

PII-ISU-1 WORKPLAN

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

Robert Mazur – Iowa State University (ISU)

Collaborating Host Country and U.S. PIs and Institutions

Dorothy Nakimbugwe, Makerere, Uganda
Michael Ugen, NaCRRI, Uganda
Henry Kizito Musoke, VEDCO, Uganda
Hilda Vasanthakalam, KIST, Rwanda
Suzanne Hendrich, ISU, U.S.
Helen Jensen, ISU, U.S.
Patricia Murphy, ISU, U.S.
Manju Reddy, ISU, U.S.
Mark Westgate, ISU, U.S.
Agnes Nakimuli, VEDCO, Uganda
Gabriel Elepu, Makerere, Uganda
Paul Kibwika, Makerere, Uganda
Michael Otim, NaCRRI, Uganda

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 hemagglutinins (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 & Gökğöz 2007; Cevdet & Gökğöz 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 understanding and identifying

solutions to 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.).

Approach

Our approach explicitly integrates activities and actors across the value chain so that decisions made regarding production will be better coordinated with those involving post-harvest management, processing, utilization, and marketing. In particular, as small scale farmers become increasingly successful in producing more beans, our project activities are expected to lead to improvements in harvesting, drying, and storage that are essential to ensuring maintenance of high quality grain for consumption, as seed, and for commercialization. Multistakeholder participatory value chain analysis and development are increasingly being recognized as keys to successful and sustainable market engagement for small scale producers. In addition to enhancing farmers' ability to realize increased income from sale of beans as a highly valued cash crop, our activities are designed to realize the tremendous opportunity that beans and bean products provide to improve dietary nutritional quality of both producing household members and a wide variety of consumers in diverse geographic and institutional contexts.

Using the sustainable livelihoods approach helps the project team develop a more holistic perspective of farmers' capabilities, assets, goals, strategies and activities. These evolve over time and in relation to successes that farmers achieve, including those resulting from project training and support, as well as challenges – persistent and emerging – that they must confront. These elements are essential for understanding the extent to which farmers individually and collectively sustainably adopt modified or new management practices and technologies, the prerequisites for doing so, and specific conditions or circumstances that may discourage or prevent this. Knowing this is particularly important when efforts are initiated to disseminate and scale up improved methods of production, storage, utilization, and marketing.

Planned Project Activities for October 1, 2010 - September 30, 2011

Objective 1: To Improve Harvested Bean Yield and Quality

Collaborators

National Crops Resources Research Institute (Kampala, Uganda)

Michael Ugen, Bean Programme, m.ugen@naro-ug.org, michaelugen@yahoo.com

Michael Otim, Entomology Department, otim_michael@yahoo.com

Volunteer Efforts for Development Concerns (Kampala, Uganda)

Henry Kizito Musoke, Executive Director, henrykizito@vedco.or.ug

Agnes Nakimuli, Eastern Region Program, anakimuli@yahoo.com

Iowa State University (Ames, Iowa)

Mark Westgate, Department of Agronomy, westgate@iastate.edu

Gerald Sebuwufu, Department of Agronomy, sebuwufu@iastate.edu

Makerere University (MAK-Kampala, Uganda)

Dorothy Nakimbugwe, Dept. of Food Science & Technology,

dnakimbugwe@agric.mak.ac.ug, dnakimbugwe@gmail.com

Rationale

Results of Phase 1 research activities prompted several adjustments in research and development activities planned for 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 variation in 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. Objective 1a will test the hypothesis that incorporating a small amount of inorganic phosphorous into the soil prior to planting will 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 a luxury for most small-landholder farmers. Use of biological control agents, however, could prove to be an affordable and effective alternative. We will enlist the expertise of entomologists at Uganda's National Crops Resources Research Institute and elsewhere (University of Illinois, ICIPE) to identify and test biological control methods for two major insect pests in common beans - aphids and thrips. Controlled field trials will be conducted to determine specificity and effectiveness against these 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 is to establish a system for community-based production of quality seed. This will require establishment of farmer groups or associations committed to large-scale bean production, establishment and management of seed quality standards for all participating farmers to adopt, and development of bulk seed storage methods suitable for long-term (3-6 months) storage without loss of product quality. We will use proven participatory methods to engage farmers in this process and establish protocols for seed production, harvesting, and storage. We hypothesize that membership in an active farmer group and market forces will have a major impact on the success and sustainability of the production groups.

