value-added bean products designed for identified consumer markets
Engagement of USAID Field Missions

USAID agricultural initiatives in Africa seek to build economies, establish and enhance partnerships, and harness science and technology to meet the needs of the vulnerable and impoverished. This project will help USAID meet its goals for improved well-being in Uganda and Rwanda through agricultural activities designed to promote best practices, develop and market nutritious bean-based value-added products, and successfully link farmers and producers to markets. We will meet periodically with Mission staff devoted to realization of their agriculture-related strategic objectives (SO 617-007 Economic Growth, Agriculture and Trade in Uganda) and SO 696-007 (Economic Growth, Agriculture and Trade) in Rwanda. We will also invite them to project-sponsored activities and share results of our research-development activities.

Networking Activities with Stakeholders

To realize project objectives and actively promote institutionalization of positive impacts of research project finds and impacts, we will effectively engage diverse key stakeholders throughout the project and in annual workshops:

- Work with farmers, groups and associations to understand local livelihoods, agronomic practices, their previous and current linkages with various types of institutions and service providers (governmental and non-governmental), private sector traders, and transporters
- Interact regularly with various types of institutions and service providers (governmental and non-governmental), private sector traders, transporters, small, medium and large scale processors and distributors etc., to gain and maintain appropriately broad perspectives on key issues in the value chain, benefit from their special expertise, and build consensus and collaborative relationships for high levels of continued success
- Hold periodic planning and review meetings to involve all partners so that challenges and constraints are discussed and strategies to deal with them developed together
- Facilitate broad involvement in research design, data collection instruments and processes, and data analysis
- Share results from various stages of the project to encourage constructive criticism and strengthen usefulness, impact and sustainability of intervention results
- Involve other developmental partners with similar interests for complementarily and dissemination of results to other areas and countries
- Project results will be shared with the research and developments communities in Uganda, Rwanda and the region through workshops and various types of publications

Leveraging of CRSP Resources

- In addition to the direct collaboration between food scientists in Uganda, Rwanda and the U.S. in this project, we are linking work done by NaCRRRI and ISU with ISAR (Institut des Sciences Agronomiques du Rwanda) and MSU through a linkage with the Pulse CRSP project directed by James D. Kelly
- Iowa State University is contributing to partial support for two Ph.D. students from Uganda
- Explore bases for possible collaboration with relevant USAID-funded projects in Uganda and Rwanda, as well as other relevant projects in these countries
- Explore possibilities of funding from members of the bean producer and processor industry
- Work to identify agencies that may fund related research, training and outreach and prepare proposals as appropriate
Performance Indicators

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 20011 - September 28, 2012)

FY 2012 PERFORMANCE INDICATORS
for Feed the Future

Project Title: Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda
Lead U.S. PI and University: Robert Mazur, Iowa State University
Host Country(s): Uganda, Rwanda

<table>
<thead>
<tr>
<th>Output Indicators</th>
<th>2012 Target</th>
<th>2012 Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree Training: Number of individuals enrolled in long-term degree training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of women</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of men</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Short-term Training: Number of individuals who received short-term training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of women</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Number of men</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Technologies and Policies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of technologies and management practices under research</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of technologies and management practices under field testing</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of technologies and management practices made available for transfer</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Number of policy studies undertaken</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Beneficiaries:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of rural households benefiting directly from CRSP interventions - Female Headed households</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Number of rural households benefiting directly from CRSP interventions - Male Headed households</td>
<td>720</td>
<td></td>
</tr>
<tr>
<td>Number of agriculture-related firms benefiting from CRSP supported interventions</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of producer organizations receiving technical assistance</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of trade and business associations receiving technical assistance</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of community-based organizations receiving technical assistance</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Number of women organizations receiving CRSP technical assistance</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Number of public-private partnerships formed as a result of CRSP assistance</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Number of HC partner organizations/institutions benefiting</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Developmental outcomes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of additional hectares under improved technologies or management practices as a result of CRSP technical assistance</td>
<td>350</td>
<td></td>
</tr>
</tbody>
</table>
## Budget Summary

