



SANREM CRSP

Annual Report 2010

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Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program

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Executive Summary

This annual report documents the research and technology dissemination activities of the SANREM CRSP for the period October 1, 2009 – September 30, 2010. The majority of SANREM CRSP research is conducted through its Long-term Research Award (LTRA) activities. This report covers the wrap-up activities of SANREM CRSP Phase III and the startup of the new SANREM CRSP Phase IV (2009-2014) LTRAs and cross-cutting research activities focusing on Conservation Agriculture Production Systems (CAPS).

Program objectives and strategy

The objectives of the SANREM CRSP program are to:

- increase scientific knowledge and technical innovations in sustainable agriculture (SA) and natural resource management (NRM);
- improve knowledge management, education, and communication leading to behavioral changes in adaptation and adoption of new SA and NRM technologies and practices;
- reform and strengthen SA and NRM governance, policies, and local institutions;
- promote the functioning of sustainable resource-based local enterprises in national, regional, and global markets.

Training and knowledge dissemination

SANREM CRSP training, publications, and other knowledge dissemination products in fiscal year 2010 (FY2010) included the following:

- Twenty-two students supported for PhD training (13 men and 9 women)
- Twenty-four students supported for Master's training (11 men and 13 women)
- Two undergraduate women supported for BS training
- 2,182 short-term training participants (1,233 men and 949 women)
- 5 referred journal articles
- 1 book
- 1 MS thesis
- 1 PhD dissertation
- 1 extension publication
- 2 fact sheets
- 2 working papers
- 20 papers or seminars presented
- 38 electronic presentations
- 4 posters
- 2 newsletters
- 11 reports

Long-term research award activities

Phase III long-term research award activities

LTRA-1: Decentralization Reforms and Property Rights: Potentials and Puzzles for Forest Sustainability and Livelihoods

Principal investigator: Elinor Ostrom, Arthur F. Bentley Professor of Political Science, Indiana University; and 2009 Nobel Laureate in Economics

Host countries: Bolivia, Kenya, Mexico, Uganda

This research analyzes the effects of forest decentralization on forest sustainability and livelihoods from a local community perspective. Researchers investigated the ways in which property rights regimes and related local institutional arrangements may be altered by the changes in public policy at the national level. Specific objectives include:

- **Objective 1.** Develop capacity within resource user groups at the selected forest sites to enable differentiated actors (particularly women, the poor, and other marginalized groups) to identify, understand, and participate in forest governance, benefits, and policy processes.
- **Objective 2.** Develop capacity within key organizations (especially government agencies and non-governmental organizations) in the forestry sector to understand the impacts of policies on differentiated local actors and to adopt strategies for inclusion of such actors within broader policy processes.
- **Objective 3.** Develop effective monitoring techniques for use by resource user groups and their partners (including NGOs and local-level agencies) at the community level to assess the impacts of decentralization and other property rights reforms on natural resources (including biodiversity) and livelihoods.

Research analyzed the effects of forest decentralization from a local community perspective. The research focused on the way property rights regimes and related local institutional arrangements may have been altered by changes in public policy at the national level and the implications of those changes for resource sustainability and community livelihoods.

The project often relied on contacts at many levels to achieve its objectives. Roughly 2,600 individuals participated in trainings and workshops throughout the course of the project, ranging from user group members and community-based organizations, to local officials, national level officials, and NGOs. In addition to regular contact with user groups, the project's partner organizations formed National Advisory Councils that met regularly throughout the project to discuss findings and needs. Roundtables, trainings, and cross-community workshops created opportunities for stakeholders at multiple levels to come together for education and

exchange. This multi-level approach culminated in international exchange meetings between the two countries in each region. Over the course of the project, this LTRA produced 6 reports, 8 papers, 10 presentations, 5 abstracts, 3 fact sheets, 2 research briefs, and 2 newsletter articles that are available on the SANREM CRSP Knowledgebase (SKB).

Findings were based on the detailed data gathered at both the household and community levels in 24 forests across four countries, complemented by a national-level forest-community survey in the two Latin American countries. Data collected includes:

- Bolivia: 572 forest plots and 165 household surveys in 7 communities (2 funded by U. of Michigan); national survey of 200 forest communities
- Kenya: 146 forest plots and 702 household surveys in 7 communities
- Mexico: 204 forest plots and 288 household surveys in 5 communities; national survey of 146 forest communities
- Uganda: 254 forest plots and 720 household surveys in 9 communities (2 funded by U. of Michigan)

LTRA-2: Developing a Participatory Socioeconomic Model for Food Security, Improved Rural Livelihoods, Watershed Management, and Biodiversity Conservation in Southern Africa

Principal investigator: Alex Travis, Associate Professor of Reproductive Biology, Cornell University

Host country: Zambia

The goal of this project was to test and optimize a “third generation” biodiversity conservation model that uses markets to link improvements in rural livelihoods and food security with biodiversity conservation objectives. The Community Markets for Conservation (COMACO) model endeavors to operate on a triple bottom line of being economically, socially, and environmentally sustainable. SANREM CRSP research evaluated specific hypotheses that stemmed from the model and defined the sets of conditions under which the model can operate so that it could potentially be replicated elsewhere. The specific research objectives were:

- **Objective 1.** Determine the extent to which the COMACO model can be economically self-sustaining and the effectiveness of the different COMACO model components.
- **Objective 2.** Identify and integrate new technologies into the COMACO model to improve its profitability, food security, and rural incomes.
- **Objective 3.** Determine the extent to which the COMACO model provides self-sustaining social institutions and meaningful roles for COMACO participants.
- **Objective 4.** Determine the extent to which the COMACO model improves biodiversity and watershed conservation.

All aspects of research covered by the no-cost extension and additional support have made continuous progress during this half year. Our new household survey focusing on food security, technology adoption, and crops/market access was performed in October-November 2009. The data has been entered, cleaned, and preliminary analyses have been completed. In the soil sciences, samples from the landscape-scale assessment have largely been analyzed for their chemical and physical properties. The team is now analyzing the data using principle component analysis. First results indicate weak effects of environmental parameters on crop yield and low comparative benefit of conservation farming (CF) as practiced by the farmers along a gradient of 280 households. This finding needs to be considered in the context of the total COMACO intervention area; interpretation of the weak comparative effect is confounded by variable farming practices and also by the fact that most non-COMACO farmers have implemented one or more CF techniques that they have learned from their COMACO neighbors or COMACO field days, as revealed by the new household level data.

Significant progress has been made on examining the impact of COMACO on carbon stocks in the Luangwa Valley. Samples have been collected from both agricultural and forest areas to determine the impacts of *Faidherbia albida*, a nitrogen fixing tree, on active and total soil carbon as well as other nutrients. Preliminary results suggest significantly higher total soil organic carbon and nitrogen under *F. albida* canopy. Progress on measurement, reporting and verification strategies for adaptation of agroforestry for carbon markets was presented at the Agriculture and Rural Development Day at the UNFCCC 15th Conference of Parties to the Kyoto Protocol in Copenhagen, Denmark in December 2009.

LTRA-3: Watershed-based Natural Resource Management in Small-scale Agriculture: Sloped Areas of the Andean Region

Principal investigator: Jeffrey Alwang, Professor of Agricultural and Applied Economics, Virginia Tech

Host countries: Bolivia, Ecuador

The project successfully engaged local decision makers in an adaptive watershed management process in Guaranda, Bolivar Province, Ecuador and Tiraque, Cochabamba Province, Bolivia. This impact is manifest in locally developed and approved plans for sustainable watershed management in two of the three study watersheds. The project has four main objectives.

- **Objective 1.** Identify economic, social, political, and environmental conditions in the watersheds and understand the determinants of these conditions.

- **Objective 2.** Generate and validate environmentally sustainable alternatives in order to improve production systems and enhance income generation.
- **Objective 3.** Create a means of evaluating the impacts of alternative actions, policies, and interventions on income generation, and social and environmental conditions.
- **Objective 4.** Build local capacity to evaluate policy alternatives, make and enforce decisions, and strengthen social capital.

The extension continued support for graduate students finishing their degrees this year. In Bolivia, project results were communicated to stakeholders in the Tiraque watersheds. In Ecuador, the final watershed modeling workshop was held.

LTRA-4: Adapting to Change in the Andes: Practices and Strategies to Address Climate Change and Market Risks in Vulnerable Agroecosystems

Principal investigator: Corinne Valdivia, Associate Professor of Agricultural Economics, University of Missouri

Host countries: Bolivia, Peru

The overall goal of this project is to evaluate and improve the adaptive capacity and capabilities of rural communities in Andean highland (Altiplano) ecosystems of Bolivia and Peru to climate and market change, drivers that affect agricultural production, food security and the sustainability of natural resources. Specific objectives included:

- **Objective 1.** Characterize the dynamics of Altiplano agro-ecosystems at various scales to understand the impact of climate and markets as drivers of change, and develop a shared understanding.
- **Objective 2.** Identify local knowledge and perceptions about production systems, landscape, and risks to assess the effect of climate and market change on livelihoods.
- **Objective 3.** Develop practices and information strategies (networks to access new information) to address changing conditions and perceived risks in soils, climate, pests and diseases, landscapes, and livelihoods.
- **Objective 4.** Develop market access strategies and institutions that contribute to resilience.
- **Objective 5.** Develop stakeholders' capacities and capabilities—ability to act—to reduce vulnerability and increase adaptation in the face of changing market and climate conditions.

A no-cost extension was provided to finalize activities related to knowledge sharing (*socialization*); participant training; and the soil quality, metagenomics, knowledge to action, and gender cross-cutting initiatives. Knowledge sharing activities were conducted in Umala and Ancoraimes (Bolivia) through January of 2010. The surveys conducted in Bolivia and Peru were

completed and the databases were developed. This will allow the research team to study changes since 2006.

The graduate students in the US are making good progress towards graduation. Aguilera defends his/her Master's/PhD thesis in April 2011, and Thibeault and Jensen defend in May. Turin passed her comprehensive exams in December and is in Peru conducting her field research. Students in Bolivia have finalized their fieldwork. Two students developed their theses with the gender cross-cutting initiative and completed their manuscripts. Three defended their theses in the last semester. MS students (Navia, Peñaranda and Yucra) in Bolivia have finalized their field research and are writing their theses. Two journal articles were accepted for publication during this period on climate change projections and livelihoods in the Altiplano of Bolivia. Findings from our project were presented by the USAID Climate Change officer at the Copenhagen meetings in December. Soil metagenomics and soil quality cross-cutting initiatives are progressing well.

LTRA-5: Agroforestry and Sustainable Vegetable Production in Southeast Asian Watersheds

Principal investigator: Manuel Reyes, Professor of Natural Resources & Environmental Design, North Carolina Agricultural and Technical State University

Host countries: Philippines, Vietnam, Indonesia

Communities in many forest and vegetable-producing watersheds in Southeast Asia are suffering from poverty and degradation of forest, soil, and water resources. The overall hypothesis of this research is: "Integrating vegetable production in tree systems and trees in vegetable production systems will alleviate poverty and will enhance environmental protection, ecosystem diversity, and sustainability on small farms in Southeast Asia." This research is being conducted by the TMPEGS research group, which derives its name from its objectives:

- **Objective 1. Technology:** develop economically viable and ecologically sound Vegetable Agroforestry (VAF) systems.
- **Objective 2. Markets:** develop a market value chain at the local, regional, and national levels that builds on existing marketing strategies.
- **Objective 3. Policy:** (1) identify policy options and institutional frameworks that promote sustainability of VAF production and reward environmental services, and (2) develop and test an incentive-based policy option and institutional framework for promoting VAF system particularly in the Philippines.
- **Objective 4. Environmental and socioeconomic impacts:** assess the short- and long-term environmental and socioeconomic impacts for farm families who adopt integrated VAF systems.

- **Objective 5. Gender:** provide mechanisms to ensure women's involvement in decision making, and sustainable production and marketing practices to improve their socioeconomic wellbeing within the VAF system.
- **Objective 6. Scaling-Up:** build host-country capacity to manage and disseminate integrated VAF.

Based on the findings of SANREM research, the International Development Enterprise (IDE) adapted their low-cost drip irrigation system to work more efficiently on sloping lands. The adapted technology significantly improves water and labor productivity, but is not adopted by farmers because it is not available in the local market. In Vietnam, the proportion of vegetable consumption that is home-produced has increased 16 percent. A vegetable agroforestry system (VAF) for katuk cultivation is in the early adoption stages in Indonesia. In the Philippines, both farmers and local government are supportive of VAF. A financial analysis of growing cacao under a cashew plantation in Vietnam showed that planting cacao under cashew canopy increased income by about 159 percent compared to the pure cashew system. The cacao-cashew system is already being adopted in nearby areas and continues to expand, showing the potential to reduce poverty in the province. A SANREM-initiated incentive-based policy in the Manupali watershed in the Philippines will be continued by another NGO and has been recognized by local government as a promising Payment for Environmental Services (PES) innovation. A pilot vermicomposting project with women has also shown positive outcomes.

Scaling up has taken place through presentations, workshops, and publications. The team presented VAF and IDE drip technologies to the Department of Agriculture-Bureau of Agricultural Research (DABAR) staff in the Philippines. A special issue of the International Journal of Agricultural Engineering was published with selected papers from the first Southeast Asia Soil and Water Assessment Tool (SWAT) SANREM-sponsored conference. The second international SANREM-sponsored SWAT-Southeast Asia Conference will be held in Vietnam in January 2011. The World Association of Soil and Water Conservation (WASWAC) will publish the outputs of this project in a set of four books, including a summary book and one book for each country. The drafts for the Vietnam and Indonesia publications are about 95 percent complete. The draft on the Philippines is 40 percent complete, and the summary has not yet been started.

Phase IV long-term research award activities

LTRA-6: A Conservation Agriculture Production System Program for the Central Plateau of Haiti

Principal investigator: Steven Hodges, professor, Department of Crop and Soil Environmental Sciences, Virginia Tech

Project partners: Virginia Tech (lead), Caritas/Hinche, Zamni Agrikol

The goal of this project is to reduce food insecurity for small-scale farmers in the Central Plateau of Haiti. The three main objectives are to assess the adaptability of existing farm and livelihood practices for transformation into conservation agricultural production systems (CAPS), to improve crop and livestock production through development of CAPS, and to increase the capacity of small-scale farmers to adapt and improve CAPS.

The SANREM CRSP CAPS program for the Central Plateau of Haiti was funded in December 2009. In January 2010, members of the Virginia Tech and Haitian teams met in Port-au-Prince and all facets of the project were introduced and discussed. Project members were scheduled to visit the research sites, set up the experiments, and discuss specific product protocols immediately after the meeting, but unfortunately the January earthquake occurred the first day of these planned activities and the team had to be evacuated.

The VT team returned to Haiti in March. They visited the State University of Haiti at Damien campus to observe the extent of the destruction. Many campus buildings were in ruins, and the team was not able to communicate with members of the faculty or the Ministry of Agriculture. They decided to postpone the baseline survey until the spring of 2011. The baseline survey instrument is now complete and ready for testing, and new modules to address the cross-cutting research areas have been incorporated. Formal field surveys are scheduled to begin in February 2011.

In the Central Plateau, research sites were established at three locations during March. Training was provided to agronomists with Zanmi Agrikol and Caritas to ensure proper management of the research site and data collection procedures. In July, additional training on harvest and data collection was completed, and plans were developed for the second planting season and the irrigated dry season. Initial trials have focused on black bean cultivar testing for CAPS rotations, and have included on-farm trials in grower fields. Cover crop seeds for twelve species were provided to initiate experimentation and evaluation of this important CAPS component. Recent visits have reestablished connections with the State University of Haiti, and verified their willingness to collaborate with the project team.

LTRA-7: Conservation Agriculture as a Potential Pathway to Better Resource Management, Higher Productivity, and Improved Socio-Economic Conditions in the Andean Region

Principal investigator: Jeffrey Alwang, professor, Department of Agricultural and Applied Economics, Virginia Tech

Research Team: Virginia Tech (lead), Penn State University, University of Denver, U.S. Department of Agriculture Soil Plant Nutrient Research Unit, Instituto Nacional de Investigaciones Agropecuarias (INIAP), International Plant Nutrition Institute, Secretaria Nacional de Ciencia y Tecnologia (SENACYT), Universidad Estatal de Bolivar (UEB), Escuela Superior Politecnica del Chimborazo (ESPOCH), Secretaria Nacional del Agua (SENAGUA), Gobierno de la Provincia de Bolivar (GBP), Alcaldia de Guaranda y Chillanes Sistema de Informacion Geografica Agropecuaria (SIGAGRO-MAG), Foundation for the Promotion and Research of Andean Products (PROINPA), Universidad Mayor de San Simon, Centro Regional Avaroa, Sindicato Agraria Tiraque, Alcaldia de Tiraque

This project's goal is to use research in soil sciences, cropping systems, plant pathology, and economic and social sciences to design, evaluate, and disseminate conservation agricultural technologies for the Andean region. The focus will be on potatoes, the key food crop of this region. A number of conservation agriculture practices will be examined and adapted to build a more productive, resilient farming system: improved crop rotations, including introduction of disease-resistant bean varieties and pest-free planting stocks; integrated pest management; use of cover crops, green manures, and biological soil and seed amendments; and higher-value crops such as medicinal herbs and Andean fruits.

This project is testing the concept of conservation agriculture (CA) for smallholder farmers in high-altitude, fragile areas of the Andean Region (Ecuador and Bolivia). It is expected that as the concept is tested and successful CAPS are identified, the project will diffuse the CAPS more widely. The research needs to identify CAPS based on its impacts for: soil health and productivity, farm incomes and its variability, food security, gender relations, and other social considerations.

In the first year, the team established research sites in two sub-watersheds in Bolivar Province, Ecuador and Tiraque, Bolivia. In the upper (Illangama) watershed in Ecuador, potatoes are the staple crop, and agricultural productivity is constrained by poor soil conditions and erratic rainfall. The lower Ecuador watershed (Alumbre) is characterized by warmer temperatures, predominance of maize and beans, very poor soil quality, low and declining productivity, low incomes, and high poverty. The site in Bolivia is a high-altitude area with low productivity, poor soils, and characterized by a predominance of potatoes mixed with small grains and tubers. In all areas, prior SANREM activities have built a strong base for collaboration with local stakeholders and identified a number of agricultural technologies with potential for incorporation in the CAPS. During the first year, project activities revolved around three broad

themes: (i) establishing a research design for on-farm CA experiments; (ii) incorporating and synthesizing findings from the prior SANREM Andean project; and (iii) building networks between researchers and other stakeholders to facilitate research and build the potential for local buy-in and capacity building.

Technical field research has been designed and research plots are being put in place on farmer fields as the new agricultural cycle begins. At both sites, the principal planting season is September-November. During the prior SANREM phase, the relationship between management practices and erosion on small-scale erosion trials was examined. For Phase IV, the research team altered these trials to reflect the most-likely CAPS to succeed and used them to evaluate erosion under different CAPS alternatives.

Several steps have taken advantage of prior SANREM research. First, during LTRA-7's team meeting in April in Bolivar, Ecuador, SANREM scientists conducted a thorough review of prior project activities and findings and identified: (i) research that should be continued in order to exploit prior accomplishments for the purpose of identifying and testing CAPS; (ii) research that needed to be synthesized and incorporated into the CAPS knowledge base; and (iii) publishable products. Second, promising publishable materials have been polished and submitted for publication. Third, the team identified research with the potential for publication where additional work was needed. These steps have been successfully incorporated into the research plan.

The training program has proceeded according to plans. There are three long-term graduate trainees (all women) who have started their programs at US universities, have worked with our partner institutions to identify long-term training needs, and have completed a number of important short-term training exercises. The most prominent example of short-term training was a month-long training in Colorado. Three (two Ecuadorian women and one Bolivian woman) scientists learned methods for development and calibration of a nitrogen index tool for adjustment of fertilization levels at SANREM research sites for eventual farmer use. This tool, which was developed by project collaborator Dr. Jorge Delgado (ARS-Colorado State University), will allow our project teams to quickly measure and gauge the sufficiency of soil nitrogen for plant needs.

Critical networks between participating scientists, the research team, and local stakeholders were established. All participating US scientists have established primary contact points with host country researchers and are now engaged in collaborative research. The training exchange between Dr. Delgado and the Ecuador and Bolivia research teams is one example of this collaboration. In addition to scientific networks, each of the host country teams has taken steps to build networks with local stakeholders. In Ecuador, a strong partnership has emerged between the research team, the Bolivar Provincial government, the Guaranda city government, local governments, and farmer groups. The team has established seven model farms where ongoing research is conducted. Neighboring farmers visit these farms for informational purposes or to participate in research activities. In Bolivia, linkages between local farmer groups

and the Tiraque municipal government have been solidified. In both countries, our teams have conducted informational meetings with USAID and other stakeholders.

LTRA 8: Improving Soil Quality and Crop Productivity through Farmers' Tested and Recommended Conservation Agricultural Practices in Cropping Systems of West Africa

Principal investigator: P.V. Vara Prasad, associate professor, Department of Agronomy, Kansas State University

Project Partners: Kansas State University (lead), Savanna Agricultural Research Institute (SARI), Wa Polytechnic, Institut d'Economie Rurale du Mali (IER)

This project's goal is to increase food security by raising the incomes of small-scale farm households dependent on rain-fed agriculture. Research will focus on sustainable conservation agriculture practices that improve soil quality, water capture, water-use efficiency, crop productivity, ecosystem services, and efficient use of farm inputs and labor.

Activities were conducted to share SANREM's approach to CAPS with stakeholders, identify local CAPS, develop cropping systems, and initiate long term experiments involving components of CAPS in Ghana and Mali. Surveys and meetings were conducted with farmers and treatments for testing were identified and implemented. These components mainly included minimum tillage, residue management, crop rotations, water harvesting techniques, and integrated fertilizer and weed management practices.

One important principle of CAPS is maintaining a permanent soil cover; however, farmers in Ghana and Mali found this requirement challenging since it will interfere with their livestock management practices. Rotation with legumes is not used in most cropping systems, but peanut, a women's crop (in Mali), and soybean (in Ghana) will be evaluated. To evaluate long term impacts of CAPS, mother trials with several components/treatment (less than 5) of CAPS with 3 to 5 replications and baby trials with few treatments (<3) involving several farmers' test-plots (78 in Ghana and 60 in Mali) were implemented. In each of the sites, soil samples were collected prior to experiment initiation. Crop data is currently being collected, and data on total biomass, yield and component of yield will be collected at harvest time. Gender and technology networks cross-cutting activities were partially initiated in a few sites and data is currently being collected and analyzed.