Numerous factors are known to affect the duration of seed quality 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 will test to confirm a well-known technique of asphyxiation using air-tight bagging to eliminate living insects from the storage container. The triple bagging technique has numerous advantages including flexible storage volume, re-usable containers, and manageable volume of individual bags (50-100 kg) for transport. This flexible storage approach will be evaluated as a means to meet the emerging need for bulk storage on farm or at community collection sites as determined most appropriate and effective for collective marketing and increased 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 will be analyzed.
- Exchange visits will be made to established seed production programs (e.g., Namulonge and western Uganda) to facilitate learning and sharing of practices and technologies.
- Drying and storage techniques will be evaluated in multiple periods to determine their effectiveness in keeping out/killing pests and maintaining seed germination viability.
- Bio-control strategies will be tested for two priority biotic pests.
- Refinements in practices and technologies (land preparation, soil nutrient management, pest and disease control, harvest and storage) will be 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 additional bean varieties with selected agronomic/nutritional traits under farmers' cropping system conditions (farmer selected and promising new NaCRRI varieties, high seed ferritin genotypes, early maturation, good yield, disease resistance). New varieties will be tested under conditions of monocropping and intercropping (with maize).

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.
3. Evaluate appropriate biological and cultural/agronomic methods to control pests/diseases (intercropping, crop rotation, and possibly later trap cropping).
4. Promote adoption and use of key management practices and technologies.

Benchmarks

Oct. 2010 – Mar. 2011

- Variety performance and fertility response analyzed
- Biological and agronomic/cultural management control strategies for primary pests and diseases initiated

Apr. – Sept. 2011

- Variety performance, fertility response, and biological and agronomic/cultural controls analyzed
- Best performing farmer-selected and new bean varieties identified and reported to breeders
- Seeds provided for post-harvest storage studies

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

Groups/Associations

1. Refine 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

Oct. 2010 – Mar. 2011

- Farmers' groups trained in management practices and group dynamics required for producing, storing and selling high quality seed
- Exchange visits conducted to established seed production programs
- Extension guide for bean CBSP initiated and tested with farmers

Apr. – Sept. 2011

- Linkages to breeders, seed processing and marketing companies established
- Seed storage facilities established

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 (‘solarization’) 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 (‘triple bagging’ and 200 liter re-sealable plastic drums), and identify and address barriers to farmers’ adoption.
5. Train farmers in management of bulking facilities (technical, organizational, and financial aspects)
6. Assess adoption of drying, threshing, and storage techniques through interviews and focus group discussions.

Benchmarks

Oct. 2010 – Mar. 2011

- Effect of solarization on germination and storage evaluated
- Farmers trained in effective use of solarization technique to preserve grain and seed
- Materials (polyethylene) for solarization procured and distributed to farmers’ groups
- Barriers to adoption of solarization identified and resolved

Apr. – Sept. 2011

- Storage techniques evaluated for pest control and germination
- Farmers trained in new storage techniques
- Storage materials procured and distributed to farmers’ groups
- Training of farmers’ groups in managing bulking facilities completed

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

1. Share and disseminate information through farmer field days at research/demonstration sites, 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

Oct. 2010 – Mar. 2011

- Exchange visits to other successful farmer groups outside the district conducted

Apr. – Sept. 2011

- Contacts with prospective districts to scale out technologies and practices initiated
- Stakeholder workshop held to review bean production training materials
- Extension materials translated and published

Target Outputs and Developmental Outcomes

We will document and publicize the contributions of production factors to increased yield, reduced lost 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 NaCRRRI 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 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

Makerere University (MAK-Kampala, Uganda)

Dorothy Nakimbugwe, Dept. of Food Science & Technology,
dnakimbugwe@agric.mak.ac.ug, dngabo@yahoo.co.uk