### Dry Grain Pulses CRSP : THIRD PERIOD (FY12)

**Enhancing Nutritional Value and Marketability on Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda**

<table>
<thead>
<tr>
<th>Institution Name</th>
<th>U.S. Institution</th>
<th>U.S. for Host Country</th>
<th>HC or U.S. Institution (1)</th>
<th>HC or U.S. Institution (2)</th>
<th>HC or U.S. Institution (3)</th>
<th>HC or U.S. Institution (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ISU</td>
<td>0</td>
<td>ISU</td>
<td>ISU</td>
<td>ISU</td>
<td>ISU</td>
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<tr>
<td>a. Personnel Cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries</td>
<td>$11,237.00</td>
<td>$14,309.00</td>
<td>$16,775.00</td>
<td>$4,400.00</td>
<td>$13,200.00</td>
<td>$4,125.00</td>
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<tr>
<td>Fringe Benefits</td>
<td>$1,151.00</td>
<td>$1,903.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Travel</td>
<td>$28,000.00</td>
<td>$12,350.00</td>
<td>$4,875.00</td>
<td>$7,810.00</td>
<td>$2,500.00</td>
<td>$2,563.00</td>
</tr>
<tr>
<td>c. Equipment ($5000 Plus)</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>d. Supplies</td>
<td>$5,254.00</td>
<td>$0.00</td>
<td>$2,250.00</td>
<td>$2,000.00</td>
<td>$11,252.00</td>
<td>$4,500.00</td>
</tr>
<tr>
<td>e. Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree</td>
<td>$1,889.00</td>
<td>$4,822.00</td>
<td>$8,750.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Degree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Other</td>
<td>$250.00</td>
<td>$0.00</td>
<td>$3,500.00</td>
<td>$900.00</td>
<td>$250.00</td>
<td>$750.00</td>
</tr>
<tr>
<td>g. Total Direct Cost</td>
<td>$47,811.00</td>
<td>$33,384.00</td>
<td>$36,150.00</td>
<td>$15,110.00</td>
<td>$27,202.00</td>
<td>$11,938.00</td>
</tr>
<tr>
<td>h. Indirect Cost</td>
<td>$11,945.00</td>
<td>$7,426.00</td>
<td>$3,615.00</td>
<td>$1,511.00</td>
<td>$2,720.00</td>
<td>$1,194.00</td>
</tr>
<tr>
<td>i. Indirect Cost on Subcontracts (First $25000)</td>
<td>$11,945.00</td>
<td>$7,426.00</td>
<td>$3,615.00</td>
<td>$1,511.00</td>
<td>$2,720.00</td>
<td>$1,194.00</td>
</tr>
<tr>
<td>j. Total Indirect Cost</td>
<td>$11,945.00</td>
<td>$7,426.00</td>
<td>$3,615.00</td>
<td>$1,511.00</td>
<td>$2,720.00</td>
<td>$1,194.00</td>
</tr>
<tr>
<td>Total</td>
<td>$59,756.00</td>
<td>$40,810.00</td>
<td>$39,765.00</td>
<td>$16,621.00</td>
<td>$29,922.00</td>
<td>$13,132.00</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>$200,008.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total direct cost budgeted for U.S. institution(s) | $47,811.00 | 27.86% |
| Total direct cost budgeted for H.C institution(s) | $123,784.00 | 72.14% |

### Cost Share

<table>
<thead>
<tr>
<th>Cost Share</th>
<th>U.S. Institution</th>
<th>U.S. for Host Country</th>
<th>HC or U.S. Institution (1)</th>
<th>HC or U.S. Institution (2)</th>
<th>HC or U.S. Institution (3)</th>
<th>HC or U.S. Institution (4)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-kind</td>
<td>$23,621.00</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$23,621.00</td>
</tr>
<tr>
<td>Cash</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
</tr>
<tr>
<td>Total</td>
<td>$23,621.00</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$23,621.00</td>
</tr>
</tbody>
</table>

### Attribution to Capacity Building

| Percentage of effort | 91.59% | 100.00% | 90.87% | 83.45% | 95.40% | 92.14% | 93.09% |
| Amount corresponding to effort | $54,730.02 | $40,810.00 | $36,134.46 | $13,870.22 | $25,945.59 | $12,099.82 | $188,190.81 |

**U.S Institution PI:** Dr. Robert Mazur, Professor of Sociology, Iowa State University

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Dry Grain Pulses CRSP

FY 12 10-01-11 - 09-30-12

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**BENCHMARKS**

Dry Grain Pulses CRSP  
Research, Training and Outreach Workplans  
(October 1, 2011 – September 28, 2012)