Workshops and farmer field days were conducted in parts of Ghana. Collaboration and leveraging activities were initiated in Ghana and Mali. These involve INTSORMIL CRSP activities in Ghana and Mali, and up-scaling the contour-ridge tillage project of the USAID Mali Mission, and the minimum tillage and cover crop project funded by EMBRAPA in Mali.

LTRA-9: Developing Sustainable Conservation Agricultural Production Systems for Smallholder Farmers in Southern Africa

Principal investigator: Neal Eash, associate professor and soil scientist, Department of Biosystems Engineering and Soil Science, University of Tennessee (UT)

Project partners: University of Tennessee (lead), National University of Lesotho, Global Conservation Agriculture Program (CIMMYT), Growing Nations

This project will research the effectiveness of different no-till and tilled crop management systems. The goal is to find an appropriate cereal, grass, and legume cover-crop mix that protects the soil surface from erosion, builds soil organic matter, sequesters carbon, limits weed germination, enhances soil fertility, and increases yields and income through adaptation of conservation agriculture systems to local conditions

The University of Tennessee team acquired a contract for this work in southern Africa in late April 2010. Therefore the money flow in the first year was much less than expected, which subsequently limited their research effectiveness especially in Mozambique. They are hopeful that a final sub contract will be approved by 1 November 2010 between the National University of Lesotho and CIMMYT for the work in Mozambique.

In January 2010, the project's PIs traveled to Lesotho and evaluated the demonstration and research plots. During this visit they met with their collaborators, discussed the project with actors in the local supply chain, and developed a list of priorities for the upcoming year. This past year's plots were managed by Dr. Marake with the National University of Lesotho and John Hebblethwaite, who was a volunteer associated with local NGO Growing Nations. Research in 2010 focused on understanding factors that determine maize yield in Lesotho, such as planting date, plant populations, fertilizer rate, and weed management. During their winter (August 2010), Neal Eash and Forbes Walker evaluated several potential cover crops for both ease of establishment and suppression of winter annual weeds during a student study abroad trip that used leveraged funds.

In March 2010, field days were held at Maphutseng, Lesotho by our cooperators to highlight work being conducted on conservation agriculture. These field days were attended by representatives from the US Embassy, NUL, and the Ministry of Agriculture as well as extension agents, NGO's, local farmers, and others.

LTRA-10: Development and transfer of conservation agriculture production systems (CAPS) for smallholder farms in eastern Uganda and western Kenya

Principal investigator: Jay Norton, assistant professor of soil fertility, Department of Renewable Resources, University of Wyoming

Project partners: University of Wyoming (lead), Makerere University, SACRED Africa, AT Uganda, Moi University, Manor House Agricultural Center (MHAC)

This project's goal is to develop field-scale farming system components through a participatory process that incorporates concepts of co-innovation and co-design among researchers, advisors, and men and women stakeholders in agriculture.

In Year 1, the research team developed relationships with our NGO partners, other host-country development organizations, and study-area stakeholders; conducted a baseline survey of 800 smallholder households in four study areas; built the host country team to ensure success of CAPS experiments; and are on schedule to begin CAPS treatments in March 2011.

The initial field visit to gather information on existing local/regional CAPS for the entire team took place during the last two weeks of March. During this trip the team met, exchanged information, and discussed potential collaboration with 18 local organizations. Activities carried out to broaden the partnership to include local farmers, research station managers, input vendors, development workers, and other stakeholders in each of the four study areas were successful. The activities set the stage for advisory group meetings, which enlisted project advisors who agree to serve for the duration of the project.

Survey instruments to identify agronomic and socio-economic constraints to CAPS were developed in a participatory manner involving all team members and various demographic groups. Cross-cutting research activities (CCRAs), including gender and technology networks, were incorporated during the visits of CCRA leaders from Virginia Tech. Baseline field interviews of 800 households (200 per district) were conducted in all four project districts during July and August. Baseline data entry is currently under way. Upon completion, data will be analyzed and combined with outcomes of the focus group discussions to refine the study design.

So far a total of five participatory rural appraisal (PRA) exercises were conducted at focus group meetings in Uganda, with one more to come in late October. The topics include gender, labor constraints, and livestock interactions. The SANREM-supported Master's student from Makerere University participated actively in the exercises. The two Kenyan NGO partners planned focus group activities for October 2010. Farmers and other stakeholders were identified during the baseline interviews and focus groups. They were invited to participate in CAPS planning meetings for each area. Preliminary conclusions from initial meetings with local

groups included the presence of many cropping systems, but little actual access to fertilizer subsidies, continuous maize production with multiple plowing and deep weeding activities, and little promotion of alternative tillage practices.

We recruited six host country graduate students (two females and two males), from Kenya, and two males from Uganda. Three of them are beginning degrees at the University of Wyoming, one student is beginning an MS degree at Makerere University in Uganda, and two students are beginning MS degrees at Moi University in Kenya. The research team has also recruited three Kenyan post-doctoral research associates who will begin work in 2011, with two stationed in Kenya and one stationed in Laramie, WY.

LTRA-11: Sustainable Management of Agroecological Resources for Tribal Societies (SMARTS)

Principal investigator: Catherine Chan-Halbrendt, professor and chair of the Department of Natural Resource and Environmental Management, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa

Project partners: University of Hawaii at Manoa (lead), Local Initiatives for Biodiversity, Research, and Development (LI-BIRD), Orissa University of Agricultural Technology, Institute of Agriculture and Animal Science (IAAS) of Tribhuvan University

The goal of the SMARTS project is to implement locally appropriate CAPS for tribal villages in India and Nepal to improve the sustainability of smallholder agricultural systems. To accomplish this goal, the research will pursue four main objectives:

1. Determine the set of CAPS to develop and investigate using participatory rural appraisal (PRA, including risk analysis).
2. Implement CAPS in controlled research settings and in farmers' fields and monitor crop production and quality, soil and water quality, economic impacts, and influences on gender participation and equity within farm households.
3. Use a participatory action research (PAR) approach to promote reflection, evaluation, and continuous improvement of CAPS by farmers and researchers.
4. Build capacity of farmers, local NGO's, regional universities, and international research organizations to adopt, adapt, disseminate, and scale-up CAPS.

During the first year, the team changed the location of its target villages in Orissa State (India) from the Koraput and Rayagada Districts to Keonjhar District. This was necessitated by a change in our major partner from Agramee to Orissa University of Agriculture and Technology (OUAT). Despite this change, the agricultural and socioeconomic situation is similar enough in Keonjhar that project goals and objectives remain the same. The team established working relationships with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and developed a formal partnership with OUAT in September 2010,

who then immediately conducted preliminary household surveys in their target villages of Tentuli, Saharpur, and Gopinathpur in the Keonjhar District.

Preliminary findings are that most farmers engage in both rice and maize-vegetable cropping systems, partitioning crops into fields based on topographic position. Most villages also utilize the surrounding forest for tree products and in some cases to cultivate pulses, a legume used for home consumption. From work by project partners, it is clear that farmers by themselves do not have the resources or education to dramatically improve the sustainability of their agricultural systems or local livelihoods; however, relatively low-cost and low-technology interventions have shown to improve sustainability and livelihoods. Thus, there is significant potential for locally appropriate CAPS to achieve the goals of the SMARTS project.

Research activities started include:

1. A preliminary household survey on farming systems and practices in three selected villages of Keonjhar
2. The establishment of CAPS experimental plots at the Krushi Vikash Kendra (KVK, an OUAT research station) in Keonjhar with various combinations of minimal tillage, cover crops, and rotation. Preliminary soil samples were analyzed, and data is being collected as the crops are growing and being managed.

As part of their capacity building activities, the research is supporting several graduate students. Training was also provided to the program director of Agrabamee, our original NGO partner, through visits and discussions with small-scale and organic farmers in Hawaii. The trips included visiting the farmer's market in Oahu and visiting the Island of Hawaii to see small goat and vegetable farming and marketing activities.

During the first year, students and faculty generated a number of important reports on Keonjhar, Orissa farm household livelihoods; a significant report on agricultural farming systems and livelihood challenges in Nepal; a detailed presentation on agricultural farming systems in tribal districts of Orissa State, India; and several presentations detailing the agricultural farming systems and socioeconomic challenges facing smallholders in tribal villages in Orissa.

LTRA-12: Conservation Agriculture for Food Security in Cambodia and the Philippines

Principal investigator: Manuel R. Reyes, professor, biological engineering, North Carolina Agricultural and Technical State University (NCA&T)

Project partners: North Carolina Agricultural and Technical State University (lead), U.S. Department of Agriculture-Natural Resources Conservation Service East National Tech Support Center, Royal University of Agriculture, Centre de Cooperation International en Recherche Agronomique pour le Developpement (CIRAD), University of the Philippine-Los Banos, Landcare Foundation of the Philippines

The goal of this project is to show how conservation agriculture principles and practices of minimal soil disturbance, continual mulching, and crop rotations can be adapted for local conditions as the best practices to create sustainable, permanent cropping systems for annual crop production under wet tropical condition using the following research objectives: to assess soil quality and measure crop yield and biomass from conservation agriculture production systems (CAPS) and compare them with results from conventional plow-based systems in Cambodia and the Philippines; to identify field- and farm-level CAPS that will minimize costs and risks for small-scale farmers while maximizing benefits and adoption; to pinpoint gendered limitations and advantages that can promote adoption of CAPS and determine how CAPS will affect farm women's situations; to quantify the effectiveness of SANREM-supported farmer groups in training knowledge leaders, being a means of knowledge transmission, and facilitating network connections leading to widespread adoption of CAPS; and to find out whether a microcredit approach and a method to facilitate access for mechanized direct seed drilling and spraying can be successful in promoting adoption of conservation agriculture in Cambodia.

Researcher and farmer managed sites were established in Cambodia and the Philippines. In the farmer managed sites, 50 farmers are testing various conservation agriculture production systems. Baseline data for each objective was gathered for both countries and networks continue to be established with stakeholders who can implement CAPS adoption when CAPS technology is proven to be successful. Stakeholders are getting involved while CAPS technology is being developed.

Synchronization of the Cambodian and Philippines studies has been done, allowing for an excellent cross-cutting partnership that will benefit both countries with a framework for cross-cutting research. In Cambodia, the team completed a plan to implement a contract between farmer organizations in CAPS (production), agro-industry (market), and banks (microcredit). Non-degree training was provided to 162 males and 113 females from host countries. Degree training was provided to host-country citizens (two males and one female). The team identified graduate students from both Cambodia and the Philippines to enter the PhD program at North

Carolina A&T State University. Several networking contacts have been established locally, nationally, and internationally.

Phase IV cross-cutting research activities

CCRA-6: Economic Analysis and Impact

The economic challenges to CAPS adoption are among the most formidable obstacles that will confront LTRAs and their collaborating host country partners. This CCRA will collaborate with and assist the LTRAs in developing a common baseline and methodology for addressing this general question. Later, as relevant LTRA data become available, plans call for the analysis to be expanded to the higher level landscapes and a more comprehensive economic impact assessment of CAPS. It is expected that the resulting comparative analysis across LTRAs will provide significant insight into general strategies that promote wide-scale adoption of CAPS:

- Objective 1: Identify the costs and benefits of CAPS in cropping systems/practices and related animal and forestry sub-systems.
- Objective 2: Identify optimal CAPS and the sequencing of CAPS elements for each cropping system being researched.
- Objective 3: Identify broader economic and social impacts of wide-scale CAPS adoption.
- Objective 4: Identify any policy changes required to enhance CAPS adoption in each crop system.

During Year 1, two primary activities occurred. First, an overall approach was developed and discussed with LTRA social scientists to gather and analyze production and cost data, soil loss data, and other information. Once completed, they will assess farm-level production system(s) and sequencing of CAPS elements that will minimize smallholder costs and risks while maximizing adoption and economic and environmental benefits. Second, with the assistance of a graduate student, a detailed model was developed, data collection was begun, and the model will be applied to the Latin America regional program in Ecuador during Year 2. The model will provide results for Ecuador, but also serves as a template for other regions. The study is also part of the graduate student's master's thesis.

CCRA-7: Gendered Perspectives for Conservation Agriculture: Local soil knowledge and crop-livestock interaction

This project's goals are to (1) Identify gender-related factors that contribute to the success or failure of CAPS across sites, and (2) recommend gender-related practices and policies to improve the success of CAPS while reducing inequities between women and men. The objectives are:

- Objective 1: Document differences in men and women's knowledge, beliefs, and perceptions of soil quality
- Objective 2: Document the gendered nature of crop-livestock interaction with respect to the conservation objective of maintaining crop residue cover on the soil

The Gendered Knowledge CCRA initiated Phase IV activities working with the Technology Networks CCRA to draft, revise, and publish the SANREM CRSP Working Paper 01-10,

[Research Framework for Technology Network and Gendered Knowledge Analyses](#). After presentations and discussions at the first annual/kickoff meeting, and preliminary field research, the CCRA focus was revised to target the gendered landscapes of crop-livestock interaction and gendered knowledge, beliefs, and perceptions of soils. A draft proposal was circulated among PIs, revised, and summarized in a one page document ready to post on the SANREM CRSP website.

Collaboration with the Technology Networks and Soils CCRA led to the development and testing of methodological instruments, integration of gender in both CCRA, and coordination of site visits. A key output was the Focus Group Activities Guide, which was revised several times based on testing in the field and distributed to LTRA teams. The CCRA PI traveled to Mali, Uganda, Ecuador, the Philippines, and Haiti to establish working relationships, introduce the CCRA, and hold workshops and focus group activities to initiate research. Four students worked with the project this year, including a graduate student supported by SANREM. The project contributed 33 SKB entries, and two online teaching modules for gendered knowledge and gendered spaces have been posted and are accessible. An earthquake in Haiti and typhoon in the Philippines disrupted some of the fieldwork and training activities.

CCRA-8: Technology Networks Cross-Cutting Research Activity

The goal of this CCRA is to identify characteristics that enable smallholder CAPS development and may be scaled up to benefit larger communities. The objectives are:

- Identify agricultural stakeholders knowledge and beliefs which inform production practices
- Quantify and describe structure and resource flows of agricultural sector networks
- Determine opinion leaders and supporting relationships needed to facilitate technological change

The Technology Networks CCRA initiated activities with the drafting, revision, and publication of a working paper on technology networks. This document has been circulated among LTRA PIs and application of the methodology has been initiated in the field with country teams of LTRA-8 in Mali and Ghana and LTRA-10 in Kenya and Uganda. LTRA-12 has initiated some data collection as well. LTRA-9 and LTRA-6 are currently developing their baseline surveys to include the Technology Networks modules.

Discussions began early with all LTRA PIs to incorporate technology network questionnaire items into their baseline surveys. After initial discussions, six LTRAs made specific suggestions for integration. This introduction of network concepts and methodology lead to the inclusion of technology network questionnaire modules in three LTRA socio-economic baseline surveys. These negotiations made it clear that flexibility is needed for adaptation to the conditions and timing in various host-country research sites. Although initial baseline surveys have been conducted by three LTRA teams, data entry and analysis has not been completed. Additional

LTRAs are expected to incorporate technology network modules into their surveys in the coming year.

CCRA-9: Soil Carbon and Soil Quality

The goal of this project is to examine the change in soil organic carbon levels due to the implementation of CAPS. Objectives are:

- Quantify total soil organic carbon (SOC) stocks on a limited number of best-bet CAPS and control plots before and after CAPS implementation.
- Quantify soil SOC fractions and grain yield with and without CAPS

Measuring soil organic carbon in all 13 LTRA countries before and after the establishment of conservation agricultural production systems (CAPS) is critical to identifying changes in soil fertility and carbon sequestration. This project is collecting soil data from all LTRAs so that there can be meaningful and scientifically verifiable comparisons across project sites. A common minimum dataset is being applied to ensure this objective. USDA soil importation permits are being obtained so that a soils library from all project areas can be established. Additionally, we are collaborating with the Gender CCRA to determine gendered knowledge of soils, and with the Economics CCRA to investigate the economic impact of carbon sequestration. Ultimately, we hope to make general recommendations for the practical establishment of CAPS to increase soil fertility and carbon sequestration throughout the developing world based on data collected from this project.

Management Entity activities

The SANREM CRSP Management Entity established the foundation for the Phase IV program with a new set of Long-Term Research Awards (LTRAs) and Cross-Cutting Research Activities (CCRAs) during the first half of Fiscal Year 2010. Phase III LTRAs were given no-cost and graduate education extensions and supplemental funds in some cases to complete educational programs, culminate research and training activities, and disseminate their findings. Although this was a transition period between Phases III and IV, sustainable agricultural and natural resource management innovations, policies, and practices continued to be tested and the results disseminated through professional publications, extension documents, and various reports to partner organizations.

Phase IV kick-off meeting

The Phase IV kick-off meeting was held May 5 - 7, 2010 in Blacksburg, VA. The three-day meeting contained presentations covering the planned research as well as programmatic issues and reporting requirements. The Management Entity (ME) covered the background and goals of the SANREM CRSP and the Cross-Cutting Research Activities for this phase. Each Principal Investigator (PI) from the Long Term Research Awards (LTRAs) presented their project and plan for the next four years. The ME also discussed reporting requirements and other important procedures and then the Technical Committee met to discuss logistics.

Publications and publicity

SANREM CRSP Knowledgebase

The SANREM CRSP Knowledgebase (SKB) is an online and open access database of information resources (books, reports, journal articles, videos, presentations) produced or identified, classified, and summarized by SANREM CRSP researchers. There are now over 3,400 metadata entries, 200 entered in FY2010, and 500 a direct result of SANREM CRSP Phase III research activities. In July 2010, the SKB was recognized by the National Agriculture Library and SANREM CRSP was invited to participate in the Agriculture Network Information Center (AgNIC). This provided an opportunity to increase access to SKB information by applying to become a member of this voluntary alliance and partnership of 60+ institutions and organizations working to provide quick and reliable access to quality agricultural information and sources. SANREM's application was accepted on July 27, 2010. As a member, the SKB will link its metadata and allow for greater searchability through AgNIC's website. The SKB is accessible at: <http://www.oired.vt.edu/sanremcrsp/professionals/knowledgebase/>.

Training and institutional development

In FY 2010, twenty U.S. and host country universities and institutions provided long-term training for 46 graduate students (22 PhD and 24 MS) and two undergraduate students associated with SANREM CRSP activities. Of these, 24 are women and 24 are men. SANREM CRSP researchers and partners held 80 short-term training events serving more than 2,182 people, including 949 women. Training events were held in 11 countries. Three seminars introduced SANRM, CAPS, and biological controls to over 83 participants. Twenty-one field

days were offered in several countries to 927 people. Forty percent of the 987 participants in training workshops were women (368 women).

Introduction

The Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP) promotes stakeholder empowerment and improved livelihoods through the discovery, organization, and dissemination of sustainable agriculture (SA) and natural resource management (NRM) knowledge. Program efforts are competitively driven and focused on the development of Conservation Agriculture Production Systems (CAPS). The approach is participatory, engaging stakeholders at all levels in research problem formulation within priority areas of inquiry, focusing on multiple countries and/or regions to facilitate scaling research findings. Gender sensitivity is integral to the SANREM approach and reinforced by gender-sensitive participant training programs that include degree and non-degree plans. All activities link sustainable NRM with the economic concerns of local populations and the promotion of good governance.

The objectives of the SANREM CRSP program are to:

- increase scientific knowledge and technical innovations in SA and NRM;
- improve knowledge management, education, and communication leading to behavioral changes in adaptation and adoption of new SA and NRM technologies and practices;
- reform and strengthen SA and NRM governance, policies, and local institutions; and
- promote the functioning of sustainable resource-based local enterprises in national, regional, and global markets.

This annual report documents the research and technology dissemination of the SANREM CRSP for the period October 1, 2009 – September 30, 2010. The majority of SANREM CRSP research is conducted through its Long-term Research Award (LTRA) activities. The SANREM CRSP Phase III (2006-2010) LTRA programs will conclude by December 2010 and the new Phase IV (2009-2014) LTRAs focusing on conservation agriculture production systems (CAPS) were initiated this past year. The initiation of the four cross-cutting research activities (CCRAs) dealing with economic impact analysis, gendered knowledge, soil quality and carbon sequestration, and technology networks, and the accomplishments of the Management Entity (ME) are also described.

SANREM CRSP Management Entity activities

The Virginia Tech Management Entity (ME) provides overall administrative and intellectual leadership of SANREM CRSP activities. This leadership is most clearly demonstrated in the financial management and program coordination of the Long-Term Research Awards (LTRAs) and Cross-Cutting Research Activities (CCRAs), networking with information providers and users, promoting sustainable agriculture (SA) and natural resource management (NRM), supporting SANREM CRSP researchers, and disseminating SANREM-generated knowledge to potential users. The ME also keeps abreast of innovations and new approaches in SA and NRM inquiry areas, nurtures innovative research and outreach activities, and circulates SA and NRM

knowledge and information among partners and the public through the SANREM CRSP website, a quarterly newsletter, working papers, and research briefs.

SANREM CRSP program extension

On June 3, 2009, USAID informed the Management Entity that the SANREM CRSP would be extended until 2014. The letter cited the continued relevance of sustainable agriculture and natural resource management during the ongoing global food crisis and commended SANREM on its technical progress and management in the past five years. The proposal submitted in response introduced a new research theme for SANREM Phase IV.

After consulting with USAID/Washington, other USAID missions, and a large number of SANREM CRSP stakeholders around the world, the following research theme was chosen for SANREM CRSP Phase IV: **“Increasing smallholder food security through the introduction of conservation agriculture production systems (CAPS).”** This unifying theme will contribute new knowledge and technological innovations for sustainable cropping and related systems that increase agricultural productivity, soil organic matter, and soil fertility in food-insecure regions of East, West, and Southern Africa; South and Southeast Asia; and Latin America and the Caribbean. SANREM CRSP Phase IV research and capacity building activities will develop and demonstrate locally sustainable CAPS for smallholder rain-fed crop production systems that improve food security and the productive capacity and ecosystem services of degraded and productive agricultural lands. These agro-silvo-pastoral production systems must include a substantial component of staple crop production.

To initiate this new program the SANREM CRSP led a symposium on conservation agriculture at the International Meeting of the Soil and Water Conservation Society (SWCS) in Dearborn, Michigan in July 2009. The SANREM symposium explored the role of declining soil quality in agricultural productivity in developing countries; the potential of conservation agriculture to improve agricultural productivity, soil quality, and ecosystems services; and challenges that must be overcome if conservation agriculture is to improve food security.