John Muyonga, Dept. of Food Science & Technology, muyongaj@agric.mak.ac.ug,
hmuyonga@yahoo.com

Iowa State University (ISU-Ames, Iowa)

Suzanne Hendrich, Department of Food Science & Human Nutrition,
shendric@iastate.edu

Patricia Murphy, Department of Food Science & Human Nutrition,
pmurphy@iastate.edu

Manju Reddy, Department of Food Science & Human Nutrition, mbreddy@iastate.edu

Martin Mutambuka, Department of Food Science & Human Nutrition,
mcmartin@iastate.edu

Kigali Institute of Science and Technology (KIST-Kigali, Rwanda)

Hilda Vasanthakalam, Dept. of Food Science & Technology, hildajeya@hotmail.com,
h.vasanthak@kist.ac.rw

Center for International Tropical Agriculture Research (CIAT-Africa)

Martha Nyagaya, Nutrition Programme – Harvest Plus, m.nyagaya@cgiar.org

Rationale

Phase 1 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 four core elements. The first is 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, 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. Finally, complementary use of produce from home gardens to increase dietary iron content and bioavailability constitutes an important, new component of the project's next phase.

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 will be developed in a planned participatory, community based competition and field day later in 2010. We hypothesize that availability of acceptable alternative ways of consuming beans will result in increased bean consumption. The central hypothesis regarding farmers' adoption, adaptation and sustainable (continuous) use is that a coordinated strategy of technological innovation to facilitate ease of utilization of bean foods for weaning and snacks and ongoing evidence of nutritional and economic benefits of beans are likely to create sustainable increased use of bean-based foods within communities.

To further enhance the nutritional benefits from beans, there is also need to evaluate the role of complementary foods on the nutritional and healthful contribution of beans, as well as promoting this knowledge and encouraging consumption of meal combinations that maximize balanced nutrient intake and enhance bioavailability. Key complementary foods commonly grown and consumed in Kamuli District (the study area in Uganda) have been identified as green vegetables, especially amaranth and citrus fruits. They are envisaged to enhance protein quality and mineral bioavailability of beans. This objective will seek to evaluate adoption and nutritional/health impact of practices aimed at

maximizing nutritional contribution of beans, especially for nutritionally vulnerable populations. It is hypothesized that dietary complementation of beans with fruits and vegetables will improve the nutritional benefits to vulnerable individuals.

Phase I results indicate that new high yielding bean varieties were not necessarily of optimal nutrition, consumer acceptability and process ability into high quality value added products. This clearly indicated a disparity between breeding for agronomic hardiness versus end user requirements. Thus, Phase II of this project will aim to bridge the gap between the breeder and the consumer 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; and with potential for niche markets as high quality value added products.

Besides utilization by communities, the project will also 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 will be 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 'seed' entrepreneurs with a supportive environment to help establish and develop their projects (Lalkaka 1996). It is hypothesized that by providing services (product refinement/optimization, 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 survival and growth prospects of bean processing enterprises in their early stages of development. Suitable private sector partners will be identified and linked to farmer organizations for maximum trickledown effect of value addition returns. We will also test three additional hypotheses: (1) processing of beans significantly improves its acceptability and market potential; (2) promotion of bean processing can lead to increased beans consumption; and (3) 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 utilize simple 'cold extrusion' technology (using hand-operated presses) at community level with processed (sprouted, fermented) beans and maize. At KIST, two 4th year students (Marie

Nkundabombi and William Karuranga) will focus their research on these activities in Rwanda. Staff of KIST's Centre for Innovation and Technology Transfer (CITT) will be involved in demonstrating, training, and disseminating this technology in rural Rwanda. Once the technology has been refined, similar efforts will be made in Uganda involving students at Makerere University and VEDCO extension staff.