**FY 2012 SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD**

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

<table>
<thead>
<tr>
<th>Objective 1</th>
<th>Improve Bean Yield and Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a. Analyzed variety perform., fertility respon., agron./cultural controls</td>
<td>X</td>
</tr>
<tr>
<td>1a. Assessment by farmers of variety acceptability completed</td>
<td>X</td>
</tr>
<tr>
<td>1a. Report to breeders on variety performance &amp; farmer acceptability</td>
<td>X</td>
</tr>
<tr>
<td>1b. Strategies for seed production profitability &amp; sustainability assessed</td>
<td>X</td>
</tr>
<tr>
<td>1b. Extension guide for CBSP of beans finalized</td>
<td>X</td>
</tr>
<tr>
<td>1b. Achievements and lessons learned from CBSP shared</td>
<td>X</td>
</tr>
<tr>
<td>1b. Assess impact of CBSP on seed systems in Kamuli district</td>
<td>X</td>
</tr>
<tr>
<td>1b. Successful strategies for CBSP profitability &amp; sustainability promoted</td>
<td>X</td>
</tr>
<tr>
<td>1c. Extension materials for drying, threshing, and storage finalized</td>
<td>X</td>
</tr>
<tr>
<td>1c. Barriers to adoption of storage techniques identified &amp; addressed</td>
<td>X</td>
</tr>
<tr>
<td>1c. Follow up training on solarization &amp; new storage techniques</td>
<td>X</td>
</tr>
<tr>
<td>1c. Adoption of drying, threshing, and storage techniques assessed</td>
<td>X</td>
</tr>
<tr>
<td>1d. Training modules compiled into a document and published</td>
<td>X</td>
</tr>
<tr>
<td>1d. Final training of all trainers conducted</td>
<td>X</td>
</tr>
<tr>
<td>1d. Two farmer field days held (one in each sub-county)</td>
<td>X</td>
</tr>
<tr>
<td>1d. Project findings shared through workshops and publications</td>
<td>X</td>
</tr>
<tr>
<td>1d. Scaling up constraints and resources needed determined</td>
<td>X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objective 2</th>
<th>Enhance the Nutritional Value and Appeal of Beans</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a. IEC materials translated into local languages</td>
<td>X</td>
</tr>
<tr>
<td>2a. Extension info., education, &amp; comm. approaches finalized</td>
<td>X</td>
</tr>
<tr>
<td>2a. Community-based dissemination field days held</td>
<td>X</td>
</tr>
<tr>
<td>2b. Culinary traits &amp; sensory char. of improved varieties documented</td>
<td>X</td>
</tr>
<tr>
<td>2b. Communicate culinary traits &amp; sensory char. to breeders</td>
<td>X</td>
</tr>
<tr>
<td>2b. Project developed to promote varieties w/ breeding programs</td>
<td>X</td>
</tr>
<tr>
<td>2b. Strategy initiated to promote improved bean varieties w/ public</td>
<td>X</td>
</tr>
<tr>
<td>2c. Infrastructure to support commercializ. of products at Makerere developed</td>
<td>X</td>
</tr>
<tr>
<td>Objective 3</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Objective 4</td>
<td></td>
</tr>
</tbody>
</table>

| 2c. Developed protocols up-scaled with private business sector | X | X |
| 2b. Marketing strategies for bean products developed and evaluated | X | X |
| 2c. Process to document industrial adoption & market perform. initiated | | |
| 2c. Process to eval. impact of indust. adop. on farmer livelihoods initiated | X | X | X |

**Increase Marketing and Consumption of Beans and Bean Products**

| 3b. Farmers trained in business plans, pricing, packaging, records | X | X |
| 3b. Market information system enhancements initiated | | X |
| 3b. Progress of farmer groups in collective marketing evaluated | X | X | X |
| 3b. Comprehensive business plans developed | X | | X |
| 3b. Strategic value chain partnerships established | X | X | X |

**Incr. Capacity, Effectiveness & Sustainability of Ag. Research Institut.**

| 4. Training M.S. students (FTN & Extension-inov.) at MAK completed | X |
| 4. Training M.S. student in FST from Rwanda on-going | X | X |
| 4. Training Ph.D. students at Iowa State University completed | X |
| 4. Inter-organizational learning fostered | X | X | X | X | X | X | X | X |
| 4. Results disseminated (conferences, publications, websites) | X | X | X | X | X |

<table>
<thead>
<tr>
<th>Name of the PI responsible for reporting on benchmarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Mazur</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signature/Initials:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date:</th>
</tr>
</thead>
</table>