During July and August 2009 a request for applicants (RFA) was widely circulated and the SANREM CRSP received 15 proposals for Long-term Research Awards (LTRAs). The LTRA applications were reviewed by a panel of SA and NRM researchers. The proposals underwent a two-stage review process and were rated on the basis of scientific merit, research impact, capacity building, participatory partnerships, and inclusion of gender and minority issues. Seven LTRA activities were selected for funding:

- **A conservation agriculture production system (CAPS) program for the Central Plateau of Haiti.**
 - Lead principal investigator (PI): Steve Hodges, Virginia Tech
- **Conservation agriculture as a potential pathway to better resource management, higher productivity, and improved socioeconomic conditions in the Andean Region**

- Lead PI: Jeffrey Alwang, Virginia Tech
- **Improving soil quality and crop productivity through conservation agricultural practices in cropping systems of West Africa.**
 - Lead PI: P.V. Vara Prasad, Kansas State University
- **Developing sustainable conservation agricultural production systems for smallholder farmers in Southern Africa.**
 - Lead PI: Neal Eash, University of Tennessee
- **CAPS for smallholder farms in eastern Uganda and western Kenya**
 - Lead PI: Jay Norton, University of Wyoming
- **CAPS among tribal societies in India and Nepal**
 - Lead PI: Travis W. Idol, University of Hawaii at Manoa
- **Conservation agriculture for food security in Cambodia and the Philippines**
 - Lead PI: Manuel R. Reyes, North Carolina Agricultural and Technical State University

These seven new LTRAs submitted their work plans and budget narratives, and began local collaboration to initiate project activities at the host country work sites. Progress and highlights from during Year 1 of Phase IV, including these LTRAs include:

- Twenty-two students supported for PhD training (13 men and 9 women)
- Twenty-four students supported for Master's training (11 men and 13 women)
- Two undergraduate women supported for BS training
- Connections with Peace Corps made in Ghana and Mali
- 2,182 short-term training participants (1,233 men and 949 women)
- 5 referred journal articles
- 1 book
- 1 Master's thesis
- 1 dissertation
- 1 extension publication
- 2 fact sheets
- 2 working papers
- 20 papers or seminars presented
- 38 electronic presentations
- 4 posters
- 2 newsletters
- 11 reports

Management Entity highlights

Annual meeting

The Phase IV Kick-off meeting was held May 5 - 7, 2010 in the International Affairs Offices in Blacksburg, VA. The agenda of this three-day meeting contained presentations covering the planned research as well as programmatic issues and reporting requirements. The first day the Managing Entity (ME) covered the background and goals of the SANREM CRSP and the cross-cutting activities being focused upon during this phase. The following day, each Principal Investigator (PI) from the Long Term Research Awards (LTRAs) presented their project and plan for the next four years. The last day, the ME discussed reporting requirements and other important procedures and then the Technical Committee met to discuss logistics. The kick-off meeting was a great way to introduce all the SANREM team members, receive feedback and suggestions for specific project aspects, and address any questions or concerns regarding reporting requirements. The meeting was attended over 40 SANREM CRSP Phase IV partners and collaborators.

SANREM CRSP Knowledgebase

The SANREM CRSP Knowledgebase is an online and open access database of information resources (books, reports, journal articles, videos, presentations) produced or identified, classified, and summarized by SANREM CRSP researchers. This database provides easy access to resources relevant to sustainable agriculture and natural resource management. The collection has already established a growing selection of resources on Conservation Agriculture. The SKB is on the SANREM CRSP website at:

<http://www.oired.vt.edu/sanremcrsp/professionals/knowledgebase/>.

Since going online in 2005, the SKB has been continually evaluated and improved. There are now over 3,400 metadata entries, 500 of them the products of SANREM CRSP Phase III. The SKB serves a dual purpose — it acts as an easily-accessible repository for SANREM CRSP-produced resources and as a searchable database for the public to access key information on SA and NRM. The SKB is available to everyone and can be searched by landscape system, title, creator, creation date, keywords, time period, location, description, language, and more. Resources matching the given criteria are returned in a list from which they can be inspected and downloaded if appropriate.

Data entry and searches are facilitated by the SKB Metadata Guide, Version 5, which was updated in April 2010 and is available online at:

<http://www.oired.vt.edu/sanremcrsp/documents/skb/SKB.Metadata.UserGuide2010.pdf>.

To improve the functionality and usability of the SKB, the ME has worked closely with the web programmer for SANREM over the past few months to update certain aspects of the database. Changes that have been made include: an advanced search option for the SKB manager which

has made it easier to generate specific bibliographies; the ability to sort entries by creator, entry date, creation date, and status; and increased functionality.

Communications program

The SANREM CRSP communications program disseminates pertinent SA and NRM information in multiple forms for various purposes. This program consists of the SANREM CRSP website, newsletters, working papers, research and policy briefs, and press releases. The communications coordinator also keeps track of articles submitted to newspapers, magazines, and other websites that highlight SANREM CRSP activities or researchers.

Five months after the resignation of SANREM's Communications Coordinator, SANREM hired a new one in August 2010. She is now coordinating our communications program, producing a quarterly newsletter, editing SANREM CRSP publications, and enhancing the effective sharing of our publications and updates.

The SANREM team recognized that social networks are an important means to reach a larger audience, so the SANREM CRSP has a Facebook page, which is updated regularly with links to SANREM publications, news, and additional information about conservation agriculture, natural resource management, and sustainable production issues. Our total number of fans has doubled since January 2010, including followers from Ecuador, Bangladesh, and the Philippines. Our Facebook page can be viewed at www.facebook.com/pages/SANREM-CRSP/69503719402.

Most recently, in July 2010 SANREM CRSP created a Twitter account to update subscribers on pertinent SA and NRM activities of USAID, non-governmental organizations, universities, and other actors in the international agricultural research field. Our twitter account is www.twitter.com/SANREMCRSP.

SANREM website

SANREM CRSP partners, development practitioners, policymakers, other stakeholders, and the public are informed of SANREM CRSP activities and announcements through the SANREM CRSP website, <http://www.oired.vt.edu/sanremcrsp>.

To increase usability and appeal to all audiences, the SANREM CRSP website has been reevaluated and reorganized and will soon have a fresh new look, with the tentative debut date as February 1, 2011. This remodeling will cater to the website visitors by being more visually pleasing and easier to navigate.

Google Analytics

The SANREM ME tracks visitors to the website using Google Analytics, a free service that generates detailed statistics on website visits. The SANREM website has seen increases in all

areas of visitation, including the number of visits, length of time on the site, and the average number pages viewed.

Since the SANREM CRSP ME launched the website in August 2006, there have been over 35,200 visits and more than 118,000 pageviews.

Figure 1: Google Analytics data for the SANREM CRSP website, FY2010

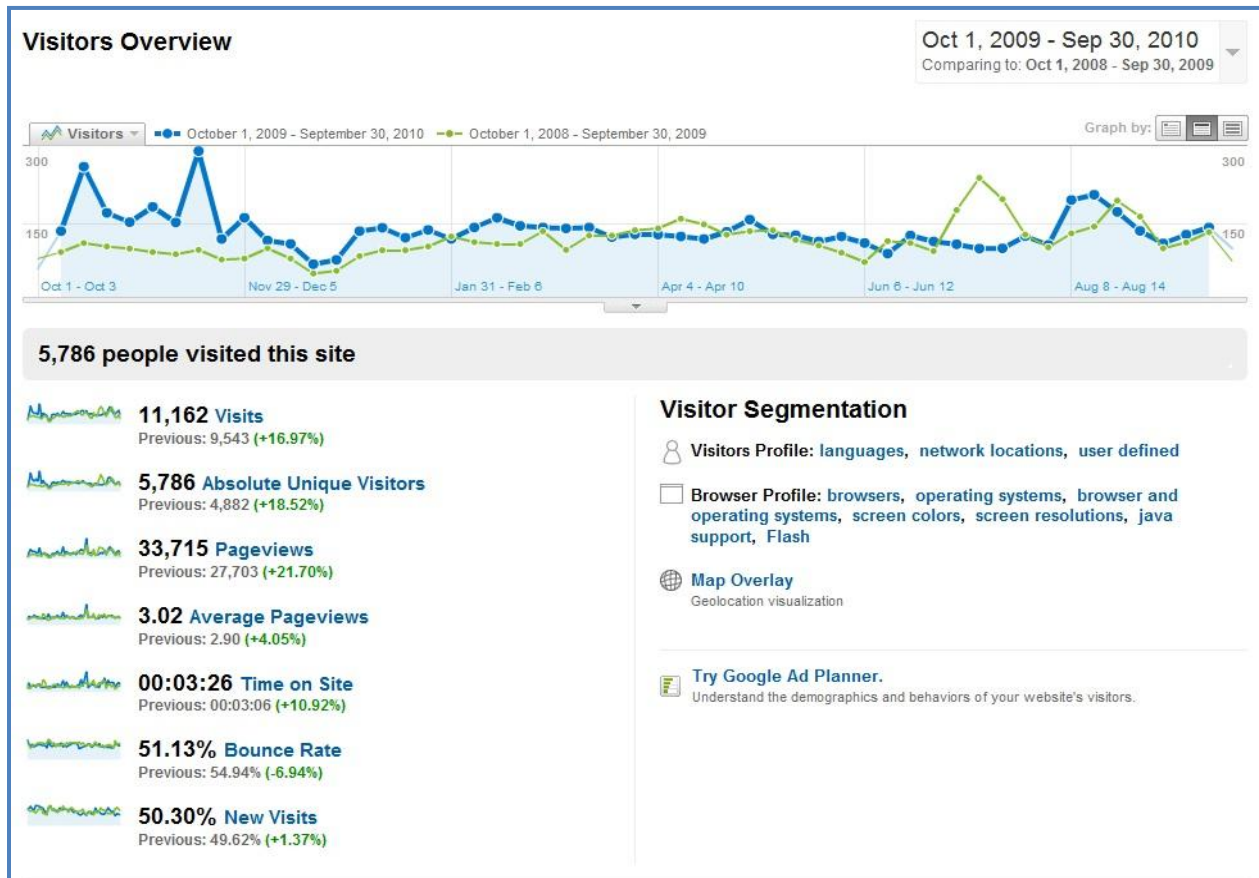


Table 1: Annual Change in SANREM CRSP website data, FY2009 to FY2010

	FY 2009	FY 2010	Change (percent)
Visits	9,543	11,162	+16.97
Pageviews	27,703	33,715	+21.70
Pages/Visit	2.90	3.02	+4.05
Bounce Rate	54.94 percent	51.13 percent	-6.94
Avg. Time on Site	3:06 minutes	3:26 minutes	+10.92
Percent. New Visits	49.62 percent	50.30 percent	+1.37

Visit: a period of interaction between a person's browser and a particular website, ending when the browser is closed or shut down, or when the user was inactive on that site for 30 minutes

Pageview: an instance of a web page being loaded by a browser.

Pages/Visit: average number of pages viewed during each visit

Bounce rate: the percentage of single-page visits, i.e., the person left the site from the homepage

Avg. Time on Site: Time on site: how long a visitor is connected. Time on site can be misleading because visitors often leave browser windows open when they are not actually viewing or using a site

New visit: a computer accessing the website for the first time

Global distribution of website visits

Visits in FY2010 came from 148 countries, using 27 languages and involved more than 11,000 visitors. Of those, about three-fourths were from the United States. About a third of the visits were direct traffic (visitor entered the URL directly and another third generated by search engines). The rest were from other websites with links to the SANREM CRSP website, with the Virginia Tech College of Agriculture and Life Sciences and USAID websites referring the highest percentage of visits. It is also worth noting that for the first time, the SANREM CRSP website was accessed via mobile devices, many of which were from countries other than the United States.

Table 2: Top 10 countries visiting SANREM CRSP website, FY2010

Country	Visits	New Visits (percent)	Change in Visits from FY 2009 (percent)
1. United States	8,254	40.09	+20.81
2. Philippines	258	89.92	-30.46
3. India	224	68.75	+44.52
4. Nepal	173	60.69	+917.65
5. United Kingdom	108	96.30	-16.92
6. Kenya	107	85.05	-13.01
7. Bolivia	99	64.65	-6.60
8. Germany	98	69.39	+58.06
9. Ecuador	80	50.00	+50.94
10. Canada	79	89.87	-32.48

Information products

The *SANREM CRSP Newsletter* is published as an e-mail bulletin and online at <http://www.oired.vt.edu/sanremcrsp/public/news/newsletters/>. It provides a concise update of SANREM CRSP activities, accomplishments, and future events. Issues in FY2010 appeared in October 2009 and August 2010.

SANREM CRSP research briefs promote and disseminate relevant sustainable agriculture and natural resource management messages and information. These concise summaries of peer-reviewed SANREM CRSP research findings suggest how new knowledge can be applied in the field. Three research briefs were produced during FY2010. *Policy briefs* present peer-reviewed findings with direct policy implications or recommendations for sustainable development. Two were produced during FY2010. The objective is to provide policy makers with easily accessible information to increase understanding of often complicated policy issues. Research and policy briefs are available at <http://www.oired.vt.edu/sanremcrsp/public/media/research-briefs/> and <http://www.oired.vt.edu/sanremcrsp/public/media/policy-briefs/>, respectively

The *SANREM CRSP working papers* series provides an early look at research in progress. Each paper was internally reviewed by the ME, but not yet refined for formal publication. Examples are preliminary baseline studies reports, discussions of methodological or thematic issues, and topical syntheses and literature reviews. The Phase III series, inaugurated in 2006, has posted 27 entries. The Phase IV series has produced two working papers thus far, with one focusing on local network analysis in the development of CAPS, and the other providing a research framework for technology networks and gendered analysis. All are available on the website: <http://www.oired.vt.edu/sanremcrsp/professionals/research-themes/working-papers/>.

SANREM CRSP publicity

Part of the SANREM CRSP's mission is to establish the program as a respected authority on sustainable agriculture and natural resource management, raise the profile of the program, and to disseminate SANREM CRSP generated knowledge around the world. The ME achieves this in part by distributing stories to newspapers, magazines, and other websites.

The research program in Haiti was highlighted in March 2010 in *Physorg.com*, an online science and research news service website, and the Virginia Tech website. These feature articles can be found at <http://www.physorg.com/help/about-us/> and <http://www.vtnews.vt.edu/articles/2010/03/2010-178.html>.

LTRA-8 researchers were featured in the Kansas State University news website for their work to improve food security in Mali and Ghana: http://www.ksre.ksu.edu/news/story/food_security012010.aspx.

The Convention on Biological Diversity featured the SKB and the SANREM CRSP Associate Award for studies on Payments for Environmental Services (PES) on their website, with a link to both webpages: <http://www.cbd.int/development/casestudies/>.

Our Future Planet referenced the SANREM research briefs in a news article about slash-and-burn farming published in January 2010 (<http://www.ourfutureplanet.org/news/331>).

The World Agroforestry Centre highlighted the promise of alternative agriculture options for smallholders and referenced the SANREM CRSP with a link to our website as well. This article can be found at <http://www.worldagroforestry.org/sea/node/188>.

The Virginia Tech website and the *Roanoke Times* featured SANREM graduate research assistant Jennifer Lamb for being the Virginia Tech Undergraduate Woman of the Year and winner of the prestigious Truman Award.

A SANREM-affiliated paper, *Beyond yield: Plant diseases in the context of ecosystem services*, was named one of the top nine papers of 2009 in *Phytopathology* by the American Phytopathological Society.

In addition, a video featuring Manny Reyes, the PI for LTRA-5 and LTRA-12 was featured in on North Carolina Agricultural and Technical State University's online research magazine discussing agro-forestry: http://www.ag.ncat.edu/research/re_search_magazine.html

In February 2010, *The Wall Street Journal* highlighted the work of SANREM project partner, Zanmi Agrikol, and the potential of the LTRA- 6 project in Haiti to feed thousands of people impacted by the earthquake. This article mentions this project could be key to revitalizing Haiti's agricultural sector and sustaining families migrating back to the rural areas from Port-Au-Prince. The article is located online at:
<http://online.wsj.com/article/SB10001424052748703494404575081744058479892.html?KEYWORD S=Zanmi+Agrikol>

Book on adaptive management for sustainable systems

The Sciences and Art of Adaptive Management: Innovating for Sustainable Agriculture and Natural Resource Management was edited by Associate Program Director Keith M. Moore and published by the Soil and Water Conservation Society in 2009. The book is available for purchase from their on-line store: <http://store.swcs.org/> or downloadable at no cost for developing country nationals at:

http://www.swcs.org/en/publications/the_sciences_and_art_of_adaptive_management/

Mark Anderson-Wilk, a leader in Extension and Experiment Station Communications at Oregon State University, reviewed the book in November of 2009. He begins his review by commending the editor for "effectively bring[ing] together the authors working in different

disciplines” and adds that adaptive management “is an approach that will become only more essential in the future.” Anderson-Wilk boasts that the book “does an impressive job of weaving practical, real-world experience together with a forward-thinking, conceptual framework.” He also says this book “makes a major step forward in the maturation of understanding about adaptive management in the natural resources management context.” In addition, he describes this book as an “indispensable resource” with “compelling” themes and he comments on the “many colorful photos” and “rich presentation of research and perspectives.” His review can be found at: <http://www.jswconline.org/content/64/6/179A.extract>.

In addition, this book was featured in DEC Express and sent out to DEC Express subscribers on July 23, 2010. The book has been given to researchers around the US and to development practitioners in Africa. It has also been referenced by Ecoagriculture Partners in their Issues Paper for State of the World 2011: Innovations that Nourish the Planet.

Networking and partnership

ME participation in the United States Agricultural Information Network (USAIN) reinforced linkages with the National Agricultural Library (NAL). In July 2010, the SKB was recognized by the NAL, and SANREM CRSP was invited to participate in the Agriculture Network Information Center (AgNIC). This organization provided another opportunity to promote information in the SKB through a membership application to AgNIC. AgNIC is a voluntary alliance and partnership of 60+ institutions and organizations working to provide quick and reliable access to quality agricultural information and sources. SANREM’s application was reviewed and then unanimously accepted on July 27, 2010. As a member, the SKB will link its metadata and allow for greater searchability through AgNIC’s website. The AgNIC membership will help SANREM CRSP to share the information in the SKB to reach a larger readership and increase the access to agricultural resources from other AgNIC members. The SKB manager has been added to the AgNIC listserv, which offers information about recent agricultural-news, webinars, and other new resources.

Additionally, the SKB has been added as a part of the Virginia Tech Libraries’ database search, located at: <http://dsp.lib.vt.edu/dsp/index.php?action=ViewDatabase&did=4730>. This will increase traffic to the SKB by students, faculty, and other researchers.

Conference participation

Since 2008, SANREM CRSP has participated in activities of the Agricultural Learning Repositories Task Force (AgLR-TF) sponsored by the Food and Agriculture Organization of the United Nations. SANREM CRSP input is often cited in the summary report (<ftp://ftp.fao.org/docrep/fao/meeting/014/ai263e.pdf>), suggesting that SANREM CRSP made a significant contribution to this early attempt at sharing knowledge across various agricultural learning repositories. Moreover, the SKB benefitted from increased exposure and conversations about the types of resources the project makes available. As a member of the AgLR-TF, the SKB

has a profile of its unique features as a learning repository and is linked and accessible for reference by other task force members as well as in the public domain, <http://aglr.aua.gr/node/19>. SANREM CRSP continues to communicate with other Task Force members through its continued membership in the online AgLR-TF community and looks forward to the possibility of sponsoring a representative at AgLR-TF conferences and/or training activities during Phase IV.

SANREM has contributed to the development environmental problem solutions through its participation in a conference organized by ASABE and EARTH University. This conference, called the “21st Century Watershed Technology: Improving Water Quality and the Environment” took place in Costa Rica from February 21-24, 2010. This successful international conference brought together several major organizations including the Soil and Water Conservation Society and the US Department of Agriculture’s Agricultural Research Service. SANREM, together with these groups, addressed solutions to water quality and quantity issues, emerging watershed problems, and solutions to manage these watersheds to meet standards.

SANREM CRSP leveraged funding

SANREM CRSP researchers were successful in leveraging additional funding to enhance their research and outreach activities (Table 3). Funding sources included U.S. and international funding agencies, as well as host country sources. This year, SANREM CRSP PIs and Co-PIs generated \$1,016,849 in leveraged funding. The majority of those funds (\$989,480) went directly to the support of SANREM CRSP activities. The governments of Indonesia, Vietnam, and Ecuador, as well as the French Embassy, are among the host country organizations offering support to SANREM CRSP research activities. (For a full accounting, see Table 21 in the appendixes).

Table 3: SANREM CRSP leveraged funding, FY2010

Source of funding/support	Non-tracked funding or support contributing to SANREM CRSP activities	Funding or support for non-SANREM CRSP activities resulting from SANREM CRSP activities	Total (\$)
U.S. organizations	\$473,000	-	\$473,000
Host country organizations	\$516,480	\$27,369	\$543,849
Total	\$989,480	\$27,369	\$1,016,849

Training and institutional capacity development

Long-term degree training

The SANREM CRSP uses degree training to strengthen the technical skills of researchers, extension agents, and teachers from U.S. and host country universities, national agricultural research services, non-governmental organizations, and relevant ministries. While developing a global knowledgebase in U.S. universities, SANREM CRSP addresses specific host country SA and NRM questions, opportunities, and constraints. In FY 2010, twenty U.S. and host country universities and institutions provided long-term training for 46 graduate students (22 PhD and 24 MS) and two undergraduate students associated with SANREM CRSP activities. Of these, 24 are women and 24 are men. (For a full accounting of these training events, see Table 13 in the appendixes).

Table 4: Long-term degree training participants by country, FY 2010

Country	Doctorate		Master's		Bachelor's		Total
	Men	Women	Men	Women	Men	Women	
Bolivia	1	3	1	3		1	9
Cambodia	2						2
Ecuador	1	2	2	1			6
Haiti	1		1				2
India			1	3			4
Indonesia		1	1				2
Kenya	1			1			2
Uganda			2				2
Lesotho			1	1			2
USA	2		2	2		1	7
Mexico	1						1
Philippines/ SE Asia	2			1			3
Zambia	2	3		1			6
Total	13	9	11	13	0	2	48

Short-term training

SANREM CRSP researchers and partners held 83 short-term training events serving more than 2,300 people, including 996 women. Training events were held in 11 countries. Three seminars introduced SANREM, CAPS, and types of biological controls to over 83 participants. Twenty-one field days were offered in several countries to 927 people. Thirty-six percent of the 1,079 participants in training workshops were women (389 women). For a full accounting of these training events, see Table 19 in the Appendixes.