2. Determine acceptability and nutritional benefits (based on analysis of nutrient intake) from consuming bean based products by the nutritionally vulnerable, including bean based weaning foods and extruded snack products. In Uganda, two M.Sc. students at Makerere University (Catherine Ndagire and Aisha Nakitto) are involved in this research. Modification of a primary school lunch program was initiated in rural Kamuli in June 2010 by CSRL with private donor funds. This activity involves incorporation of common beans into a lunch program previously limited to maize porridge. Integrating a research element into this existing program will provide valuable data regarding a new 'market' for rural bean growers' produce. In Rwanda, two 4th year students at KIST (Idrissa Habiyaremye and Noel Mulinda) are focusing their research in rural and peri-urban areas on this.
3. 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. This is an essential component for achieving meaningful impact in rural communities, and is planned for FY12. In Uganda, information about improved practices and technologies will be integrated into training and support that VEDCO extension staff and community based trainers provide to 1,200 farm households in Kamuli district on an on-going basis. As this process unfolds during Phase II, team members from VEDCO, Makerere University, NaCRRI, and ISU will monitor and evaluate the use of these materials and their impacts at farm level and among households. In Rwanda, KIST faculty and students will collaborate with CITT staff in the development of IEC materials and monitoring their impacts.

Benchmarks

Oct. 2010 – Mar. 2011

- Cold extruded bean products and cold extrusion process developed at KIST demonstrated in Rwanda and Uganda

Apr. – Sept. 2011

- Bean-based weaning foods developed for Uganda and Rwanda
- Extension approaches for popularization of bean products identified and content developed
- Farmers trained in bean cold extrusion processing
- Baseline nutritional status established for bean-based weaning food study in Uganda and Rwanda and cold extruded snack products

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

1. Identify desirable culinary properties and sensory characteristics of beans in different regions. An incoming graduate student at Makerere University will conduct this research for beans from different regions of Uganda.
2. Analyze culinary properties of improved bean varieties in Uganda (NaCRRI) and Rwanda (ISAR). An incoming graduate student at Makerere University will conduct this research on improved bean varieties from NaCRRI, and a 4th year student at KIST will conduct this research on improved bean varieties from ISAR.
3. Analyze sensory characteristics (color, texture, taste, flavor, etc.) and consumer acceptability of improved bean varieties in Uganda (NaCRRI) and in Rwanda (ISAR). An incoming graduate student at Makerere University will conduct this research on improved bean varieties from NaCRRI, and a 4th year student at KIST will conduct this research on improved bean varieties from ISAR.
4. Liaise with national bean breeding programs to match consumer requirements with culinary and sensory characteristics of new varieties

Benchmarks

Oct. 2010 – Mar. 2011

- Analysis protocol for culinary properties obtained from the University of Pretoria
- Analysis of desirable culinary traits and sensory characteristics of current bean varieties initiated

Apr. – Sept. 2011

- Culinary traits and sensory characteristics of current bean varieties documented
- Analysis of desirable culinary traits and sensory characteristics of 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. Ugandan Ph.D. student Martin Mutambuka will learn from the experiences of specialists at two ISU centers – the Leopold Center for Sustainable Agriculture and the Agricultural Marketing Resource Center – both of which have extensive project experience and linkages with private sector businesses in value addition and marketing. He will identify applications in Uganda of principles and lessons learned.
2. Engage private sector actors in developing protocols for value-added bean products (including utilizing the semi-processed bean flour). The Food Technology and Business Incubation Centre in the Department of Food Science and Technology at

Makerere University already has been making arrangements with a private sector company, Nutreal Limited, to commercialize the flour. The plan involves raw materials (beans) to be sourced from project farmers, who through our other project activities on increasing production and better post-harvest handling, should have beans with the desired quality and quantities. Three students will be involved in these research activities: Jonathan Byasi, Cabrine Nankanja, and Annet Gayita.

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. One Makerere University M.Sc. student, George Jjagwe, is focusing his research on this.
4. Support commercialization of bean products through technology and business incubation in the Makerere University, Department of Food Science, Technology and Business Incubation Centre. Three students will be involved in these research activities: Jonathan Byasi, Cabrine Nankanja, and Annet Gayita.