Table 5: Short-term training participants by country, FY 2010

Country	Men	Women	Total
Bolivia	20	15	35
Cambodia	82	34	116
Ecuador	247	158	405
Ghana	76	34	110
Haiti	86	18	104
Kenya	11	11	22
Lesotho	583	541	1124
Mali	66	45	111
Philippines	92	86	178
Uganda	24	15	39
USA	9	5	14
TOTAL	1296	962	2258

Phase III Long-term Research Award (LTRA) program

LTRA-1: Decentralization Reforms and Property Rights: Potentials and Puzzles for Forest Sustainability and Livelihoods

Principal investigator: Elinor Ostrom, Arthur F. Bentley Professor of Political Science, Indiana University

Host countries: Bolivia, Kenya, Mexico, Uganda

Research team:

- University of Colorado: Kristen Par Andersson, political science
- International Food Policy Research Institute: Ruth Meinzen-Dick, senior research fellow, environment and production technology
- Harvard University: Esther Mwangi, Giorgio Ruffolo Post-doctoral Fellow in Sustainability Science, Center for International Development, Kennedy School of Government
- Charles Darwin University: Bruce Campbell, director, Research School of Environmental Studies
- University of Alberta: Marty Luckert, forest economics

Research progress by objective

The objectives for this project are closely intertwined, since all three objectives involve building different capacities among stakeholder groups. For this reason, and because these complementary capacity-building activities must be considered together to assess the project's effectiveness, three objectives are addressed together in the section below:

Objective 1: to develop capacity within resource user groups at the selected forest sites to enable differentiated actors to identify, understand, and participate in forest governance, benefits, and policy processes

Objective 2: to develop capacity within key organizations in the forestry sector to understand the impacts of policies on differentiated local actors and to adopt strategies for inclusion of such actors within broader policy processes

Objective 3: to develop effective monitoring techniques for use by resource user groups and their partners at the community level to assess the impacts of decentralization and other property rights reforms on natural resources and livelihoods

Critical research accomplishments

The primary accomplishments of this project revolve around the gathering of detailed data at both the household and community levels in 24 forests across four countries, complemented by a national-level forest-community survey in the two Latin American countries. Community-level data was collected following the International Forestry Resources and Institutions (IFRI) protocol, which captures both social and biological information. This collection of data allowed

project partners to assess the institutional compatibility of stakeholder organizations, user groups, policy makers, and others involved in forest governance. The data also helped identify gaps and capacity-building needs that would enable stakeholders to better achieve natural resource and livelihood goals. Data collected includes:

Bolivia: 572 forest plots and 165 household surveys in 7 communities (2 funded by U. of Michigan); national survey of 200 forest communities

Kenya: 146 forest plots and 702 household surveys in 7 communities

Mexico: 204 forest plots and 288 household surveys in 5 communities; national survey of 146 forest communities

Uganda: 254 forest plots and 720 household surveys in 9 communities (2 funded by U. of Michigan)

Throughout the project, the research team relied on contacts at many levels to facilitate all three objectives. In addition to regular contact with user groups, their partner organizations formed National Advisory Councils (NACs) that met regularly throughout the project to discuss findings and needs. The NACs also helped identify study sites, and provided a perspective on trends and policies at higher levels of governance. Roundtables, trainings, and cross-community workshops created opportunities for stakeholders at multiple levels to come together for education and exchange. This multi-level approach culminated in international exchange meetings between the two countries in each region, held in 2008 (for Uganda and Kenya) and 2009 (for Bolivia and Mexico).

Development impact

In addition to enabling researchers to draw conclusions at national, regional, and international scales, the data gathering activities also benefit the inhabitants of the targeted communities by building skills, providing site-specific information, and otherwise improving local quality of life.

In an analysis of the overall project data, the team found that:

- Decentralization was associated with increased forest investment (e.g. tree planting) in Mexico, Uganda, and Bolivia; forest investment actually dropped significantly in Kenya, a result that we had not predicted. This outcome may be because the reforms are so new that people perceive the new rules as institutional instability, and may require some time to adapt to the new institutional environment.
- Local-level rulemaking was expected to increase in all countries as a result of decentralization; however, the only significant changes in this variable occurred in Uganda. We speculated that the macro-level instability was so significant that user groups were induced to make local rules to compensate.
- The effect of decentralization on wealth inequality was expected to vary. In Mexico, we found a strong correlation between years of decentralization and a more equal distribution of wealth. In Uganda, wealth inequality increased significantly following decentralization.

- The anticipated effects of decentralization on expectations of forest conditions in the four countries were more difficult to predict. The effects on perceived forest conditions in Mexico were positive and very large, as we predicted. However, in the other countries decentralization policies had little effect on the perception of forest conditions compared to similar forests in the region.
- Because of these disparate findings, we argue that expectations related to natural resource decentralization should be adjusted to the context of the types of decentralization reforms being implemented and the country within which they are implemented. Decentralization includes a wide variety of concepts that should be explicitly defined when discussing any potential impacts.

The theory indicating how decentralization will vary by context is imprecise. The Coleman *et al* analysis indicates that the stability of reforms, scarcity of forest products, size of the forest units affected, and dependence of user groups on the resource will affect many decentralization goals. In addition, these effects might differ depending on details of the decentralization reform. Previous analyses of forest decentralization have focused on the macro level. We have looked instead at the behavior of local users. The changes and adaptations of local institutions and user behaviors in response to broader policy reforms, as well as the environmental outcomes of such reforms, need to be given greater attention.

Further analysis conducted during the extension period showed the following:

- Despite recent work suggesting that rights of access and use (to enter the forest and harvest) are the most important types of property rights for forest users, we find that households with rights of access are actually less likely to perceive the forest vegetation as having a high density than those who have no rights of access or use. Those with more complete property rights (management, exclusion, alienation) are those who are the most likely to rank the vegetative density of the forest highly.
- Property rights are most significantly and substantively related to high ranking of vegetative conditions in government forests, rather than community and private forests. Formal property rights are necessary in government forests to ensure that there is not over-exploitation of the forest stock, while less formal rights may be sufficient in community or private forests---in communities because informal norms exert control over behavior and in private forests because of informal contracts between owners and households.
- Households with property rights in government forests as well as other forests are more likely to rank the vegetative conditions in government forests more highly than those who only have rights in government forests. However, households with property rights in community forests as well as other forests are less likely to rank the vegetative conditions of community forests highly than those with property rights only in community forests. In other words: Those who rely solely on a community forest do not over-exploit it, while those who rely on a community forest as one among other types of forests which can be accessed, tend to rank conditions more poorly--perhaps because they have more forests to compare to or perhaps because they can exploit the community forest and risk violating social norms, yet

- still have some access to resources in other forests. Those who use only a government forest, however, are more likely to over-exploit the government forests, but when there are alternative forests available they switch their use to them.
- Households with more assets tend to rank all types of forest vegetation poorly. Those who are distant from markets are more likely to rank the forests poorly while those who live farther from the forest are more likely to rank the forest highly. When rules are perceived as fair, forest vegetation is more likely to be ranked highly. Forest subsistence is negatively related to vegetation in private forests, and not significantly correlated in government or community forests.

Uganda:

In Uganda, the first SANREM site (Mabira forest) has been involved in a particularly contentious struggle to determine the fate of the forest. Throughout the conflict, SANREM partners have worked closely with neighboring communities Kirugu and Nakalanga to strengthen forest management committees, monitor the level of illegal activities in the forests managed by the communities, and assist the communities in diversifying sources of income through pineapple farming and goat- and cattle-rearing.

Part of the learning experience also derived from exchanges between communities, exemplified by the trip arranged for leaders from Kyarukooka to Sango Bay, where there is a successful collaborative forest management system. Residents of Sango Bay's Mujanjabula and Mugamba settlements formed a "Save the Forest" Association – they carry out joint patrols with National Forest Authority officials, planted a community woodlot, and plant trees for timber and medicinal purposes. The level of illegal activities in the forests managed by the association is low, and the forest has continued to improve. The group also visited neighboring communities who were in the process of forming forest management committees.

Community leaders from Nakalanga and Kirugu visited communities who have started collaborative forest management in nearby forest patches of Mabira Forest reserve.

During the extension period, half-day workshops were held in Wakisi, Malamaganbo, and Kakindo to discuss the roles of communities and local institutions in the management of forest resources following the implementation of the forest sector reforms. A policy brief in the local language (translated during the extension period) was used in the discussion and was distributed to local leadership and members of the forest associations in the study sites.

Community-level learning was complemented by multiple strategies, including the formation of a National Advisory Committee (NAC), whose members represented numerous scales of governance, and who could influence changes in policies as the need was identified. NAC members in Uganda also participated in feedback workshops to share research findings with forest user groups. Researchers noted that joint implementation (as embodied by the NAC and other steps to involve different players) showcased to researchers the validity of local knowledge; to local people, the relevance and usefulness of science; and to local officials, the

usefulness of research in decision making, thus enhancing the acceptability of scientific research to local level practitioners.

Using these various mechanisms, Ugandan researchers found there is an increasing rate of deforestation in the country, but there are some communities and districts where management of forest resources has improved (*Ecosystem and Community/watershed level*). They found that the participation of local communities and local councils in decision-making on forest issues is still limited (*Policy/market level*), and there is an increased rate of tree planting by the private sector and individual farmers (*Farm household/enterprise*). Finally, they concluded that the National Forest Authority has made an impact on plantation establishment but has not been very successful in conservation of natural forests (*Policy/market*).

Kenya

In Kenya, the research team worked with resource persons from other government ministries to equip community members with forest management skills, including tree nursery management, seed production and storage, group dynamics, conflict resolution and leadership, business skills to manage PFM projects, basic bookkeeping, bee keeping, proposal writing, and participatory skills for problem identification. Training topics were selected based on community circumstances.

The Kenyan team noted an increase in the number of community forest organizations throughout the project; they also found greater awareness of Kenya's new Forest Act following the team's site visit. Physical improvements were also evident, with a new electric fence in one site preventing cattle from grazing in the forest. Another community developed an eco-tourism facility in collaboration with other organizations and with the advice of the research team.

Target communities in Kenya also showed an increase in the number of NGOs and community-based organizations working within the natural resource sector, and an increase in the number of government projects aimed at poverty alleviation (*Policy/market*). In Aberdares, examples included Green Zones and the Plantation Establishment and Livelihood Improvement Scheme (PELIS), both Kenya Forest Service initiatives; in Ramogi, PLAN International, Action Aid, and CARE Kenya were also active by the second visit. In the second case, the town council was taking a more proactive role in forest management than the team saw during their initial visit (*Policy/market*). They also found greater acceptance among foresters of community member involvement in forest management (*Policy/market*).

Analysis of the household surveys collected in Kenya showed the following:

- Most forests in the country face challenges due to population pressure, high poverty levels, and unemployment, which contribute to a high dependence on forest products. In all the sites, forest-adjacent communities depended fully on the forests for all their energy needs, most of their poles and posts, all their herbal medicine needs, and some of their construction needs. Some forests, such as Aberdares and

- Mau, were heavily degraded due to human impacts, which included clearing of large tracts of forestland for agricultural cultivation.
- Forests did not provide dependable cash income. A majority of the communities harvested products for subsistence use but did not rely on the forest products fully for cash income. Their needs for cash had to be supplemented through formal and self-employment, casual labor, small-scale business opportunities, remittances from relatives, and other sources. Poor farmers therefore dedicated limited time to forest activities.
 - Government linkages with communities are poor due to conflicts between the forest managers and users, high corruption among the forest managers, poor forest management strategies, and poor communication flow to communities. Linkages with other stakeholders were also limited and only a few were beneficiaries of information from non-governmental organizations. Most women and other marginalized groups were often left out of development activities because of low or no education, lack of time to attend meetings, and lack of contacts within the local settings. The general lack of technical knowledge of forest management and conservation among community members also limited their involvement in management activities.
 - Women are unlikely to inherit property (an exception is Aberdares, where unmarried women can inherit land) and are also disadvantaged by the expectations of the new forest act. For instance, due to low education many women could not be selected for leadership positions. Time constraints also affected their ability to attend meetings. Although women spent much time in the forest collecting products, they were rarely consulted about any forest management initiatives.
 - The Ramogi Hills forest was selected as a good example of a sacred forest with strong cultural ties and institutions. Results from the study of this forest indicated that the rules crafted to protect the forest were respected by a majority of the community and there was fear and respect for anything regarded sacred – even illegal harvesters avoided harvesting from within the sacred grove. Because the people value the sacred forest for its cultural and historical significance, they also made extra efforts to assist in the conservation and management of the forest, including use of energy-saving stoves and restrictions on the sale of wood products.

The Kenya team has also been involved in piloting an educational program in schools, starting with several schools adjacent to the Ramogi Hills, Kakamega, and Mau forest sites, to raise awareness of the importance of forest conservation. Children planted indigenous trees and established a nursery to raise thousands more. They hope to expand the program to schools across the country in the future.

Mexico

In Mexico, data from the national survey of 146 forest communities showed two clear tendencies: from 1994 to 2000, forest production grew by 49 percent, (from 6.3 million cubic meters of round wood to 9.4 million cubic meters). Five years later in 2005, timber production

had dropped to the 1994 level. This loss of wood production during the early 2000s has occurred in the middle of a considerable increase in the national consumption of forest products, which grew from 16.3 million cubic meters of round wood in 2000 to 27.5 million in 2003 and 21.3 million in 2005. As a consequence, the deficit of forest products increased in volume and value. In those five years the volume of the deficit increased by 167 percent and its value grew by 222 percent, in spite of the relative monetary stability during this period. (*Ecosystem and policy/market level*)

The data on the performance of the forest sector during 2000-2005 reflects an important loss of community capacities to produce raw materials and add value to their products, a reality made even more alarming by the fact that public investment in the forest sector remarkably grew during this period. The analysis of the distribution of the increased public budget highlights some of the reasons for policy failures: 60 percent of the resources were invested in reforestation and plantations based mostly in top down approaches, with poor or little attention to the development of planning, management, administrative, and productive local capacities.

Given an increasing national focus on restoration and conservation in Mexico, and because the majority of forests in Mexico are collectively owned, a failure to provide additional training and advice to forest communities could both further marginalize these communities and undermine the likelihood that these policies will succeed.

The national survey identified some of the main challenges faced in achieving sustainable forest management arrangements: (i) Right holders in the majority of ejidos are aging, and the generational replacement required for forest protection and community entrepreneurship is under threat in the majority of forest communities. (ii) Tenure conflicts are frequent and have pervasive impacts on local peace and on forest areas. (iii) Poverty is widespread and the income alternatives of forest populations are poor and often not compatible with the conservation of the forest cover. This is particularly true for those forest ecosystems with the highest biodiversity. (iv) There are few incentives to sustain and develop local institutions. (v) Forest communities are facing a loss in productive capacity, and are becoming less able to compete in today's open markets. Most of these challenges have not been addressed by any public program; those that have tried to support local institutional and production capabilities are marginal in financial and political terms.

Social organization has not been perceived as a key resource by mainstream forest and environmental policies; on the contrary, policies have often negatively impacted community organizations because they disregard local collective property arrangements and the potential advantage of groups with communal social capital for sustainable forest governance. The results from the national survey in Mexico show that communities with stronger organizations are also those with more intense protection and conservation activities. Communities with developed and successful forestry experiences are only a small percentage of all forest communities, but their presence and success expresses the viability of community forestry as a driver of local economy in forest regions.

Bolivia

Researchers in Bolivia focused their final months of work on the preparation of numerous papers. They also participated in a national workshop on indigenous territories and forest valuation, and junior researchers received certificates from the Latin American Council of Social Sciences. Findings show a low level of efficiency in municipalities involved in forest management. The municipal governments have constructed infrastructure (including roads, drinking water systems, and electricity) in some areas but are largely absent from forest sector activities. The Forest Superintendence, charged with fulfilling the goals of the forest law, is largely absent as well. (*Policy/market*)

As part of the closing activities of the project, Bolivia hosted both a community exchange meeting and an exchange meeting with researchers from Mexico, held in series at the end of September 2009. The community meeting was attended by 13 representatives from six of the Bolivian communities studied during the course of the SANREM grant, and gave community members an opportunity to build additional capacities as well as share experiences with other communities.

During the meeting, communities presented the details and challenges of forest management in their community and compared their experiences with other communities. All attendees learned about the design principles articulated by Elinor Ostrom, and were asked to apply these concepts to their own communities, followed by a general discussion. All communities received folders describing the physical, human, social, and institutional conditions of each community and the team's findings in their community.

This training was followed immediately by the exchange meeting with the Mexican research team and the community representatives participated in this meeting as well. Both teams presented on the conditions and findings in their communities. In addition, one community (TIM Ivirgarzama) presented their experience as a subject of SANREM's research. Twenty additional participants joined in this meeting.

Significant training, capacity building, and networking activities

Degree and non-degree training activities

Over the course of the project, partners have trained 1,468 men and 1,251 women from numerous backgrounds on numerous topics. All of these individuals were trained in host countries. Participants ranged from user group members and community-based organizations, to local officials, national-level officials and NGOs.

In addition, the project supported 8 students (4 male, 4 female) in degree programs.

Publications, presentations, and other products

Over the course of the project, the research team produced 1 dissertation, 6 reports, 10 papers, 10 presentations, 5 abstracts, 3 fact sheets, 2 research briefs, and 2 newsletter articles that have

been made available on the SKB. Other materials will be entered as soon as they become available.

Networking activities

In Kenya, an IFRI Regional Training was carried out and participants from different organizations and universities in Kenya and Tanzania were trained on the IFRI methodology and IFRI data management.

In Bolivia, the research team participated in a national workshop on indigenous territories and forest valuation for sustainable forest management and certification, held in Santa Cruz, Bolivia. The team also hosted the exchange workshop described above, attended by representatives from the NGO Jatun Sach'a, the Forest Superintendence, the Ministry of Rural Development, and others.

In Mexico, part of the project's support was provided by the Instituto de Investigaciones Sociales of UNAM, enabling Leticia Merino's participation and giving access to office space, computers, and vehicles for field work. The National Forest Commission (CONAFOR) and UNAM have supported training activities with communities. Two NGOs, Grupo de Estudios Ambientales (GEA) and Grupo Autónomo para la Investigación Ambiental (GAIA) also supported one of the training activities.

In Uganda, partners produced a DVD geared toward researchers and policy makers that addresses forest policy and community forest management issues.

LTRA-2: Developing a Participatory Socioeconomic Model for Food Security, Improved Rural Livelihoods, Watershed Management, and Biodiversity Conservation in Southern Africa

Principal investigator: Alex Travis, Assistant Professor, College of Veterinary Medicine, Cornell University

Host country: Zambia

Research team:

- Cornell University: Alfonso Torres, College of Veterinary Medicine
- Wildlife Conservation Society-Zambia: Dale Lewis

Research progress by objective

Objective 1: Social

Progress towards completing critical annual work plan tasks:

- Designed survey instrument, pre-tested survey, trained enumerators, and revised survey.
- Performed social survey of COMACO and non-COMACO farmers in the Lundazi area of the Luangwa Valley.
- Entered, cleaned, and analyzed data.

Significant research findings:

- Analysis of all household survey data on men and women farmers both COMACO and non-COMACO, and before and after joining COMACO, demonstrated that farmers joining COMACO were less wealthy than their counterparts when they joined, although differences dissipated over time as the conservation farming practices helped improve and stabilize incomes. The analysis also found that women COMACO participants achieved higher yields for groundnuts, maize, and rice than the other groupings, although income differences were not found.
- Both the COMACO participants and non-COMACO participants still experience food insecurity. However, distinguishing differences in both social parameters and in soil/crop metrics between these groups is made difficult by the fact that conservation farming practices are becoming more generalized in the population.

Objective 2: Soil

Progress towards completing critical annual work plan tasks:

- Finished foliar analyses from 8 plots of each of the 280 farms to quantify plant nutrition along the environmental gradient.

- Generated landscape properties and terrain attributes from digital elevation models and compared them with the field data. This information is useful in examining the relationship between yield, landscape, and soil properties.
- Gatere's Dissertation expected to be completed by December 2010.

Significant research findings:

- No significant difference was found in maize yields between conservation farming and traditional farming as farmer management practices varied considerably in both groups.
- There is no significant difference between farmer managed CF plots and researcher managed CF plots with gliricidia leaves or manure only due to nitrogen immobilization.
- Significant increased maize yields for plots with organic amendment (biochar, manure) together with (as opposed to without) fertilizer.

Objective 3: Natural Resources

Progress towards completing critical annual work plan tasks:

- Soil samples were collected from different land use categories in the valley and on the plateau. Samples were collected from forests in order to estimate a maximum carbon stock level, and from agricultural areas (including conservation farming plots) to examine active and total soil organic carbon (and other nutrients) on agricultural lands. Soil samples were also collected from under the canopy of mature *Faidherbia albida* in these areas to investigate the impact of this species on soil carbon. The methodology involved replicate sampling at 0-15 cm, and 15-30 cm, from individual plots, along with replicated bulk density samples, in order to determine the degree of within-plot variability and help define future minimum (cost-effective) sampling strategies, shedding light on measurement, reporting and verification (MRV) strategies. It was found that over a three-year period farmers conducting both Conservation Farming and traditional practices on the same soils had significantly higher total soil carbon in the 0-15 cm range, although no difference was noted in the 15-30 cm range.
- Modeling the growth rate of *F. albida* is underway in order to estimate the rate of carbon sequestration possible in these agroforestry systems.
- A manuscript describing the findings of the contingent valuation study measuring the value of wildlife to South Luangwa National Park was drafted.

Significant research findings:

- Preliminary results indicate significantly higher levels of total soil organic carbon and nitrogen under the canopy of *Faidherbia albida*. The value of COMACO's agroforestry activities will be examined in terms of the net greenhouse gases removed from the atmosphere by soils and woody biomass, as well as through predicting changes in yields.

- There is a stabilization of numbers of large ungulates (hoofed animals) both in and outside of the national parks. Numbers declined in the 1990s, but between 1999-2002 and 2006-2009, most populations have stabilized, with some increasing and some have increased. Only buffalo numbers are in decline. Control of poaching through conservation farming seems to be working, as fewer snares are being found.

Significant training, capacity building, and networking activities

One graduate student performed the social survey with partial support from this grant: Kim Bothi is mentored by Drs. Louise Buck and Jim Lassoie, and received assistance in survey design and analysis by a team led by Dr. David Lee.

One graduate student, Lydiah Gatere, is being trained through this grant in soil sciences. Her advisor, Dr. Johannes Lehmann, was able to present a small portion of the data to a forum on world hunger assembled by Jeffrey Sachs at Columbia University in October 2009, which afforded important networking opportunities. The interactions have led to one manuscript that is currently being submitted for publication.

Another graduate student, Sam Bell, is being trained through this grant in natural resource economics. He has taken the lead in conducting the analysis and drafting an overview paper that evaluates the overall COMACO model from multiple perspectives. Conservation farming practices are being increasingly adopted in the region: 2008 (31 percent); 2009 (50 percent); and 2010 (79 percent).

Bell and business economics researcher John Fay were instrumental in highlighting the relevance of COMACO's agroforestry plans to developing global carbon markets. As noted in previous reports, non-SANREM funding was leveraged to pursue the carbon aims beyond the scope of the SANREM. In addition to the presentations at the COP15 meeting in December, Sam also presented his work to representatives of the Ministry of Tourism, Environment, and Natural Resources in Zambia.

Research strategy and development objectives

Progress achieving milestones:

- For the soil work on conservation farming technology, field research and the laboratory analysis is complete. Write-up is underway for publications.
- Landscape properties were generated to aid in examining the relationship between yield and soil properties. Work in progress could possibly lead to a map for Eastern Zambia that gives spatially-explicit information about average farmer yields and the total yield potential if conservation agriculture were to be adopted on a larger scale.
- Analytical work to quantify changes in carbon quality shortly after CF adoption has fully started, and will likely be completed in June 2010.

- Social science survey data reveal important unanticipated benefits provided by COMACO to non-COMACO members in terms of technology adoption. More and more non-COMACO members are conducting conservation agriculture practices.
- Data on soil carbon will provide additional important information on the impact of agroforestry while simultaneously offering potential access to global carbon markets.

Contribution to progress along the development impact pathway:

- This research focused on the potential of conservation farming to alleviate food insecurity through increasing soil fertility with locally-available organic matter. Improvement in soil fertility and conservation measures increases food security.
- The planned map of potential yield in Eastern Zambia will be a valuable tool for the decision-making process and for giving policy advice.
- The impact of COMACO in the Luangwa Valley is greater than simply the impacts on its participants. Extension training activities are being transformed, expanding impacts beyond the intervention itself.
- SANREM research has also helped provide a foundation for important carbon MRV methodologies in complex rural landscapes.

Lessons learned relevant to development goals:

- To alleviate hunger with conservation farming, the principles of CF ought to be adapted and applied to local conditions.
- Technology adoption by non-participants can confound both social and biophysical quantifications of intervention impacts.

LTRA-3: Watershed-based Natural Resource Management in Small-scale Agriculture: Sloped Areas of the Andean Region

Principal investigator: Jeffrey Alwang, Professor of Agricultural and Applied Economics, Virginia Tech

Host countries: Bolivia, Ecuador

Research team:

Virginia Tech: George W. Norton and Darrell Bosch, agricultural and applied economics; Mary Leigh Wolfe, Brian Benham, and Conrad Heatwole, biological systems engineering

Penn State: Paul Backman, plant pathology; Jonathan Lynch, horticulture and plant nutrition

Florida A&M: Wills Flowers, entomology and biocontrol

University of Denver: Sarah Hamilton, international development and gender analysis

INIAP/Ecuador: Victor Barrera, Carlos Monar, Elena Cruz, Luis Escudero

ECOCIENCIA/Ecuador: Adriana Cardenas, Juan Calles

Sigagro/Ecuador: Juan Montufar

PROINPA/Bolivia: Ruben Botello, Nadezda Amaya, Illich Figueroa

PROMIC/Bolivia: Omar Vargas, Ana Karina Saavedra

Graduate students:

Nadezda Amaya (VT/AgEcon) defended her thesis in December 2009 and submitted it to the graduate school in January 2010. She returned to Bolivia and has drafted and submitted a paper for publication in *World Development*. She also completed a draft of a chapter for the SANREM gendered markets book.

Catherine LaRoche (VT/AgEcon) is continuing progress toward completion of her dissertation. She has also completed two paper drafts, one on the role of risk in livelihood choice, and the other on spatial dispersion of livelihood choices and its impact on risk reduction and market choice.

Anissa Polatewich (Plant Pathology/PSU) completed her PhD with a dissertation on fruit tree disease management.

Rachel Melnick (Plant Pathology/PSU) completed her PhD with a dissertation on the Ecology and potential for biological control of cacao diseases.

Stakeholder communication:

Jeffrey Alwang conducted two half-day workshops at PROINPA headquarters in Cochabamba with participation from a broad spectrum of stakeholders. Many comments were provided with the bulk of them focusing on the need for follow-up to the extensive community engagement. Stakeholders were also interested in continuing the watershed monitoring efforts.

Progress achieving research milestones:

There are four articles currently at different stages of review and two more are being written/edited. The edited book, *Experiencias de manejo integrado de recursos naturales en la subcuenca del río Chimbo, Ecuador*, describes the results of the research and has been published.

LTRA-4: Adapting to Change in the Andes: Practices and Strategies to Address Climate and Market Risks in Vulnerable Agro-ecosystems

Principal investigator: Corinne Valdivia, Associate Professor of Agricultural Economics, Division of Applied Social Sciences, University of Missouri

Host countries: Bolivia, Ecuador

Research team:

- University of Missouri: Peter Motavalli, soil science; Jere Gilles, rural sociology
- Kansas State University: Karen Garrett, plant pathology
- University of Connecticut: Anji Seth, climatology
- Iowa State University: Cornelia Flora, sociology, agriculture and life sciences; Jan Flora, sociology
- International Potato Center: Greg Forbes, plant pathology; Roberto Quiroz, natural resource management
- Universidad Mayor de San Andrés, Bolivia: Jorge Cusicanqui, plant production systems; Magalí García, agro-climatology
- Universidad de La Cordillera, Bolivia: Elizabeth Jiménez, economics
- Fundación PROINPA, Bolivia: Miguel Angel Gonzales, Javier Aguilera, agronomy
- Universidad Nacional Agraria La Molina, Peru: Edith Fernández-Baca, sustainable production; Celia Turín, animal sciences

Research progress by objective

Integration is the overarching theme of the final year of this research. Therefore the findings on dynamics and perceptions of changes (Objectives 1 and 2) are integrated with the practices and strategies to adapt to change (Objectives 3, 4, and 5). Several products have been or are being developed. These include journal articles that show the projections of climate change in South America (Seth et al.) and the Altiplano (Thibeault et al; Seth et al), as well as the process of integrating knowledge about livelihoods, perceptions of risks, and participatory processes (Valdivia et al). Along with these, two books are being finalized. The first contains most of the field research activities developed in Bolivia, including theses research. The second is a book published through CIDES with research products that integrate and synthesize findings.

Objectives 3 and 4: practices and strategies to adapt to change

Peter Motavalli has organized with Sarah Beebout of IRRI a symposium entitled “Global Food Security in a Changing Climate” for the 2010 American Society of Agronomy Meetings in Long Beach, California, which will be occurring from Oct. 31 to Nov. 4, 2010. This symposium is co-sponsored by SANREM and will provide a forum for presentation of the research results from the project. The plan is to publish the research results in a peer-reviewed journal such as *Agricultural Systems*.

Objective 5: capacities and capabilities – ability to act

Field work activities took place through February of 2010 in Peru and January of 2010 in Bolivia. The surveys were completed and the databases have been developed. Knowledge sharing took

place in Bolivia and Peru, where the results from the research were shared with local stakeholders. This included integrating the local knowledge, the participatory research findings, and the disciplinary research findings. Most of the products appear as extension publications in the SANREM Knowledge Base (SKB). Community participation varied by site. Although the intention was to hold knowledge sharing workshops in all the communities, only two of the four communities in the Central Altiplano (Bolivia) were engaged in the process. Problems in the other two communities prevented the final meetings from taking place, so the team contacted officials and delivered the products without workshops.

In the Northern Altiplano (Peru), the communities' process was different. It entailed returning the findings through multiple meetings. Both the marketing and climate products were returned in the context of soil and pest management findings. In this region, UMSA has been able to establish itself as a trusted institution through the project. It has a greater presence, and there is commitment to long-term collaboration with the communities. Universidad de la Cordillera and UMSA were in charge of the knowledge sharing process in Bolivia. In Peru, knowledge sharing was conducted in the last semester, along with the survey activities led by Pedro Condor and Universidad del Altiplano.

Fieldwork for the Gender and Markets crosscutting initiatives was completed and results returned to the communities during the knowledge sharing workshops. Two theses in Bolivia were completed and the defense dates are pending. A working paper on gender in Peru is being finalized. Abstracts were submitted for inclusion in a proposal by the gender cross-cutting PI.

We continue to analyze data and develop articles and chapters with our collaborators. We continue to seek funding opportunities to accelerate this process.

Soil quality CCRA

Mid infrared scans were completed of humic acid extracted from soil samples received from Indonesia and the Philippines. In addition, all the survey results were compiled and analyzed. The Thai PhD student completed her comprehensive exam and is completing her dissertation.

Metagenomics CCRA

The metagenomics cross-cutting project was designed to link with existing SANREM projects, adding complementary information about soil microbial community responses to agricultural management and about microbes that are potential indicators for soil degradation. The project is one of the first to use advanced sequencing approaches to address the sustainability of agricultural systems and the research team successfully coordinated synergistic links with the other LTRAs. In LTRA-4 the focus is on the analysis of microbial communities in the Bolivian Altiplano and their responses to changing fallow periods and to the pressure to remove plants for fuel during fallow periods. The entire DNA sequencing information for this project has been performed, as well as preliminary analyses. A paper is being completed for submission based on an award-winning poster presented by Lorena Gomez at this year's American Phytopathology Society annual meeting. This project is a collaboration of colleagues at PROINPA, UMSA, and University of Missouri.

In LTRA-3, Neshmi Salaues (student with PROINPA) is focusing on the analysis of microbial communities across elevations in Bolivian inter-Andean valleys and across levels of soil quality. She has the DNA from the samples, but additional funds are needed to prepare the samples for sequencing and to perform the sequencing. In addition to providing information about microbial diversity, this project will identify microorganisms that could be used as bioindicators of soil fertility. Using these bioindicators will make it possible to give farmers specific advice on land management strategies to increase the presence of beneficial microorganisms in their fields, which could improve agricultural production. Therefore, this research is of significant practical relevance for Bolivian farmers. This project is in collaboration with colleagues at PROINPA in Cochabamba, Bolivia. In Zambia, the samples collected by Lydiah Gatere (graduate student at Cornell) to evaluate the effects of conservation agriculture strategies on soil communities in Zambia are being analyzed. The sequences from this experiment are in hand, and the plan is to analyze the data and submit the paper in early 2011 in collaboration with colleagues at Cornell.

This project will provide a completely new perspective on the sustainability of soils in these agricultural systems. It will also result in three substantial papers in peer-reviewed journals, representing collaborations across the three LTRA projects.

Changes in research design or methods, obstacles encountered, and actions taken

No changes. There were difficulties in scheduling meetings with some communities. The actions taken consisted of delivering the socialization materials through the community officers in Umala.

Significant research findings

No changes from the findings reported at the end of Year Four. The following are some of the capabilities elements of the research design and how these are taking shape:

- In Bolivia, early warning systems networks are being developed based on the project. Bridging capital and networks were facilitated by the project through the development of trust, which was the result of the quality of the research products and the trust-building interactions with the communities.
- In Peru, research has given us a clearer view of the effect climate change is having on agricultural activities and livelihood strategies in both communities and on fiber commercialization specifically in Apopata. Findings have served as inputs for the formulation of development and research proposals that look at key issues for the community such as organizational strengthening through networking, and generating and acquiring knowledge to develop new strategies to face climate change, among other issues.
- In both countries the project became a trusted source of information, not only for farmers and government agencies, but also for USAID offices.

Significant training, capacity building, and networking activities

Degree training students supported

The Bolivian PhD candidate, Javier Aguilera, was sponsored by the project completed and defended his dissertation in May 2010.

The Peruvian PhD candidate Cecilia Turin passed her comprehensive examination and is currently in Peru conducting field research in the highland communities of Puno Peru. She has identified her study communities and is currently gathering baseline data for her dissertation.

The American PhD candidate Jeanne Thibeault is defended her dissertation May 3. She has published two articles and has submitted two additional articles on climate change in the Andes for review.

The American MS student Nathaniel Jensen, funded by the University of Missouri, is completing his thesis research titled "Adaptation and Vulnerabilities, and Socio Ecological Systems in Bolivia." He presented a poster at the American Agricultural and Applied Economics Association in July on the geography of risks and capitals in the Altiplano. He defended his MS thesis in May, and has been accepted for doctoral studies at Cornell.

The Peruvian MS student Doris Bartolo, enrolled in the masters' program for "Innovation for Development" at the La Molina National Agrarian University (UNALM), is working on her thesis "Building new knowledge and participatory research within the context of climate change in four communities in the Peru-Bolivia Altiplano." So far she has collected data from all sites in Peru and Bolivia. She is now conducting the analysis in preparation for drafting her thesis.

The Peruvian MS student Clovis Baylon has also finished his course work and has already received approval for his thesis project "Traditional soil management (aynokas) and its effect on soil fertility." He was attacked and severely beaten which has slowed/stopped work on his thesis.

Christian Candela, who received a partial scholarship, is also working on his thesis draft. His proposal "Effects of SANREM project participatory workshops over the capacities (attitudes and aptitudes) of participants" has been approved conditional on a certain number of changes that were incorporated. We are expecting him to finish and defend his proposal in December 2010.

Three licenciatura theses were defended at UMSA:

- Mamani, B. "*Caracterización de suelos, según su índice de fertilidad y aptitud de uso, en el municipio de Ancoraimes.*" Tesis de licenciatura, Universidad Mayor de San Andrés. 2009.
- Quispe, M. "*Determinación del efecto residual de abonos (orgánicos e inorgánicos) en la humedad y la eficiencia del uso del agua en el comportamiento agronómico de la papa*"

en la comunidad de Chinchaya (municipio de Ancoraimes).” Tesis de licenciatura, Universidad Mayor de San Andrés. 2010.

- Sarmiento, J. “*Caracterización in-situ de los cultivos de papa (Solanum spp.) y oca (Oxalis tuberosa) en las comunidades de Chojñapata y Calahuancane del municipio de Ancoraimes.*” Tesis de licenciatura, Universidad Mayor de San Andrés. 2010.

As indicated above, doctoral and MS students in the US are continuing as expected. A serious illness has delayed the research of the student in soil quality. Students in the region are also progressing as described above. While thesis research has been completed, many of the students are waiting for their universities to assign juries for the defense.

Short-term training events conducted

Knowledge sharing activities were carried out between October 2009 and February 2010 to return the results of the research activities to the communities as part of the knowledge systems linking goal (Objective 1).

Updated publications list

Several reports and knowledge sharing products that are similar in format to those already in the SKB have been produced and shared with farmer groups. Other recent publications are either in press or are working papers that cannot yet be uploaded to the SKB.

Special events or networking activities

Findings from this project were integrated into a presentation at the Copenhagen Meetings by John Furlow of the USAID Climate Change Team. The presentation was titled “Adapting to a World without Glaciers” and was presented at the 2009 UN Climate Change Conference on December 14, 2009.

Professor Gilles and the team from UMSA have participated with the National Program on Climate Change in Bolivia to train officers around the country on Climate Change Adaptation in October and November of 2009.

With the support of UMSA we continue to monitor pests in the communities of Ancoraimes.

Dr. Gilles and Dr. García are leading a monitoring project on climate in several communities of the Altiplano.

USAID Deputy Chief Officer Economic Growth and Environment contacted us to link with the office to provide research results on climate change for the Andes.

Research strategy and development objectives

Progress achieving research milestones

The team shared their research products on dynamics of change and on-farm research on soils and pests with local partners. This should be an iterative process. They were only able to complete the first phase of the process, which brought back the findings on dynamics along with the findings on participatory research. In order to increase success it is desirable to continue the research collaboration with the farmers. The team developed a proposal on conservation agriculture that would have allowed focus on specific practices to improve conservation of resources, especially soils and water; however, they were not successful in obtaining funds to continue this collaboration process.

Progress along the development impact pathway

The research team impacted knowledge, perceptions and skills. Farmers in their knowledge sharing meetings recognize climate changes and the potential impacts of new practices to adapt to the changes. The second survey and the knowledge sharing workshops are their mechanisms to assess those impacts. The workshops have been successful in 8 of the 10 communities in terms of involvement. Farmers hoped that the collaborations would continue.

Below is a summary of the results in Puno as an example of the project impact.

Training in both communities has been differentiated both by quantity of activities as well as by topics addressed. In Santa Maria, 30 capacity building activities have taken place around the following themes: (i) natural resources diagnosis; (ii) mapping and geo-referencing; (iii) Aynocas characterization and management; (iv) integrated weevil (gorgojo de los Andes) management; (v) animal health; and (vi) advocacy coalitions.

The community of Apopata went through nine different training workshops which have been classified according to the following topics: (i) Natural resources diagnosis; (ii) mapping and geo-referencing; (iii) management of *bofedales*; (iv) animal health; and (v) advocacy coalitions. The degree of participation was also different from that in Santa Maria. In Santa Maria there was a greater percentage of female participation (54 percent). The opposite was observed in Apopata where female participation was only 42 percent.

Since there were more of them in Santa Maria, capacity building activities seem to have been more useful there. These activities gave farmers access to new technical tools, which will help them incorporate new practices such as collecting adult weevils, harvesting potatoes with cloths (*cosecha en mantas*), and installing live barriers using Tarwi (*Lupinus mutabilis*). In terms of soil management, the use of organic fertilizers has increased considerably. In Apopata, results have been less visible given that there were fewer capacity building activities.

However, when it came to Networking activities, the community of Apopata made better use of this process because communal authorities were more willing to engage and participate in

actions with local actors. As a result, strategic alliances with public and private institutions were established to build capacities for improved pasture management, preparation of project proposals, and trout production and management. The networking and alliance formation process with Santa Maria was abruptly ended and never continued due to the unwillingness of the communal president to participate and lead a community-based process -- he preferred to depend on government assistance.

Discuss any lessons learned relevant to development goals

More time and iterations are needed in participatory research in the Andes, due to the nature of the production process and the high variability in climate presentations in the region. In order to address adaptation a longer time horizon is needed.

LTRA-5: Agroforestry and Sustainable Vegetable Production in Southeast Asian Watersheds

Principal investigator: Manuel Reyes, Professor, Natural Resources and Environmental Design, North Carolina Agricultural and Technical State University (NCA&T)

Host countries: Philippines, Vietnam, Indonesia

Research team:

- University of California-Berkeley: Robin Marsh
- Virginia Tech: Ronald Morse, Conrad Heatwole
- Central Queensland University: David Midmore
- Mars Inc. and University of California-Davis: Howard Yana Shapiro
- Texas A&M: Raghavan Srinivasan
- International Center for Research in Agroforestry (ICRAF), Philippines: Delia Catacutan, Agustin Mercado
- ICRAF, Indonesia: Suseno Budidarsono
- ICRAF and Winrock International, Indonesia: James Roshetko
- Asian Vegetable Research and Development Center (AVRDC), Taiwan: Manuel Palada, Liwayway Engle, Edwin Javier, Greg Luther, Srinivasan Ramsamany
- Nong Lam University, Vietnam: Dang Ha
- Bogor Agricultural University, Indonesia: Anas Susila, Bambang Purwoko
- De la Salle University, Philippines: Ma. Elena Chiong-Javier
- University of the Philippines-Los Baños: Victor Ella, Ma. Victoria Espaldon
- Central Mindanao University, Philippines: Anthony Penaso
- University of the Philippines Open University: Jean Saludadez
- Don Bosco Technical College, Philippines: Paul Catalan

Research progress by objective

Goal: Communities in many forest and vegetable producing watersheds in Southeast Asia are suffering from poverty and degradation of forest, soil and water resources. The goal is to develop economically viable and ecologically sound vegetable-agroforestry systems (VAF) and to quantify the potential economic and environmental benefits of these systems.

Objective 1: Technology

Develop economically viable and ecologically-sound vegetable-agroforestry (VAF) systems.

Drip irrigation studies continued through additional funding from the International Development Enterprise (IDE). SANREM scientists found that the IDE drip system (IDE drip) had low irrigation efficiency on sloping land, so IDE engineers developed adjustable pressure lateral take-off valves (APLTV). SANREM scientists found that the APLTV significantly improved the water distribution uniformity of IDE drip. Results of profitability analysis of IDE drip for selected vegetable farms in the Philippines indicated a benefit-cost ratio greater than 1.0, averaging 1.18. A new set of APLTV drip equipment funded by IDE was tested in June.

Water distribution uniformity of the 100 square meter microtube-type drip irrigation system increased significantly. Extremely low and high emitter discharge values are avoided with APLTVs. However, even with a head of 1.5 meters further improvement of APLTVs for steep slopes is unlikely. SANREM has provided scientific backstopping for the development of these drip kits.

Objective 2: Marketing

Develop market value chain at the local, regional, and national levels that builds upon existing marketing strategies.

Nothing to report for this period; objectives have been achieved.

Objective 3: Policy

Identify options and institutional frameworks that promote sustainability of vegetable-agroforestry production and reward environmental services.

Cross-Cutting Research Activity in Knowledge to Action (K2A) continued to progress:

- Conducted Research Feedback Session with researchers on October 8, 2009 in Malaybalay City, the Philippines
- Conducted Research Feedback Session with policy-makers, extension experts and farmers on October 9, 2009 in Malaybalay City, the Philippines
- Developed video production on K2A process of SANREM Phase III in Manupali watershed.
- Completed K2A case studies in Vietnam and the Philippines.

Objective 4: Environmental and socio-economic impact

Assess the short and long-term environmental and socio-economic impacts for farm families of adopting integrated vegetable-agroforestry systems

Economics of IDE drip irrigation technology and its adoption:

- Results of profitability analysis of IDE drip for selected vegetable farms in the Philippines indicated a benefit-cost ratio greater than 1.0, averaging 1.18. The payback period for IDE drip irrigated vegetable farms ranged from 1 year to 2.5 years.
- In Vietnam, evaluation of the economic feasibility of using IDE drip for home garden vegetable cultivation in an upland community showed that yield and income from vegetable cultivation in farmer's home garden increased only slightly when applying IDE drip as compared to farmer's current irrigation practice. However, in terms of resources usage, IDE drip helped farmers achieve significantly higher water and labor productivity in home garden vegetable cultivation.
- For both countries, there was no adoption of IDE drip by local farmers because it is not available in the local market. The drip irrigation for young cacao designed by Nong Lam University in 2007 also had no adoption due to high initial investment.

Adoption of vegetable agroforestry:

- In Vietnam, information on vegetable trials and nutrition benefits from vegetable consumption were transferred to local farmers. A survey on daily food consumption conducted in 2005 and at the end of 2008/early 2009 revealed that the home-produced vegetables share of total vegetable consumption increased by 16 percent.
- In Indonesia, adoption of vegetable agroforestry systems in Nanggung sub-district represented by katuk cultivation has entered the early adoption stage. This early adoption is in its critical stage and needs to be maintained through sound pest management and guaranteed supply of fertilizer. If this stage fails, farmers will not adopt.
- In the Philippines, vegetable farmers and local government favored VAF. Participation in the research and extension activities increased knowledge, skills, attitudes and aspiration among the vegetable farmers which could facilitate adoption of the VAF system in the area. However, farmers assess the availability of financial and input/output markets as they decide to adopt VAF technology.