Benchmarks

Oct. 2010 – Mar. 2011

- Successful technology incubation (and transfer) models identified and modified to suit unique characteristics of Uganda's and Rwanda's production/market economies
- Local and international industries as potential markets for beans and value added products identified
- Private industry interest in and conditions to adopt bean processing technology evaluated

Apr. – Sept. 2011

- Strong links created and fostered between farmers' associations and the private food processing industries in Uganda and Rwanda
- Development of protocols for value added bean products with private sector partners 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. Our initial feeding trials will be evaluated in terms of participation and dietary impact, and the results published. 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

Makerere University (MAK - Kampala, Uganda)

Paul Kibwika, Dept. of Agricultural Economics & Agribusiness,
pkibwika@agric.mak.ac.ug

Gabriel Elepu, Dept. of Agricultural Economics & Agribusiness,
elepu@agric.mak.ac.ug

Volunteer Efforts for Development Concerns (VEDCO - Kampala, Uganda)

Agnes Nakimuli, Eastern Region Program, anakimuli@yahoo.com

Iowa State University (ISU - Ames, Iowa)

Helen Jensen, Department of Economics, hhjensen@iastate.edu

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 achieve higher prices, they increase marketing. 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. Transactions 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 participate in marketing. 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. 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

Oct. 2010 – Mar. 2011

- Farmer groups' composition, roles, assets, and capabilities identified

Apr. – Sept. 2011

- Farmer groups' needs for profitability and sustainability determined and prioritized

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

Oct. 2010 – Mar. 2011

- Farmers trained in group / association dynamics and gender equity
- Partner meetings held in each of the two sub-counties
- Participatory market research groups formed

Apr. – Sept. 2011

- Participatory market chain analysis for the bean enterprises conducted
- Market information sources assessed

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

Makerere University (MAK - Kampala, Uganda)

Dorothy Nakimbugwe, Dept. of Food Science & Technology,
dnakimbugwe@agric.mak.ac.ug, dnakimbugwe@gmail.com

John Muyonga, Dept. of Food Science & Technology, muyongaj@agric.mak.ac.ug

Paul Kibwika, Dept. of Agricultural Economics & Agribusiness,
pkibwika@agric.mak.ac.ug

Gabriel Elepu, Dept. of Agricultural Economics & Agribusiness, elepu@agric.mak.ac.ug

National Crops Resources Research Institute (NaCRRI - Kampala, Uganda)

Michael Ugen, Beans Programme, m.ugen@naro-ug.org, michaelugen@yahoo.com

Michael Otim, Entomology Department, otim_michael@yahoo.com

Kigali Institute of Science and Technology (KIST-Kigali, Rwanda)

Hilda Vasanthakaalam, Dept. of Food Science & Technology,
hildajeya@hotmail.com, h.vasanthak@kist.ac.rw

Iowa State University (ISU - Ames, Iowa)

Robert Mazur, Center for Sustainable Rural Livelihoods, Iowa State University,
rmazur@iastate.edu

Mark Westgate, Department of Agronomy, westgate@iastate.edu

Suzanne Hendrich, Department of Food Science & Human Nutrition,
shendric@iastate.edu

Patricia Murphy, Department of Food Science & Human Nutrition, pmurphy@iastate.edu

Manju Reddy, Department of Food Science & Human Nutrition,
mbreddy@iastate.edu

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
 - Since KIST has not yet developed a M.S. degree training program in Food Science and Technology, B.S. students who are required to conduct 4th year research projects have been integrated into this project's research, and faculty members are required to supervise the student researchers. This arrangement and the resulting lab group 'synergy' have been very successful in terms of research findings. Moreover, it enables Co-PI Dr. Hilda Vasanthakaalam to identify the best candidates for M.S. training. Upon graduation, the most

capable and promising of these students are typically offered positions as teaching or research assistants and may become candidates for staff development, involving training elsewhere for the M.S. degree.