Economics of growing cacao in cashew plantations and its promising rapid adoption:

- A financial analysis on growing cacao under a cashew plantation in Vietnam showed that planting cacao under the cashew canopy increased income by 159 percent compared to the pure cashew system. The net present value (NPV) increased from VND 47.7 million for one ha of pure cashew to VND 123.6 million per ha when cacao was planted under cashew canopy. This study therefore supports the finding that there is an increase in the farm income levels when cacao is integrated into an existing cashew plantation. Furthermore, the cacao-cashew system continues to be more profitable than the pure cashew system even with a 60 percent reduction in cocoa price or yield.
- With support from the cacao program of Binh Phuoc province, the cacao-cashew system continues to expand in the province. High adoption rates of cacao are reported in the nearby Duc Lieu village and in Bu Dang district. Binh Phuoc has become the second province with substantial cacao area in the country. The cacao-cashew system has high potential for reducing poverty in the province. With a large cashew area in Binh Phuoc province and in other provinces in the South-East region and the Central Highland of Vietnam, there is a great potential to expand the cacao-cashew system.

Adoption of no weeding and reduced pesticide use in cashew plantations:

- Information on no-weeding practices for cashew production has been transferred to local farmers through various field visits and local workshops. Based on group discussions conducted with local farmers and village leaders in July 2009, the number of farmers applying either no-weeding or reduced weeding practices in cashew cultivation has increased by an estimated 18 percent.

Objective 5: Gender

Provide mechanisms to ensure women's involvement in decision-making and sustainable production and marketing practices to improve their socio-economic wellbeing within the vegetable agroforestry system.

Responding to the need of women farmers for cost-saving fertilizer inputs, a pilot vermicomposting project using an African nightcrawler species (*Eudrilus eugeniae*) was started with 10 women farmers who produced commercial vegetables and agroforestry crops in an upland barangay of Lantapan, Bukidnon. The technology was not only easy for women to adopt, but it also harnessed interest and participation of male spouses and children. Replacing urea and chicken dung with vermicast generated savings that women could channel to pay for other pressing household needs. Based on some initial sales of worms and cast, it promises to be a lucrative source of additional income that could be sustained on minimal capital. Moreover, women's scientific interest was aroused as they experimented with different combinations of organic waste materials from VAF farms to produce the greatest worm and cast harvests. The major challenge lies in standardizing the women's vermicomposting practices.

The team contributed three papers to the cross-cutting gender research and results are in the cross-cutting gender project report.

Objective 6: Scaling-up

Build host country capacity to manage and disseminate integrated vegetable-agroforestry

- The World Association of Soil and Water Conservation (WASWAC) agreed to publish the outputs of this project in a set of four books entitled: (i) Vegetable Agroforestry Systems, (2) Vegetable Agroforestry Systems in Indonesia, (iii) Vegetable Agroforestry Systems in the Philippines, and (iv) Vegetable Agroforestry and Cashew-Cacao Systems in Vietnam. These books will be packaged as a set of 4 books. An additional \$2400 has already been raised to supplement publication costs beyond that provided by SANREM. Mars, Inc. donated money and the USDA-National Agroforestry Center purchased copies in advance for distribution to their staff.
- There will be a series of book launchings. For Vietnam, the book will be released at the 2nd Soil and Water Assessment Tool-Southeast Asia Conference in January 2011, and is being worked on by WASWAC at this time. The rest of the books will be released in Indonesia in February (Bogor and ICRAF teams is organizing the event already and it will be in IPB); and in the Philippines in March 2011 (no venue or occasion yet). The four volume set will be presented at the Association of 1890 Research Directors, Inc. meeting in Atlanta, GA, April 2011. World Agroforestry agreed to be co-publisher with WASWAC and Dennis Garrity, director general of the World Agroforestry Centre, agreed to write the preface for the entire set.
- The implementation of incentive-based policy started by SANREM will be continued through the World Agroforestry Center's Rewarding Upland Poor for

Environmental Services (RUPES) project in Manupali watershed, where the incentive-based policy is considered as a new approach to reward environmental services.

- The Lantapan incentive-based policy has been identified by the Bukidnon Environment and Natural Resource Office (BENRO) as a locally promising innovation that promotes payments for environmental services (PES) through their TULSEA (Tree on multi-Use Landscape in Southeast Asia) project.
- The Lantapan incentive-based policy was shared with East African Landcare delegates as one of the local government's mechanisms to reward farmers.
- In the Philippines, VAF and IDE drip technologies were presented to the Department of Agriculture-Bureau of Agricultural Research (DABAR) staff, and they are looking forward to hearing about the socioeconomic aspects of these technologies.
- IDE drip and VAF technologies were proposed to be included in the 2011-2015 DABAR agricultural research and development priorities.
- A special issue publication in the *International Journal of Agricultural Engineering* on selected papers presented at the first Southeast Asia Soil and Water Assessment Tool conference was completed.
- Workshops on beginner-level SWAT, advanced SWAT, MapWindows GIS, and stream restoration have been arranged to coincide with the second international SWAT-Southeast Asia conference in Vietnam on January 4-8, 2011 and are all advertised on the SWAT-SEA 2 website. This conference is sponsored by SANREM.
- The team contributed papers in the books for cross-cutting gendered networks and knowledge to action studies and produced a video on the K2A process of SANREM Phase III at the Manupali watershed.
- As a spin-off, research on vegetable agroforestry in North Carolina was funded by the USDA and is now being implemented in three small farms in the state.

Significant training, capacity building, and networking activities

- Presentation of VAF and IDE drip technologies to the Philippines' Department of Agriculture-Bureau of Agricultural Research (DABAR) staff.
- K2A research feedback session and workshop for Policy-makers, extension professionals and farmers

Research strategy and development objectives

There are encouraging indications of early adoption of vegetable agroforestry and introduction of cacao in cashew plantations. IDE drip needs to be manufactured in the country for it to be adopted. The SWAT users in the Southeast Asian academic community have been growing. In Indonesia, SWAT has been incorporated in a course and in Vietnam many undergraduate and graduate students are being introduced to SWAT technology.

Phase IV Long-Term Research Award (LTRA) program

LTRA-6: A Conservation Agriculture Production System Program for the Central Plateau of Haiti

Principal Investigator: Steven Hodges, professor, Department of Crop and Soil Environmental Sciences, Virginia Tech

Host Countries: Haiti

Research Team:

- Virginia Tech: Department of Crop and Soil Environmental Sciences: M.M. Alley, James R. McKenna, Katy M. Rainey, Wade Thomason; Department of Forestry: Gregory S. Amacher; Agricultural and Extension Education: Rick Rudd
- Haiti Ministry of Agriculture and National Resources: Robert J. Badio
- Caritas/Hinche: Jacques Volcius, Augustin Guedry
- Zamni Agrikol: Gillaine Warne, Larose Deus, Stenio Louis-Jeune, Fereste Sonneus

The overall goal of the project is to test the hypothesis that adoptable CAPS for the social, economic and bio-physical conditions of Haiti's Central Plateau can be developed. The purpose is to determine if these locally adapted CAPS can improve smallholder livelihoods, significantly increase agricultural production, and restore agricultural production capacity. This goal and purpose is being examined through three research objectives:

Research progress by objective:

Objective 1: Assess the adaptability of existing agricultural production and livelihood systems for transformation into CAPS.

Critical research accomplishments

In December, the Virginia Tech team met to plan a January trip to Port-au-Prince and research sites at Corporant, Lachateau, and Maissade in the Plateau Central of Haiti. The research protocol for both the baseline study and in-field research was discussed and responsibilities for the implementation of these protocols were established. These matters were discussed at the Kick-Off Workshop on 11-12 January 2010 in Port-au-Prince. A major, devastating earthquake struck Haiti on 12 January (see Challenges and Response below), disrupting plans to begin surveys of households in early spring.

We have developed a survey instrument that focuses on adoption and retention of conservation agricultural practices, and also on adaptation of household decisions to climate, health, and

migration shocks for subsistence households in the Central Plateau. The instrument will also assess how market pressures and shifts in markets caused by the recent earthquake are affecting household decisions.

Two additional modules, in support of the cross cutting initiatives, have been added that will: (i) account for resource use within the household and research how interactions between male and female decision makers affects resource use and on- and off-farm decisions impacting natural environments, and (ii) explore information and relationship networks outside of the household that are important to household labor and farming/grazing decisions.

Development impact

This phase of the project is still under development and initial testing with the delay and redesign of the baseline survey.

Challenges and responses

Just 25 minutes after the conclusion of the January Kick-Off Workshop, Port-au-Prince was rocked by a 7.0 magnitude earthquake. The research team immediately postponed the field portion of their mission. Over the next two months, they monitored the situation in Haiti. The team decided to postpone the baseline study planned for spring due to the large number of internally displaced people from farm households in the Central Plateau and the challenges of recruiting a survey team with the university in ruins and classes canceled.

The earthquake delayed bringing a Haitian economist graduate student into the program this spring as planned. By mid-February, conditions in the Central Plateau allowed return of a Virginia Tech technical team to identify the research sites and present the research protocol to the agronomists at Zanmi Agrikol and Caritas. Based on findings from this visit, instrument design was altered as noted above, and the survey rescheduled for early spring of 2011.

We are now working on developing a sample frame and intend to begin pretesting the instrument and developing our survey infrastructure in December and January. Full blown survey sampling will begin in February.

Objective 2: Increase agricultural production through development of CAPS.

The goals of this objective are to research CAPS that deliver increased production capacity and improve soil quality. CAPS will be developed to address farmer production and livelihood priorities beginning with 'best bet' options particularly focused on improving water productivity, soil quality/fertility, soil organic matter (SOM), and developing higher productivity rotations. Tasks under this objective will include testing and integrating improved practices and inputs to establish viable CAPS through a series of on-station and on-farm research trials.

Critical research accomplishments

In March, experimental farm sites were established at partner sites at Corporant, Lachateau/Boucan Carre (Zanmi Agrikol), and Maïssade (Caritas). These sites occur at an elevation of 300 m or less. Research plots were identified, staked out, soil and bulk density samples taken, a percolation test conducted, and GPS/GIS coordinates obtained. Dr. Badio sent soil samples to the A&L Laboratory in Richmond, Virginia for nutrient analysis. These three locations will operate as main research and demonstration sites for CAPS practices. Farmers will then take selected best guess practices for testing in their own fields.

Initial results from soil testing indicate very low levels of plant-available phosphorus and zinc, which may limit crop productivity at all three sites. Acidity is not a factor at any of the sites. These soils are currently undergoing analysis for soil organic matter content and density fractions.

The local agronomists were trained in plot establishment research protocols. Haitian team members reviewed the research protocol and were provided the plot plans, bean seed, planting ropes, and data collection books. They were also provided a soil probe, milk scales, balance, min/max thermometer, rain gauge, and bean disease compendium for each site.

The initial research effort began with a focus on variety trials with maize and black beans. Variety trials are readily understood by farmers and offer a means of introducing important research concepts. Proper selection of varieties for CAPS development is likewise critical, and requires inclusion of the best adapted and preferred local varieties from the outset. Improved black bean varieties were identified and obtained from collaborators within the Pulses CRSP in Puerto Rico, and improved maize varieties were obtained from CIMMYT in Mexico. Dr. Badio took responsibility for receiving maize seed and for delivery to each research location.

On-farm black bean trials were established at two higher elevation locations (600-700m elevation) in April using CAPS techniques, including residue not being burned and minimal tillage. Grain yield and quality data was collected in July, and seed was prepared so the Zanmi Agrikol agronomists could replicate these trials at three high elevation sites (Bois Joly, Balandri, and Morne Michel), which will be harvested in October 2010. One black bean trial was planted to coincide with the second rainy season in July near Maïssade at the demonstration farm (300 m elevation) using conventional techniques.

Seed of 12 cover crop species was provided to agronomists from both NGO groups in July to initiate experimentation with and evaluation of this important component of CAPS. The cover crops are to be seeded into the maize crop after maize grain maturity with the goal of selecting the most appropriate species and developing year-round soil cover. Cover crops selected include velvet bean, lablab, sunn hemp, cowpea, sesbania, arrowleaf clover, crimson clover, yellow sweet clover, alfalfa, subterranean clover, soybean, and stylosanthes.

Development impact

Agronomists with both NGO groups, Caritas and Zanmi Agrikol, have gained experience with CAPS implementation. Similarly they have begun to learn appropriate field experimentation techniques and data collection protocols.

Challenges and responses

Two team members, including the lead-PI, were offered early retirement options, and were no longer available to work on the project, effective June 30. A new lead-PI joined the team in May.

The intended 'best bet' CAPS maize trials were not implemented due to delay in maize seed delivery. Post-earthquake infrastructure and communication disruption limited the team's ability to put resources in place this year. Recovery from this disaster continues and capacity is being restored.

Since maize seed was unavailable, and it was too late to plant black beans at the low elevation sites (Corporant and Lachateau), the decision was made to conduct two on-farm, replicated trials at nearby high elevation sites (see Objective 3). Black beans will be planted at Corporant and Lachateau in November. Because of delayed seed delivery and erratic summer rainfall, maize trials will be planted using reduced tillage without burning residue at the Zanmi Agrikol farms near Corporant and Boucan Carre in the dry season (December).

The rains arrived late in Maïssade, preventing site preparation, so there was no first season crop. Conventional planting methods (tillage) were used to establish a black bean trial at this site in July for harvest in October.

With the impacts of the earthquake at the State University of Haiti, and our inability to reestablish communications with faculty there, our connection to the University and its expertise was severed for several months. Several visits were made to the University in early October, and Dean Blaise and Vice Dean Carvil agreed to assign appropriate faculty to work with the project in a research and technical capacity.

Objective 3. Increase the capacity of smallholders to adapt and improve CAPS.

Critical research accomplishments

In April, black bean trials were planted using CAPS techniques (slashing existing vegetation with machete and planting with a planting stick) in grower fields at two sites. Farmers in Bois Joly and Balandri gained firsthand experience with these planting techniques and were able to observe the trials throughout the season and through harvest. On steep and stony sites such as these, reduced tillage planting practices may be readily accepted by farmers. These trials were harvested in early July. Grain yield and quality data were collected. In July, members of the

SANREM test met with farmers in Bois Joly and discussed the trials; specifically which types the local farmers liked and why. Local growers expressed a preference for one line in particular, not due to yield, but due to dry-down characteristics.

Farmer interest in these plots indicates potential for developing an on-farm research program using farmer managed plots.

Development impact

Agronomists from Zanmi Agrikol selected the most promising black beans from spring testing, and seed was bulked and seed multiplication was begun with planting in the second rainy season. If this method is successful, seed availability to local farmers will be greatly enhanced.

Challenges and responses

In January, all of the members of the Virginia Tech and Haitian teams met at the College of Agriculture (Damien) in Port-au-Prince for the Kick-Off Workshop. All facets of the project were introduced and discussed. After the workshop both teams visited the research sites, laid out the experiments, and discussed specific protocols. The earthquake delayed the tasks for this objective.

Haitian peasant farms are diverse and their needs vary by operation and location. Farmers on steep uplands understand that soil loss through erosion is their major concern, while those on floodplains near the rivers are more concerned with irrigation capacity. Proposed CAPS systems must be adaptable and the framework must be in place to facilitate that adaptation to these varied environments.

Degree and non-degree training activities

Degree training

In the first year we have recruited two US graduate students, Nathan Kennedy and Ryan Stewart, one working on a PhD (Resource Economics) and the other working on a MS (Crop and Soil Science). Attempts to recruit Haitian national and/or female students for degree training are being vigorously pursued.

Non-degree training

A kick-off workshop with all Virginia Tech and Haitian partners was held in January in Port-au-Prince, and Dr. Badio and the VT team members attended the SANREM Phase IV Kick-Off/2010 Annual Meeting in Blacksburg, VA in May. Several trainings in essential research protocols sessions have also been conducted with agronomists at Zanmi Agrikol and Caritas. At this point, 86 men and 18 women have received training during 7 separate training events. All except one of these individuals (a US citizen affiliated with an NGO) are Haitian.

Publications, presentations, and other SANREM CRSP products Publications include 12 presentations made during the Haitian SANREM CRSP Kick-Off Conference, and 1 presentation made during the SANREM Phase IV Kickoff/2010 Annual Meeting.

Networking activities

Major Networking activities have included at least two visits each to Port-au-Prince or to each of the three research sites by VT faculty (Thomason, Martin, Hodges). Within the Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR), the Director General, the Conseiller, and leadership of several Directions (Forests and Soils, Research and Documentation, Grasslands), have been introduced to the project and requested that we keep them informed of our progress. Recent visits to the Faculty of Agriculture and Veterinary Medicine (FAMV) at the State University of Haiti have included productive meetings with Dean Jacques Blaise, Vice Dean Carvil Nicholas, and several faculty members. The research team met with James Woolley, senior agronomist, on two occasions at the US Embassy/USAID offices. The last meeting resulted in additional contact with the Director/Party Chief of the WINNER project, Jean-Robert Estimé. Caritas has connections with Sustainable Development Committee of the Richmond Diocese in Virginia, and additional visits have been made to keep them informed of our progress.

Project highlights

Three research and demonstration sites focused on the development of adoptable conservation agriculture production systems have been established in the Central Plateau of Haiti, an important agricultural region without existing research facilities. These farms will work with smallholders, both on-site and in their own fields, to develop, test, and demonstrate locally-effective, research-based conservation practices that will enhance agricultural productivity and improve soil quality.

LTRA-7: Conservation Agriculture as a Potential Pathway to Better Resource Management, Higher Productivity, and Improved Socio-Economic Conditions in the Andean Region

Principal Investigator: Jeffry Alwang, professor, Department of Agricultural and Applied Economics, Virginia Tech

Host Countries: Ecuador, Bolivia

Research Team:

Virginia Tech: Department of Agricultural and Applied Economics: George W. Norton, Darrell Bosch

Penn State University: Department of Plant Pathology: Paul Backman; Department of Crop and Soil Sciences: Robert Sean Gallagher, Richard Stehouwer

University of Denver: International Development: Sarah Hamilton

U.S. Department of Agriculture Soil Plant Nutrient Research Unit: Jorge A. Delgado

Research progress by objective

Due to the recent start of the project, the research team has not yet made significant progress along the development pathway. While they have built networks and established research activities, it is too early in the process to claim a development impact; therefore, they are not reporting on impacts along the development pathway.

Objective 1: Identify and evaluate production practices and farming components that can be assembled into CA production systems for Bolivar, Ecuador and Tiraque, Bolivia.

Critical research accomplishments

Task 1.1: Establish field research design and identify locations for crop and cover crop research. This has been completed and the research team has farmer field trials being established in Ecuador and Bolivia. This design was established by using vulnerability maps produced as a part of the prior SANREM CRSP, through consultations with farmers and other stakeholders, and through consultations between the host-country and US research teams.

Task 1.2: Assess potential CA components for each farming system. The team conducted an assessment of feasible components. The SANREM team underwent three days of intensive planning and field visits to create a research plan for current and subsequent years (April 11-14 in Guaranda, Ecuador). April 11 was spent reviewing the proposal, reviewing research design and progress in Ecuador and Bolivia, and discussing alterations/enhancements to research design. During this meeting and the subsequent annual meeting in Blacksburg (May 2010), the research design was finalized.

Task 1.3: Identify the most likely full CAPS for each farming system.

Ecuador:

See table 1 for our most likely CAPS in Ecuador. This identification was completed during meetings in Ecuador and Blacksburg (May 2010), where inputs from participatory appraisals were considered. Subsequent CAPS were validated with focus groups in Bolivia and Ecuador.

Table 6: Description of CAPS in two cultivation systems, Ecuador

Illangama sub-watershed (Upper watershed)	Alumbre sub-watershed (Lower watershed)
Soil conservation practices: with and without deviation ditches	Soil conservation practices: with and without deviation ditches
Tillage: conventional and reduced.	Tillage: conventional and reduced.
Rotation: potato, barley, faba, and forage mix. Note: improved forage mix has been identified with prior research.	Rotation: hard maize, bush beans, hard maize, peas and hard maize.
Rotation: potato, barley, oats-vetch and forage mix.	Rotation: hard maize, bush beans, hard maize, oats-vetch and hard maize.
Management: Soil use (fallow, grass with residuals removed, grass with residuals retained), fertilization with N and cover crops (faba and quinoa).	Management: tillage options (conventional and reduced), cover crops (peas, oats-vetch, maralfalfa-- <i>Pennisetum sp.</i> and native trees)
Intensive pasture management (improved forages) with overseeding of clover.	Use of maralfalfa and fruit trees in contours to form live barriers.

Challenges and Responses

Our research toward this objective is proceeding exactly as planned. The only possible problem is related to the planting season; because the project was only started in January 2010, the team lost a complete year in their research, since most planting takes place in September-November. In Ecuador, they were able to continue prior SANREM research and establish new treatments corresponding to CA on some of their plots, but the bulk of the trials were not started until September 2010 and onward.

Objective 2: Validate candidate CAPS in terms of impacts on: soil health, soil retention, carbon and nutrient balances; sustained productivity; profitability; risk bearing; the environment; compatibility with household livelihood strategies; and social conditions including gender considerations.

Critical research accomplishments

Task 2.1: Create protocol for evaluating soil and crop sustainability in experiments: physical, chemical and biological changes over time and due to differences in practices. This has been completed through consultations with scientists at Penn State, the Soils CCRA, Dr. Delgado (ARS), and local partners. The team is currently gathering samples for a soils baseline.

Task 2.2: Establish experiments for CA components, component combinations, and full CAPS. The team has already begun field experiments in Ecuador. They are using a complete randomized block design (DBCA in Spanish) with a 2x2x2 factorial. Several parcels have already been divided. The principal parcel corresponds to factor “A” soil conservation practices. Sub-parcels include combinations of tillage combined with rotations. There are three repetitions in each experiment.

- Evaluation of cultivation systems, tillage systems, and rotations in potato (*Solanum tuberosum L.*), Illangama sub watershed, Ecuador.

Table 7: Treatments according to crop cycle

Treatment	Soil conservation practices	Tillage system	Rotations			
			1st cycle	2nd cycle	3rd cycle	4th cycle
T1	With ditches	Conventional	Potato	Barley	Faba	Forage mix
T2	With ditches	Conventional	Potato	Barley	Oats-vetch	Forage mix
T3	With ditches	Reduced	Potato	Barley	Faba	Forage mix
T4	With ditches	Reduced	Potato	Barley	Oats-vetch	Forage mix
T5	W/o ditches	Conventional	Potato	Barley	Faba	Forage mix
T6	W/o ditches	Conventional	Potato	Barley	Oats-vetch	Forage mix
T7	W/o ditches	Reduced	Potato	Barley	Faba	Forage mix
T8	W/o ditches	Reduced	Potato	Barley	Oats-vetch	Forage mix

- Evaluation of cultivation systems, tillage systems and rotations in hard maize (*Zea mays* L.), Alumbre sub watershed, Ecuador.

Table 8: Treatments according to crop cycle

Treatment	Soil conservation practices	Tillage system	Rotations				
			1st cycle	2nd cycle	3rd cycle	4th cycle	5th cycle
T1	With ditches	Conventional	Maize	Beans	Maize	Peas	Maize
T2	With ditches	Conventional	Maize	Beans	Maize	Oats-vetch	Maize
T3	With ditches	Reduced	Maize	Beans	Maize	Peas	Maize
T4	With ditches	Reduced	Maize	Beans	Maize	Oats-vetch	Maize
T5	W/o ditches	Conventional	Maize	Beans	Maize	Peas	Maize
T6	W/o ditches	Conventional	Maize	Beans	Maize	Oats-vetch	Maize
T7	W/o ditches	Reduced	Maize	Beans	Maize	Peas	Maize
T8	W/o ditches	Reduced	Maize	Beans	Maize	Oats-vetch	Maize

Variables and indicators are shown in Table 9

Table 9: Variables and indicators for field experiments

Variables	Indicators
Reduction of erosion	Depth of soil erosion
	Total weight of soil loss (in treatments in erosion controls)
	Apparent density
	Soil humidity
	Compaction
Soil nutrient dynamics	Nutritional content of plants (macro and micronutrients)
	Nutrient uptake by crop
	Plants harvested
	Dry-weight yield
	Chemical fertilizer efficiency
	Biomass production and total content of carbon and nitrogen
Available phosphorus	

The Ecuador team has conducted a preliminary analysis of the experimental results from the Illangama site, where they have harvested potato on three repetitions and from the Alumbre site, where they have harvested maize. These results only show impacts of two factors: conservation practices (with and without deviation ditches) and tillage practices (conventional and reduced tillage).

ANOVA analysis of yield shows no statistically significant difference between the treatments or with interaction effects (table 5). These preliminary results are shown for demonstration purposes only.

Table 10: Mean potato yields (t/ha). Illangama-Ecuador, 2010

Tillage system	Soil conservation regime		Mean
	With ditches	W/o ditches	
Conventional	8.43	9.67	9.05
Reduced	9.78	9.49	9.64
Mean	9.10	9.58	

The research team measured soil compaction up to 50 cm, expressed in Kgf/cm². They did not observe differences across the practices, but compaction is directly related (negatively) to soil depth, as expected. Given that this is the first year of experiments, they did not expect to find significant differences.

To determine apparent density they used the stove method and took samples at two depths (0 to 10 cm and 10 to 20 cm). Values are slightly lower at the lower depths, but they found no significant difference across treatments.

Their initial assessment of relative humidity similarly found no statistically significant differences across treatments.

Bolivia:

In Bolivia, they are also focusing on potato-based systems, but conditions in Bolivia differ from those in Ecuador, so they modified their approach. In particular, soil quality is extremely low, pathogen content is high, and the entire agricultural system is stressed by low levels of precipitation and soil moisture content. Growing cover crops in such conditions is a challenge, and soil health limitations require us to explore a variety of soil-health improving biological amendments.

Table 11: Treatments in primary experiment, Tiraque, Bolivia

	Year 1	Year 2, cycle 1	Year 2, cycle 2	Year 3
T1a	Fallow	Potato (RT)	Fallow	Faba RT
T1b	Fallow	Potato (RT)	Fallow	Faba C
T2a	Fallow	Potato (RT)	Harvested crop ^a	Faba RT
T2b	Fallow	Potato (RT)	Harvested crop ^a	Faba C
T3a	Fallow	Potato (RT)	Cover crop	Faba RT
T3b	Fallow	Potato (RT)	Cover crop	Faba C
T4a	Harvested vetch (residue retained)	Potato (RT)	Fallow	Faba RT
T4b	Harvested vetch (residue retained)	Potato (RT)	Fallow	Faba C
T5a	Harvested vetch (residue retained)	Potato (RT)	Harvested crop ^a	Faba RT
T5b	Harvested vetch (residue retained)	Potato (RT)	Harvested crop ^a	Faba C
T6a	Harvested vetch (residue retained)	Potato (RT)	Cover crop	Faba RT
T6b	Harvested vetch (residue retained)	Potato (RT)	Cover crop	Faba C
T7a	Incorporated vetch	Potato (RT)	Fallow	Faba RT
T7b	Incorporated vetch	Potato (RT)	Fallow	Faba C
T8a	Incorporated vetch	Potato (RT)	Harvested crop ^a	Faba RT
T8b	Incorporated vetch	Potato (RT)	Harvested crop ^a	Faba C
T9a	Incorporated vetch	Potato (RT)	Cover crop	Faba RT
T9b	Incorporated vetch	Potato (RT)	Cover crop	Faba C

RT=reduced tillage; C=conventional tillage

^a Likely quinoa

Complementary experiments, Bolivia. In addition to these primary experiments, we will have several side treatments:

- Impact of the micro organism *bacillus subtilis* on phosphorus solubilization and on the incidence of plant diseases such as *Rizhoctoniasis* in potato.
- Effect of application of mineral fertilizer on vetch productivity (two levels of treatment—high and low).
- Impacts of alternative cover crops on soil health, productivity, and moisture content.
- Tillage in potato: conventional, reduced, and minimum tillage
- Potato variety evaluation: Waych'a (*andigena*), V2 = Desiree (*tuberosum*)

Task 2.3: Create and follow protocol for measuring economic dimensions of CAPS. These dimensions include fixed and variable costs of practices, productivity and profitability (including rotation effects and incorporation of new products), labor and time requirements,

impacts on risk and variability, and gender roles. Each country team has been provided a template for collecting the needed data. Consultations held at the two meetings (see above) indicate no obstacles to such data collection. Field trials will provide information on rotational effects.

Task 2.4: Adapt the Mexican nitrogen index tool to conditions in Ecuador and Bolivia.

Drs. Delgado and Gallagher visited Bolivia and Ecuador to establish protocols for collecting the data needed to calibrate the nitrogen index model. A version of this model is available in the programming language Java. Farmers and extension agents in the US and Mexico use it to estimate plant uptake and losses of nitrogen in different cropping systems in order to develop nitrogen application recommendations. Data from experimental trials conducted during the prior phase of SANREM were instrumental in calibrating the model. In their SANREM research, they collected information on soil total nitrogen, nitrates (NO₃), ammonia (NH₄), texture, apparent density, compaction, organic matter content, and the carbon-nitrogen relationship. This data was used to calibrate the model during a month-long training conducted by Dr. Delgado at the ARS laboratories in Fort Collins, CO. Luis Escudero, Carlos Monar (Ecuador), and Ana Karina Saavedra (Bolivia) participated in this training. The team worked on completing two publications on the application of the nitrogen index in each country. A Java prototype of the index has already been created in English and Spanish and is being tested and validated.

Challenges and responses

Research toward this objective is proceeding exactly as planned.

Objective 3: Promote adoption of the most appropriate CAPS by identifying mechanisms to increase their profitability.

The bulk of the research toward this objective will begin in years 2-3 of the project. In the current year, some steps were taken in task 3.1.

Critical research accomplishments

Task 3.1: Explore the potential for increased local input production. The main focus of work this year has been to further refine biological controls and biological inputs for improved productivity. PROINPA (Bolivia) has a well-developed capacity (a bio-control production facility) to produce biological organisms, but work is needed to refine the particular isolates. We are examining steps to use *Bacilli* from quinoa to control quinoa diseases. At Penn State, several experiments have been performed to isolate endospore-forming *Bacilli* from *Chenopodium quinoa* seeds. This work is ongoing. Isolates that are verified to form endospores will be checked for their ability to solubilize phosphate by utilizing the National Botanical Research Institute's phosphate growth medium. Cultures will be tested for their ability to colonize *C. quinoa* in growth chamber assays and promote growth of *C. quinoa* in a low-phosphate Andean proxy soil (actually a soil from the state of Washington with similar soil attributes to Altiplano soils).

The research team established protocols for incorporating locally produced biological controls into our CAPS treatments.

Challenges and responses

Our research toward this objective is proceeding exactly as planned.

Objective 4: Design and evaluate mechanisms for disseminating results to similar areas.

Work on this objective was not started during the current year. This was consistent with the initial work plan submitted during preparation of the revised project proposal and our approved Year 1 work plan.

Objective 5: Evaluate overall impacts of the CRSP research program along several dimensions including soil health, productivity, economic, social and environmental.

The bulk of the research toward this objective will begin in years 2-3 of the project.

Critical research accomplishments

Soil health and productivity impacts:

- Baseline soil samples have been taken on our farmer fields. Some of the analysis will be conducted locally, some will be conducted at Penn State, and some at Virginia Tech by the soil CCRA. We are following soil CCRA protocols. Analysis has not been started.
- Protocol for measuring erosion loss under different CA management practices has been established (see above and below for details).
- Training in use of nitrogen index has been undertaken. This tool will be used by research teams to evaluate nitrogen needs in our research sites and to adjust nutrient application recommendations to changing conditions.

Economic and social impacts:

- Have established protocols for collecting data on costs for all field experiments (in conjunction with the economic analysis and impact CCRA). These costs include fixed (equipment) and variable costs, including family labor use in cultivation and harvest.
- The project is collecting market data on input and product prices. Regular market surveys are being undertaken.
- Regular participatory assessments are being conducted in areas where field experiments are being undertaken. One purpose of these assessments is to identify and evaluate unanticipated social impacts or obstacles to CA diffusion.

Environmental impacts:

- The team agreed on research protocol within soil erosion test plots. These plots include metal-demarcated boundaries, erosion collection points, and mechanisms for monitoring

rainfall events. They had been established under the prior SANREM project to measure the relationship between weather events and soil loss, conditioned on management practices. The current SANREM team agreed that these experiments should continue. Table 4 shows some of the indicators being collected in these experiments.

- During the annual meeting in Guaranda, Ecuador, Dr. Flowers presented and discussed his efforts during the previous SANREM phase to monitor water quality using counts of macro-invertebrates. He explained that such measurement would be relatively inexpensive to continue and could be used to engage local stakeholders (particularly young people) in the project. The team agreed and Dr. Flowers worked to reinstitute the water quality monitoring program.

Challenges and responses

Our research toward this objective is proceeding exactly as planned.

Objective 6: Strengthen the capacity of government and non-government institutions to develop and disseminate CAPS in the Andean regions of target countries

Critical research accomplishments

Task 6.1: Conduct gender sensitivity training for all project staff. Collect data on participation rates by gender and by disadvantaged groups.

During the current year, an important objective was to promote gender equity among team members and stakeholders as much as was possible. For example, the Ecuador team and partner institutions participated in the international workshop “Gender and participatory methodologies in agricultural research.” This workshop was presented by Maria Elisa Christie from 7-10 April in Guaranda. Recommendations from participants in this workshop were subsequently adopted by the research team. One clear problem is the imbalance between men and women in the research team (75 percent male, 25 percent female).

The teams in both countries have already taken concrete steps to improve female participation in training events and this representation has grown in recent years. In Illangama, the women’s inability to speak Spanish was identified as a problem and we have hired two bilingual assistants to address this problem.

Table 12: Indicators of female participation in SANREM CRSP-Ecuador, 2010

Indicators	Number
1 Number of female scientists in research team	2
2 Males in research team	6
3 Women participating in short-term training	0
4 Men participating in short-term training	2
5 Female extension agents working directly with farmers	5
6 Gender-focused activities, current year	2

Challenges and responses

Our research toward this objective is proceeding exactly as planned.

Degree and non-degree training activities

Currently, four students (all female) are engaged in SANREM-related long-term degree training. Two (US citizens) are seeking PhDs in Plant Pathology at Penn State and two are seeking PhDs in Agricultural and Applied Economics at Virginia Tech (one is Bolivian). All but one is receiving substantial co-funding from departmental sources. The team has also identified undergraduate honors students in Bolivia and Ecuador (one in each country, both women) who will conduct thesis research on the project.

We have had eight workshops, one seminar, one short course and one field day, with a total of 386 attendees.

Publications, presentations, and other SANREM CRSP products

These have been entered in SKB.

Networking activities

Country teams have worked diligently to promote linkages with universities and other researchers, USAID-sponsored projects, and other donors. Linkages with local institutions have also been solidified.

Ecuador:

- Víctor Barrera and Elena Cruz participated in a workshop at Centro Internacional de la Papa (CIP—the International Potato Center) in Lima, Peru, to discuss linkages between SANREM and an ongoing project to evaluate vulnerability among small-scale producers in the Andean highlands. The projects are now coordinating their activities and sharing findings.
- The SANREM team in Ecuador has received \$500,000 (\$100,000 has already been disbursed) funding from SENACYT (the Ecuador NSF equivalent) to conduct a project based on SANREM conceptual framework in Saraguro, Ecuador. This project will last two years and will focus on means of promoting CA for food security in a dry and vulnerable region. This is the same area of the country where Victor Barrera conducted his dissertation research under prior SANREM activities.

- The SANREM team presented another proposal to SENACYT on integrated watershed management and CA. This proposal has not yet been approved, but indications are favorable.
- Several informal and formal linkages have been made with Bolivar and Saraguro Provincial Councils to develop CA for water quality improvement.
- The SANREM team participated in USAID-sponsored review of projects related to environmental management in Quito, August 2010.
- The SANREM team met with the mayor of Chillanes. He indicated that he was interested in exploring the potential for value-added processing of blackberry in the area (Chillanes currently has more than 1,200 of Ecuador's total land area of 6,000 hectares in blackberry). Such an investment would improve returns to blackberry producers and thus make CA more profitable in the region.

Bolivia:

- The SANREM Team (Alejandro Bonifacio and Javier Aguilera from PROINPA, Alwang and Backman) met with the leadership of the USAID-funded "Proyecto Integrado de Seguridad Alimentaria" (PISA), an integrated food security project. Present at the meeting were Ricardo Roca (USAID), Sergio Claire (PISA Director), Gonzalo Avila (PISA Vice Director), Boris Fernandez (PISA Biodiversity Specialist), Cesin Curi (Director CPTS—Sustainable Production Technology Center—an NGO working on quinoa for PISA). PISA made a presentation on the nine components of their integrated project which include, among other things, components to address production and marketing systems, quinoa, biodiversity conservation, adaption to climate change, health, and infrastructure. It is clear that the project needs specialized technical help in a number of areas related to agricultural production constraints, soil quality, and impact assessment.
- The SANREM Team met with representatives of USAID-supported organic cacao promotion program (the Actividad Rural Competitiva, or ARCo). The purpose of meeting was to discuss potential collaboration with SANREM. This project provides full assistance to the cacao value chain in Alto Beni (Yungas province).

Project highlights

- Experimental trials have been designed and protocols for measuring key variables have been established.
- Gender training for both country teams has been completed.
- A nitrogen index prototype has been developed. This tool will assist farmers and extension agents in evaluating nitrogen balances without resorting to costly soil chemical evaluations.

LTRA-8: Improving Soil Quality and Crop Productivity through Farmers' Tested and Recommended Conservation Agricultural Practices in Cropping Systems of West Africa

Principal investigator: P.V. Vara Prasad, associate professor, Department of Agronomy, Kansas State University

Countries: Ghana, Mali

Research team:

- Kansas State University: Department of Agronomy: Scott A. Staggenborg, Charles W. Rice, DeAnn Presley; Department of Agricultural Economics: Timothy J. Dalton, Kevin Dhuyvetter; Department of Plant Pathology: Karen Garrett; Department of Biology: Ari Jumponen; Department of Sociology, Anthropology, and Social Work: Theresa Selfa; International Agricultural Programs: Nina Lilja
- Savanna Agricultural Research Institute (SARI): J.B. Naab, I. Yahaya; S.S. Seini, M.A. Askia
- Wa Polytechnic: P.H. Momori
- Institut d'Economie Rurale du Mali (IER): M. Doumbia, K. Traore, P. Sissoko, A. Berthe, O. Samake

Research progress by objective

Objective 1: Evaluate local CAPS Critical Research Accomplishments

Ghana: Baseline surveys of local CAPS and socio-economic aspects were conducted at all sites. The total number of participants in the surveys was 358 (201 men and 157 women). The main components of CAPS identified were minimum tillage, crop rotations with soybean, residue management, soil moisture conservation practices, and fertilizer and weed management.

Mali: Baseline surveys of local CAPS were conducted at the sites in Fansirakoro and Konobougou. Surveys for Cinzana, Noyaradougou (Sikasso), and Lagasagou (Mopti) have been delayed to avoid interference with farmers' activity at the onset of the rainy season. Critical findings from the two sites were (i) 'permanent ground cover with either cover crop or crop residues' strongly conflicts with a key component of the farming systems, livestock management, and (ii) 'rotation with a legume' will be most convenient with peanut, which is the crop often grown by women on lands (usually degraded) allocated to them.

Development impact

The impact sought is the development and adoption of local CAPS, which include selected components of the SANREM approach. The farming communities have learned about these components, but they only found them partially compatible with local practices.

Challenges and responses

In Mali, the timeline of this objective was not met in three of the sites in Mali. However, a rapid, rural appraisal was made in each of these sites to get an idea of farmers' perceptions to the SANREM approach of conservation agriculture. Rain water harvesting was identified as critical for all the agricultural regions/cropping systems, except Mopti. At Mopti the soil is mostly sandy and flat which makes water harvesting difficult due to percolation losses and the challenge of making ridges in loose soil.

Objective 2: Develop Cropping Systems

Critical research accomplishments

Ghana: On-farm and on-station tests are being implemented in cooperation with partners in Upper West region of Ghana. Cropping systems mainly include maize and soybean. Soil samples were collected prior to the start of each experiment for analysis. Data collection is in progress and data on yield and yield components will be collected at harvest.

Mali: On-farm (8) and on-station (8) tests are being implemented in 4 agricultural systems in Mali. These tests involve 60 farmers. Cropping systems mainly include cereal (maize, sorghum, millet) and legume (cowpea and peanut). Soil samples were collected prior to setting each experiment for laboratory analysis. Crop data such as plant density and height have been collected. At harvest, grain and total biomass data will be collected.

Development impact

These participatory tests (in both designing and implementation) are a key milestone towards developing local CAPS. Brainstorming with local partners on how the SANREM approach might be adapted to local cropping systems began the process of building awareness regarding the local potential of CAPS.

Challenges and responses

In designing the tests, the ground cover component conflicted with local conditions of each site/cropping system. Management of crop residues has been included as a better alternative. Cover crops (using legume or grass to cover the soil during offseason) were found to be 'inappropriate' mainly due to free grazing of animals, cost of seed and lack of economic value and alternative uses such as food or forage. The rainfall was very erratic (initial rains in May followed by prolonged 5 week drought, again followed by heavy rains in Aug) which caused delays in planting and caused flooding in some experiments.

Objective 3: Foster and Advance Rapid Adoption of Local CAPS and Integrated Practices

Critical research accomplishments

Initial testing of CAPS (on the basis of discussions with farmers) has been initiated in each site through baby trials using several farmer field trials as replications. These baby tests involve few components of CAPS. Cross-cutting research activities were started. The rapid rural appraisal conducted in these sites has confirmed most of the findings listed in Objective 1 (evaluation of local CAPS).

Development impact

On-farm testing was initiated in each site and cross-cutting issues were assessed in selected sites (locations). The initial phase of adoption of CAPS was achieved: sharing with the local farming communities components of CAPS.

Challenges and responses

The timeline is being met. The challenge of permanent ground cover still remains and needs to be addressed. However, the research team will collaborate with other on-going projects that are testing cover crops (e.g. cover crops tests at the Sotuba research station funded by EMBRAPA).

Objective 4: Assess Long Term Effects of CAPS

Critical research accomplishments

Ghana: A total of five long term experiments are being implemented. Soil samples were collected prior to setting each experiment for laboratory analysis. Crop data such as plant density and height have been collected. At harvest, grain and total biomass data will be collected.

Mali: A total of eight long term experiments are being implemented at four research stations. Soil samples were collected for laboratory analysis prior to initiation of each experiment. Crop data such as plant density and height have been collected. At harvest, grain and total biomass data will be collected.

Development impact

A minimum data set is being collected in each of these long term experiments. The tests will be partially conducted at host country and samples will be sent to the US for further analyses.

Challenges and responses

Determination of minimum dataset for soil analyses was a challenge. However, initial soils samples were collected and based on availability of resources most of items indicated in minimum dataset will be met. All the components of CAPS could not be implemented, as no cover-crop treatment was included. This was identified by farmers as the most difficult and

they did not want to include this component due to conflict with livestock management. We will see opportunities and necessary adjustments will be made for the next cropping season.

Objective 5: Modeling to Predict Impacts of CAPS

No task was planned for the first year of the project.

Objective 6: Assess the Cost and Benefits of Training and Transfer Activities

No task was planned for the first year of the project.

Degree and non-degree training activities

Field days were organized in Ghana at two locations and farmers from other sites and neighboring villages were invited. There was active interaction and participation. More than 150 farmers participated in these activities. There were both men and women (about 30 percent) who participated in these activities. In Mali, no workshop/demonstration was made during this first year of the project.

Ghana: Two candidates were identified for long term training. One candidate did not meet the GRE score requirement for admission at Kansas State University, and he is taking the exam again. Another candidate is currently pursuing a MS, and will start his program next summer.

Mali: No short and long (degree) term training was performed during this first year of the project. Penda Sissoko, identified as a potential candidate, failed to apply. Other candidates are currently being identified.

Publications, presentations, and other SANREM CRSP products

Prasad PVV, Dalton TD, Naab JB. 2010. Improving Soil Quality and Crop Productivity through Use of Conservation Agricultural Practices. USAID - Ghana Mission.

Naab JB, Prasad PVV and Dalton TD. 2010. Sustainable Agricultural and Natural Resource Management - Collaborative Research Support Project - Ghana Program. Scientific Committee of Savanna Agricultural Research Institute, Tamale, Ghana.

Doumbia M. 2010. SANREM Project Components - Mali. Presentation to Scientific Committee of IER, Mali.

Prasad PVV. 2010. Impact of Climate Change on Productivity of Food Grains Crops. Presentation at Indian Council of Agricultural Research - Soil and Water Conservation Research Training Institute, Ooty, Tamil Nadu, India.

Prasad PVV. 2010. Impact of Climate Change on Productivity of Food Grains Crops. Presentation at Tamil Nadu Agricultural University, Coimbatore, India.