- At Makerere University, some who have completed all requirements for the B.S. degree (in June 2010) have been integrated into project research activities while they await receipt of their diplomas (Oct. 2010) and formal admission to M.S. degree program (only possible in Aug. 2011). While not yet permitted to formally enroll in the graduate program of study, engaging young scholars in this manner contributes to build individual and group research capacity and provides a great opportunity for Project Co-PI Dr. Dorothy Nakimbugwe to identify the best students for M.S. training. Some funds from the CRSP project are leveraged with those from other sources to support these students' lab and field research activities. It is recognized that their M.S. program of study will necessarily continue to mid-2013, beyond the end date of this CRSP project.
- Guide development of students' research proposals and supervise their research

Benchmarks

Oct. 2010 – Mar. 2011

- Training M.S. students (Food Science & Technology, and Agricultural Economics and Agribusiness) at Makerere University on-going
- Training M.S. student in Food Science & Technology from Rwanda on-going
- Training Ph.D. students (Food Science & Human Nutrition, and Agronomy) at Iowa State University on-going

Apr. 2011 – Sept. 2011

- Training M.S. students at Makerere University on-going
- Training Ph.D. at Iowa State University on-going
- 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: \$47,298
Direct cost: \$39,106
Indirect cost: \$8,192
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: 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: \$43,114
Direct cost: \$35,563
Indirect cost: \$7,551
U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University

Trainee #3

First and Other Given Names: TBD
Last Name: TBD
Citizenship: TBD
Gender: TBD
Degree Program for training: Ph.D.
Program Areas or Discipline: Sociology or Economics
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: Robert Mazur
Start Date: August 2011
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: \$26,491

Direct cost: \$22,012

Indirect cost: \$4,479

U.S. or HC Institution to receive CRSP funding for training activity: Iowa State University

Trainee #4

First and Other Given Names: TBD

Last Name: TBD

Citizenship: Rwanda

Gender: TBD

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 2010

Project Completion Date: August 2012

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 2009

Project completion date: May 2011

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: Ag. Economics & Agribusiness *or* Ag. Extension & Education

Host Country Institution to benefit from training: Makerere University, Uganda

University to provide training: Makerere University

Supervising CRSP PI: Dorothy Nakimbugwe

Start date: August 2009

Project completion date: August 2011

Type of CRSP Support (full, partial or indirect): Partial

Contribution of Project to Target USAID Performance Indicators

- Six scientists will undergo degree training (two female, three male) during this budget cycle at Makerere University (three M.S.) and Iowa State University (three Ph.D.).
- We expect 67 farmers (56 female, 11 male) to participate in advanced training regarding production, harvesting, and post-harvest methods in Uganda.
- Important technologies and management practices that are under research or 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 development, 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 plans 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 67 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 15 acres will be cultivated using improved technologies by 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 Rural Development Extensionists, 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, link 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
- Identify, with Mission staff, the potential for an Associate Award
- 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

TMAC EVALUATIONS AND RECOMMENDATIONS PLUS PI RESPONSES

Phase II Project: PII-ISU-1, *Enhancing Nutritional Value and Marketability of Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda*

Lead U.S. PI- Dr. Robert Mazur, Iowa State University

A. Comments Regarding the FY11 Workplan

1. The TMAC views this as an important project for the Pulse CRSP, with the potential to have substantial impact.
2. The TMAC continues to be concerned about the value of certain research priorities and what is considered to be a lack of focus, especially for Objective 2. While the work plan includes changes in response to TMAC earlier recommendations, the current work plan has not been approved.
3. The breadth of the work may be jeopardizing the scientific quality of the work.
4. Scalability is a key aspect for all the Pulse CRSP projects and that is not clear within the current project.
5. The TMAC understands that commitments have been made to students on their research programs and want to consider these student research projects in their evaluation of the workplan.

B. TMAC Recommendations

1. The TMAC requests that the Lead PI prepare a document that shows the link between each graduate student's research and the proposed activities and objectives listed in the current work plan.
2. The TMAC will be responsible for rapidly reviewing the response in point B1.
3. TMAC members will arrange a conference call to explain the TMAC's concerns about focus and scalability, after they have received the information regarding the student's research. Of particular concern was the adding of additional activities in Objective 2 from the workplan reviewed in February 2010. The TMAC recommendations from that review are attached.
4. Changes to the project objectives and sub-objectives will be needed to ensure greater focus on key objectives with high scientific quality, concentrating on efforts with highest probability for scalability, and thus enabling researchers and students to accomplish the key objectives.

The project PI would then submit a revised workplan, budget and performance indicators subject to approval. The TMAC members will review and make a recommendation to the Pulse CRSP full TMAC and then to the Management Office before September 30, 2010.

**Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2010 - September 30, 2011)**

**FY 2011 PERFORMANCE INDICATORS
for Foreign Assistance Framework and the Initiative to End Hunger in Africa (IEHA)**

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

Output Indicators	2011 Target (Oct. 1, 2010 - Sept. 30, 2011)	2011 Actual
Degree Training: Number of individuals enrolled in degree training		
Number of women	2	
Number of men	3	
Short-term Training: Number of individuals who received short-term training		
Number of women	75	
Number of men	48	
Technologies and Policies		
Number of technologies and management practices under research	5	
Number of technologies and management practices under field testing	5	
Number of technologies and management practices made available for transfer	5	
Number of policy studies undertaken	0	
Beneficiaries:		
Number of rural households benefiting directly	467	
Number of agricultural firms/enterprises benefiting	3	
Number of producer and/or community-based organizations receiving technical assistance	50	
Number of women organizations receiving technical assistance	50	
Number of HC partner organizations/institutions benefiting	4	
Developmental outcomes:		
Number of additional hectares under improved technologies or management practices	115	

Dry Grain Pulses CRSP FY 2011 Workplans

Dry Grain Pulses CRSP : SECOND PERIOD (FY11)						
Enhancing Nutritional Value and Marketability on Beans through Research and Strengthening Key Value Chain Stakeholders in Uganda and Rwanda						
10/01/10 - 09/30/11						
Institution Name	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)
	ISU	0	Makerere U.	NaCRRRI	VEDCO	Kigali Inst.
a. Personnel Cost						
Salaries	\$3,790.00	\$19,996.00	\$18,300.00	\$4,800.00	\$14,400.00	\$4,500.00
Fringe Benefits	\$285.00	\$2,639.00				
b. Travel	\$9,150.00	\$0.00	\$9,560.00	\$9,820.00	\$2,500.00	\$2,563.00
c. Equipment (\$5000 Plus)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
d. Supplies	\$4,500.00	\$0.00	\$9,750.00	\$2,250.00	\$15,502.00	\$8,000.00
e. Training						
Degree	\$1,855.00	\$9,334.00	\$8,750.00			
Non-Degree						
f. Other	\$474.00	\$0.00	\$1,000.00	\$900.00	\$250.00	\$750.00
g. Total Direct Cost	\$20,054.00	\$31,969.00	\$47,360.00	\$17,770.00	\$32,652.00	\$15,813.00
h. Indirect Cost	\$4,732.00	\$5,885.00	\$4,736.00	\$1,777.00	\$3,265.00	\$1,581.00
i. Indirect Cost on Subcontracts (First \$25000)						
j. Total Indirect Cost	\$4,732.00	\$5,885.00	\$4,736.00	\$1,777.00	\$3,265.00	\$1,581.00
Total	\$24,786.00	\$37,854.00	\$52,096.00	\$19,547.00	\$35,917.00	\$17,394.00
Grand Total	\$187,594.00					

	Amount	Percentage
Total direct cost budgeted for U.S. institution(s)	\$20,054.00	12.11%
Total direct cost budgeted for H.C institution(s)	\$145,564.00	87.89%

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	\$13,167.00						\$ 13,167.00
Cash							\$ -
Total	\$ 13,167.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 13,167.00

Attribution to Capacity Building							
Percentage of effort	86.96%	100.00%	88.81%	83.12%	81.62%		80.62%
Amount corresponding to effort	\$21,553.91	\$37,854.00	\$46,266.46	\$16,247.47	\$29,315.46	\$0.00	\$151,237.29

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

Dry Grain Pulses CRSP FY 2011 Workplans

Dry Grain Pulses CRSP
Research, Training and Outreach Workplans
(October 1, 2010 -- September 30, 2011)

FY 2011 SEMI-ANNUAL INDICATORS OF PROGRESS BY INSTITUTIONS AND TIME PERIOD

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

Identify Benchmark Indicators by Objectives	Abbreviated name of institutions											
	Iowa State		Makerere		NaCRRI		VEDCO		KIST			
	4/1/11	9/30/11	4/1/11	9/30/11	4/1/11	9/30/11	4/1/11	9/30/11	4/1/11	9/30/11	4/1/11	9/30/11
Objective 1	Improve Bean Yield and Quality											
1a. Variety performance and fertility responses analyzed	X				X							
1a. Biological & agronomic controls for pests & diseases initiated	X				X		X					
1a. Variety perform., fertility respon., bio. & agron. controls analyzed		X				X						
1a. Best performing bean varieties reported to breeders		X				X		X				
1a. Seeds provided for post-harvest storage studies						X		X				
1b. Training in group dynamics & mgmt. practices for quality seed					X		X					
1b. Exchange visits to established seed production programs					X		X					
1b. Extension guide for bean CBSP initiated and tested					X		X					
1b. Linkages establ. for breeders, seed processors, marketers						X		X				
1b. Seed storage facilities established						X		X				
1c. Effects of solarization on germination and storage evaluated	X				X		X					
1c. Farmers trained in effective use of solarization technique					X		X					
1c. Polyethylene for solarization distributed to farmers groups					X		X					
1c. Barriers to adoption of solarization identified and resolved	X				X		X					
1c. Storage techniques evaluated for pest control and germination		X				X		X				
1c. Farmers trained in new solar techniques						X		X				
1c. Storage materials produced and distributed to farmers						X		X				
1c. Training in managing bulking facilities completed						X		X				
1d. Exchange visits of other farmer groups conducted					X		X					
1d. Contacts establ. w/ districts to scale technologies & practices						X		X				
1d. Stakeholder workshop to review bean prod. training materials		X				X		X				
1d. Extension materials translated and published						X		X				
Objective 2	Enhance the Nutritional Value and Appeal of Beans											
2a. Cold extruded bean products & process developed at KIST									X			
2a. Bean-based weaning foods developed for Uganda & Rwanda	X		X							X		
2a. Extension approaches identified and content developed	X		X					X			X	
2a. Farmers trained in bean cold extrusion processing											X	
2a. Baseline nutritional status established for feeding studies	X		X								X	
2b. Analysis protocol for culinary properties obtained			X						X			
2b. Analysis of desirable culinary traits of current varieties initiated			X						X			
2b. Culinary traits & sensory char. of current varieties documented	X		X								X	
2b. Analysis of culinary traits & sensory char. of improv. var. initiated			X								X	
2c. Tech. incubation & transfer models identified and modified			X									
2c. Local & intl. industries as potential markets for beans identified			X									
2c. Private industry interest/conditions to adopt bean tech. evaluated			X									
2c. Links establ. btw. farmers' assoc. & private industries			X		X		X					
2c. Protocols for value-addition w/ private sector partners initiated			X									
Objective 3	Increase Marketing and Consumption of Beans and Bean Products											
3a. Farmer groups' composition, roles, assets, capabilities identified							X					
3a. Farmer groups' needs determined and prioritized	X							X				
3b. Farmers trained in group/assoc. dynamics and gender equity							X					
3b. Partner meetings held in two sub-counties			X				X					
3b. Participatory market research groups formed			X				X					
3b. Market chain analysis for bean enterprises conducted	X		X					X				
3b. Market information sources assessed	X		X					X				
Objective 4	Incr. Capacity, Effectiveness & Sustainability of Ag. Research Institut.											
4. Training M.S. (FST and AgEcon) at MAK on-going			X									
4. Training M.S. student in FST from Rwanda on-going			X						X			
4. Training M.S. students at Makerere University completed				X						X		
4. Training Ph.D. students at Iowa State University ongoing	X	X										
4. Inter-organizational learning fostered	X	X	X	X	X	X	X	X	X	X	X	
4. Prelim. results disseminated (conf., public., websites)		X		X		X		X		X		

Name of the PI responsible for reporting on benchmarks	Robert Mazur	Dorothy Nakimbugwe	Michael Ugen	Henry Kizito Musoke	Hilda Vasanthakaalam
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Signature/Initials:					
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Date: _____