Networking activities

Collaboration/integration of activities has been initiated with the following projects/programs:

- Integrated activities of the project funded by INTSORMIL in both Ghana and Mali
- Up-scaling the contour-ridge tillage project funded by the USAID Mission of Mali
- The minimum tillage and cover crop project funded by EMBRAPA in Mali

Project highlights

Key critical findings, results and impacts include:

- The components of the SANREM approach of CAPS were shared with local communities of each site. This approach has already been shared with other agricultural stakeholders during the kickoff workshop and again during the meetings with stakeholders during the cropping season.
- Components of CAPS to be evaluated were identified and long term experiments (on-station and on-farm) were initiated through mother trails. The treatments mainly included minimum tillage, residue management, crop rotations, water harvesting techniques, integrated fertilizer and weed management practices. Similarly, evaluation of selected components through baby trials was initiated.
- The component of CAPS dealing with permanent ground cover conflicts with a key component of farming: livestock management. Cover crops were found to be inappropriate by farmers. Management of crop residues was selected by farmers as a better alternative; however, managing the residue is challenging.
- Visits will be organized for selected leaders of each site to the EMBRAPA experiments that test different cover crops at the Sotuba station in Mali. This is expected to improve farmers' perception and adoption of CAPS.

LTRA-9: Developing Sustainable Conservation Agricultural Production Systems for Smallholder Farmers in Southern Africa

Principal investigator: Neal Eash, associate professor and soil scientist, Department of Biosystems Engineering and Soil Science, University of Tennessee

Countries: Lesotho, Mozambique

Research team:

- University of Tennessee: Department of Biosystems Engineering and Soil Science: Forbes Walker; Department of Agricultural and Resource Economics: Dayton Lambert, Michael Wilcox
- National University of Lesotho: Department of Soil Science: Makoala Marake
- International Maize and Wheat Improvement Center (CIMMYT): Global Conservation Agriculture Program: Patrick Wall
- Growing Nations: August Basson

Research progress by objective

Objective 1: Integrate cover crops into CAPS to protect soil from erosion, provide weed suppression or control, include crop rotations that provide forages for livestock, improve soil quality as measured by soil carbon, decrease risk and vulnerability to drought.

Cover crops have been evaluated during the winter (August 2010) in Lesotho and their effects will be monitored through the early maize growing season. Maize yields from research plots in Lesotho are economically viable using expensive fertilizer inputs. The goal is to use legume cover crops for biological nitrogen fixation; hence the ongoing cover crop evaluation.

Discussions with collaborators in Mozambique are forthcoming with the intent to discover mutual agronomic and socio-economic research questions between the two best bet CAPS in both countries.

Objective 2: Determine the agronomic and economic fertilizer rate for maize in both the basin and machine no-till methods.

Fertilizer rate studies were completed and the research team anticipates no changes to the protocol for this year so that two site-years of data can be evaluated. This year they plan to assess minor refinements to the fertilizer rates to determine if the design needs to be changed for Year Three. Maize yields surpassed 6 t/ha. Discussions with collaborators in Mozambique are forthcoming.

In Lesotho the research team made some progress understanding the overall potential of the conservation agriculture systems. Once they have the yield data analyzed, they will collate the results and assess what changes need to be made for the upcoming season. In Mozambique they hope to meet soon with our collaborators and figure out ways and means to assist their

respective research and outreach programs. The biggest lesson learned is the age old lesson one hears about Africa—you can never have too much seed or fertilizer on hand prior to the planting season. In Lesotho they will have more seed and fertilizer stockpiled a minimum of one month prior to the onset of the rainy season.

Objective 3: Characterize the composition and contribution of N and C from legume/grass cover crops and determine the best species for maintaining soil residue cover until after maize crop harvest.

Different cover crop species have been planted in Lesotho and will be evaluated for N and C composition during the winter growing period. Species evaluated include pink seradella (*Ornithopus sativus*), rose clover (*Trifolium hirtum*), subterranean clover (*Trifolium subterranean*), sweet clover (*Melilotus officinalis*), grazing vetch (*Vicia sativa*), and sweet vetch (*Hedysarum L.*) Similar work will be initiated in Mozambique following discussions with collaborators. The team plans to measure carbon flux at the Lesotho site in November 2010.

Objective 4a: Determine the short- and long-term impacts of CAS on gender equity especially in terms of household income and economic impact and to involve women in decisions that impact their welfare.

While in Lesotho in January 2010, the research team discussed how to determine the impacts of CAPS. Impromptu, semi-structured interviews were conducted with women engaged in CAPS to gain initial insight in how CAPS has been introduced, motivation for adoption and expectations for incentives and outcomes.

The team developed a baseline household survey that will be field tested and implemented November/December 2010 in the Botha-Buthe District. Development of the survey was in concert with partners from Lesotho, including Dr. Marake (National University of Lesotho), Jaap Knot (Free State University), John Hebblethwaite (Growing Nations), and Keith Moore (SANREM ME).

Working with Pete West (Director of a conservation agriculture NGO based in Botha-Buthe) and Dr. Marake, the team is finalizing a list frame from which to sample households in the Botha-Buthe district. The list frame combines census information from the Lesotho Bureau of Statistics and information about extension efforts regarding CA (the “likoti” or pothole system, in particular). They will also combine this information with a list frame of villages in which the Lesotho Ministry of Agriculture has been working with larger scale, mechanized farms using conservation cultivation methods.

Objective 4b: Evaluate ways and means to improve fertilizer adoption rates among smallholder farmers, the degree to which market structure influences fertilizer use, and determine welfare implications based on price margins.

Field research during the current growing season will provide data to assist with understanding fertilizer economics in smallholder maize production. Preliminary secondary data, in the form of spot prices for key inputs and outputs in Lesotho, were obtained from contacts whose acquaintance was developed and strengthened during the trip in January/February. Work in the coming year will further investigate market networks, supported by input and commodity price information collected in November/December. Break even yields analyses based on production data from this season are being summarized and presented at the Soil Science Society of America Meeting in Long Beach, CA, in November 2010.

Degree and non-degree training activities

The team has two U.S. graduate MS student working on this project and hope that another female Lesotho graduate student will enroll at UT early in 2011. As can be seen from the short-term training table, we have provided training for many people on the principles of conservation agricultural systems. Overall, 1,122 people have been trained. Of these, 541 were female and 581 were male. Approximately one-third was field day attendees and the rest were involved in more formal training. The team included training of pastors and church leaders which increased the number of men trained.

Publications, presentations, and other SANREM CRSP products

The research team developed an internal database that houses all of the articles, reports, data, and other information that has been generated in the literature and by partners or directly by the project team. This information is available to everyone in our immediate project team and is serving as the foundation of our literature review and intercontinental workspace. All SANREM personnel are welcome to access this database and include their research as they deem appropriate. We have also submitted a PERSUAP application and anticipate approval of this document.

Networking activities

In early February they met with the U.S. Ambassador to Lesotho, Robert Nolan along with Craig Anderson (Management Counselor), Elizabeth Power (Deputy Chief of Mission), and Sara Devlin (PDEP Officer) to discuss USAID objectives. The team met with them for an hour, and discussed ongoing demonstrations and research. The ambassador and his staff were enthusiastic in their support for this work and planned to visit the research site in Maphutseng.

We look forward to networking with our collaborators in Mozambique as soon as the sub contract is complete.

Project highlights

- More than one thousand people have had some training on conservation agricultural systems; of these, nearly one half were female.
- Maize yields on the research site exceeded 6 t/ha, more than twenty times the national average for maize yields in Lesotho.
- Several species of winter cover crops were successfully established and evaluated for winter annual weed suppression.

LTRA-10: Development and transfer of conservation agriculture production systems (CAPS) for smallholder farms in eastern Uganda and western Kenya

Principal investigator: Jay Norton, assistant professor of soil fertility, Department of Renewable Resources, University of Wyoming

Host countries: Kenya, Uganda

Research team:

- University of Wyoming: Department of Management and Marketing: Eric Arnould, Melea Press; Department of Plant Sciences: Urszula Norton; Department of Agricultural and Applied Economics: Danelle Peck
- Makere University: Department of Agricultural Economics and Agribusiness: Bernard Bashaasha
- Moi University: School of Agriculture and Biotechnology: John R. Okalebo
- SACRED Africa: Eusebius Mukhwana
- AT Uganda: Rita Ojok
- Manor House Agricultural Center (MHAC): Emmanuel Omondi

Research progress by objective

Objective 1: Compile information for prototype CAPS development. Form stakeholder advisory groups for each area.

Critical research accomplishments

Task 1: Gather information on existing local/regional CAPS: survey past/ongoing agricultural development work in the region. Initial field visit for entire team took place during last two weeks of March. During the trip the team met, exchanged information, and discussed potential collaboration with the several organizations.

Information gleaned from these meetings informed development of the baseline survey (Task 2). Important preliminary conclusions include:

- Though there are many alternative crops and cropping systems being developed and introduced to farmers, as well as programs in place to subsidize fertilizer purchases and improve access to fair markets, there is little adoption by the farmers surveyed. Most do not have access to fertilizer subsidies for a number of reasons, and describe unfair market practices as a major problem.
- Continuous maize production that includes plowing twice before planting and two deep weedings with hand hoes is practiced on most of the land in all the districts. There are differences in practices, such as intercropping with beans, use of fertilizers, use of

improved varieties, use of pesticides, plowing traction, and second-season crops, but intense, repeated tillage is the norm.

- Alternative tillage practices that reduce disturbance and leave more residue on the surface are not on the agenda of large research organizations, but are being promoted by at least two NGOs: ACT and KENDAT, Nairobi.

Task 2: Develop survey instruments to identify agronomic and socio-economic constraints to CAPS, and develop strategies for reaching various demographic groups. Survey instruments were developed in a participatory and consultative manner with the involvement of all team members. They were finalized during a face to face meeting between partners of all three NGOs at Manor House Agricultural Centre (MHAC), Kitale, in mid July. Cross-cutting research priorities, including gender and technology networks, were incorporated during the visits of Keith Moore and Maria Elisa Christie from Virginia Tech to Kenya and Uganda, respectively. The survey instrument is available upon request.

Task 3: Carry out baseline field interviews. Baseline field interviews were conducted in all four project districts during July and August. Eight hundred household interviews were conducted (200 per district). Half of the selected respondents were women. Surveys were conducted using the following guidelines developed during the July meeting at MHAC:

1. Two hundred interviews were conducted per district/ location, (100 at each of two sub-locations). In each sub-location two communities were selected, one experimental and one control. Therefore each district had four subsamples of 50 households each – 25 male respondents and 25 female respondents.
2. Within each sub-location a complete sample frame of all households was developed, making sure that female-headed households were included.
3. From the sample frame, 50 households were randomly selected using a systematic sampling from a random start.
4. Out of the selected 50 households, female-headed households were removed and put on the female interview list. The number of additional female interviewees needed to make 25 female interviewees was then calculated. That number was then randomly selected from the list of selected households so that two sublists of 25 – one for women and one for men -- were created.
5. Dr. Keith Moore's questions about technology networks were asked in one location in each catchment area and not in the other, so he will receive 100 questionnaires from each study area.

A Microsoft Access data entry template was developed at Makerere University and forwarded to each of the participating NGOs. Uganda data entry (400 interviews) is being completed by a SANREM-funded Makerere University MS student under supervision of team member Bernard Bashaasha. Data entry for the Tran Nzoia, Kenya study area (200 surveys) is being supervised by MHAC and for the Bungoma study area by SACRED Africa. Data entry was about 30 percent complete at the time this report was submitted.

Task 4: Participatory rural appraisal (PRA) exercises at focus group meetings in each area.

The focus group data collection approach was developed to complement the baseline survey data. So far a total of five PRA exercises have been conducted in Uganda. The topics include the following:

- Gender – Kapchorwa, June 25th
- Labor Constraints – Tororo, Sept 6th
- Livestock Interactions – Tororo, Sept 7th
- Labor Constraints – Kapchorwa, Sept 9th
- Livestock Interactions – Kapchorwa, Sept 10th

These exercises produced a wealth of information on the local farming systems and the constraints that will affect the adoption of proposed CAPS. Summaries of the meeting results are available upon request. The SANREM-supported MS student from Makerere University participated actively in the exercises.

A final gender focus group in Tororo is planned for late October. The two Kenya NGO partners have similar focus-group discussions planned for late October 2010.

Task 5: Analyze and summarize baseline information to identify socio-economic and agronomic constraints that prototype CAPS must address. Development of the Access database for data entry caused delays in this task, but data entry is currently under way and the team anticipates completion by October 30, 2010. At this time the data will be analyzed and combined with outcomes of the focus group discussions. In doing so, the will refine the study design for evaluating CAPS in each study area developed in advisory group meetings (Objective 2) to be held in early October, 2010.

Task 6: Identify and enlist stakeholder advisory group participants in each study area based on NGOs and host-country universities' existing relationships and interviews. Farmers and other stakeholders were identified during the baseline interviews and focus groups. They were invited to participate in CAPS planning meetings for each area planned for mid-October. These stakeholder advisory committees include links to organized farmer groups in each of the program areas who have expressed interest in participating in the on-farm CAPS trials in the coming season.

Development impact

Activities carried out under Objective 1 were successful in broadening project partnerships to include local farmers, research station managers, input vendors, development workers, and other stakeholders in each of the four study areas. The activities set the stage for advisory group meetings (mid October, 2010), to enlist project advisors agreeing to serve for the duration of the project. Objective 1 activities will enable successful co-design of testable CAPS for each study area where local participants have a real stake in the design and outcomes of the research. This is crucial underpinning for successful field research, as well as for potential CAPS adoption and long-term development impact as the project is implemented.

Challenges and responses

Close interpersonal relationships and frequent communication among all the partners have provided for remarkably smooth accomplishment of the baseline survey and initial focus group meetings. The only challenge has come from delays in data entry, but this has only put the team one month behind schedule. This will not impact implementation of the CAPS research because there is still ample time to define and implement the trials by the next planting season in February and March, 2011.

Objective 2: Define traditional systems and prototype CAPS for each area, based on local knowledge and agronomic/socio-economic constraints.

Implementation of Objective 2 activities has been pushed back one month to October 2010. The team is conducting these activities as this report is being written.

Objective 3: Establish protocols and initiate testing of agronomic, ecological, and economic sustainability of CAPS versus traditional practices.

Objective 3 activities have also been pushed back to the first part of Year 2. The team is meeting now to discuss research design details.

Degree and non-degree training activities

The research team has recruited six host country graduate students, two females and two males from Kenya, and two males from Uganda. Three of them are beginning degrees at the University of Wyoming (one MS, two PhD; one female, two males). One male student is beginning an MS degree in agricultural economics at Makerere University in Uganda, and one female and one male are beginning MS degrees in soil science at Moi University in Kenya.

Publications, presentations, and other SANREM CRSP products

We anticipate that baseline and focus-group activities conducted in Year 1 will support peer-review and outreach publications. A poster presentation is in preparation for the Green Revolution 2.0 – Advances in the Green Revolution in Africa symposium at the 2010 meetings of the American Society of Agronomy in November.

Networking activities

Year 1 of the project focused on Networking activities, starting with assembling the extended team and enlisting everyone from university accountants in Wyoming to smallholder farmers in Kenya and Uganda to help make it successful. The most important Networking activities included the following:

1. The March, 2010, trip to the host countries in which the five University of Wyoming PIs met host-country partners and traveled with them to meet important players in

agriculture research and development and local farmer/stakeholder opinion leaders in our study areas. Participants included:

- CIAT Tropical Soil Biology and Fertility Program, Nairobi. Drs. Saidou Koala, AfNet coordinator, and Dr. Pieter Pypers, soil scientist;
- Kenyan Network for Dissemination of Appropriate Technology (KENDAT), Nairobi and conservation agriculture field site near Mwea, Dr. Joseph Mutua;
- USAID Kenya Mission, Nairobi. Allen Fleming, Director, Agriculture, Business and Environment Office, and Dr. Peter Ewell, Regional Agricultural Advisor;
- Kenya Agricultural Research Institute, Nairobi. Dr. P.T. Gicheru, Director, including the soil survey/GIS facility and soil fertility testing laboratory;
- African Conservation Tillage (ACT) Network, Nairobi. Saidi Mkomwa, Executive Secretary;
- CGIAR International Livestock Research Institute, Nairobi. Teleconference with Shirley Tarawali, Director, Jan de Leeuw, Bruno Gerard, and Alan Duncan from Addis Ababa; Nils Teufel from Delhi; and Carl Rich from Oslo;
- Moi University, Eldoret, Kenya soil science faculty and students;
- Manor House Agriculture Centre, Kitale. Met with staff and trustees, signed subaward;
- Farmers' group near Tororo, Uganda, and associated agricultural marketing information center;
- Farmers' group near Mbale, Uganda;
- Kapchorwa Commercial Farmers Association (KACOFA), Uganda. Director David Kissa with field facilitators and board members, district environmental officer, Land Care Chapter officer;
- Kapchorwa farmers' group, Uganda;
- Farmers' group near Chwele, Kenya
- Chwele Market and Kenya Agricultural Commodity Exchange (KACE) Office;
- SACRED Africa staff, board members, and students;
- Two farmers' groups near Bungoma;
- Kenya Climate Change Working Group, Nairobi. Susy Wandera, steering committee;
- Eugene Wamalwa, Member of Parliament from Trans Nzoia District, presidential candidate, and farmer interested in developing legislation to support conservation and equitable market access.

2. During the baseline survey and focus group meetings, host-country NGO partners talked to hundreds of stakeholders in each study area, creating general knowledge of and local support for the project. This led to smooth implementation of the advisory groups and location identification of on-station and on-farm study sites occurring early in Year 2.

Project highlights

- Early and broad-scale networking created awareness of the research team's work and willingness to collaborate among agencies, NGOs, government agencies and others doing related work in our host countries. This resulted in willing participation in subsequent baseline surveys and focus groups and will have a significant impact on the overall success of the project.
- An inclusive process supported development of a comprehensive baseline survey and focus group instruments and their successful implementation. This process resulted in tightening the project's wide-ranging partnerships and enlisting local on-the-ground farmer/stakeholder cooperators. The significance of this successful process is clear in the smooth implementation of the Year 2 advisory group meetings to identify study sites and design CA treatments.
- Recruitment of six host-country students with excellent credentials and references adds an enthusiastic and able workforce that is having significant impact on our ability to fulfill the demands of the project. This will contribute significantly to capacity building and development impact success of the project.

LTRA-11: Sustainable Management of Agroecological Resources for Tribal Societies (SMARTS)

Principal Investigator: Catherine Chan-Halbrendt, professor and chair of the Department of Natural Resource and Environmental Management, University of Hawaii at Manoa

Host Countries: Nepal, India

Research Team:

- University of Hawaii at Manoa: Department of Natural Resources and Environmental Management: Travis Idol; Department of Civil and Environmental Engineering: Chittaranjan Ray
- Orissa University of Agricultural Technology (OUAT): Dr. Roul, Dr. Mishra, and Dr. Dash

Research progress by objective

Objective 1. Determine the set of CAPS to develop and investigate using participatory rural appraisal (PAR), including risk analysis.

Critical research accomplishments

1. The research team completed preliminary farm household production surveys for three villages. In June, 2010, the associate researchers traveled to three local villages (Sharpur, Tentuli and Gopinathpur) each afternoon to conduct socio-economic surveys. All activities were assisted by an OUAT collaborator: Dr. Roul (26-29 Jun), Dr. Mishra (29-Jun – 02-Jul), and Dr. Dash (02-05 Jul). Sharpur, Tentuli and Gopinathpur villages have 64, 59, and 24 farm households respectively. The survey questionnaire consisted of six major sections. They were: household member profiles; agricultural and non-agricultural assets inventory, value, storage and livestock numbers; agricultural land and input use; labor use; product description by plot; and grain output transactions by crop.
2. The team interviewed village community groups on farming and marketing practices. Preliminary data collected on farm production households were entered into a spreadsheet. Very preliminary analysis for the 15 surveys shows that about 40 percent of respondents have no education and 30 percent have primary education. Examples of the types of crop sold by households were maize (71 percent), mustards (35 percent), cowpeas (21 percent), okra (21 percent), and cucumbers (57 percent). The types of crops purchased by households were: lentils (64 percent), rice (57 percent), potatoes (21 percent) and other vegetables (28 percent). Three types of intercropping generally practiced were: maize and mustard; maize, cucumber and cowpea; and maize, cucumber and pumpkin. Seventy-four percent of households retained their seeds. For inputs, 44 percent used manure, 29 percent used compost and 17 percent used urea. The majority of households have bulls, goats, and chickens. The average size of cropland owned is 2.7 acres.
3. The team established experimental plots of likely CAPS on the Keonjhar KVK station.

Development impact

The initial CAPS selected will be implemented in farmer fields in 2011. Through time, CAPS will likely enhance the yield and the economic conditions of those farm households that participate.

Challenges and responses

The team is behind schedule for completing the farm production household survey, but they anticipate having this completed by March of 2011, and have the economic analysis completed before implementing initial CAPS in farmer fields.

The university partner OUAT has been very cooperative in finalizing an MOU between the universities so that field and research assistants can be hired to assist with field experiments and farm household surveys.

Objective 2. Implement CAPS in controlled research settings and in farmer fields. Monitor crop production and quality, soil and water quality, economic impacts, and influences on gender participation and equity within farm households.

Critical research accomplishments

1. First set of experimental CAPS plots has been established at the KVK station in Keonjhar. The set of experiments consists of 24 randomized plots measuring 10 m by 5 m each. Each plot has varying levels of tillage, soil cover, and crop rotation. Tillage has two treatments – conventional and conservation. Soil cover treatments were cover crop or no cover crop and crop rotation treatments are either maize or an intercrop of maize-cowpea.
2. Initial soils data was collected and analyzed. The soil pH was measured at two depths and the pH levels are mostly acidic, in the high 4s. Other data on bulk density and soil moisture was collected and some samples were air-dried for further chemical analysis at OUAT.

Development impact

The crop is still growing, so data from the first harvest is not available yet. When the crop yield and input data are collected then we can assess the economics of each CAP plot.

Challenges and responses

Progress is going as outlined in the timeline. Communications with our OUAT faculty partners regarding the status of the experiment has been difficult. Hiring of project staff by OUAT in Year 2 should facilitate more timely communications.

Objective 3. Use a participatory action research (PAR) approach to promote reflection, evaluation, and continuous improvement of CAPS by farmers and researchers.

Critical research accomplishments

Discussions with OUAT research faculty, extension and site visits had led to the design of the CAPS experiments at Keonjhar KVK. The first training session will be conducted in March 2011.

Development impact

Nothing to report.

Challenges and Responses

The team intended to have the initial training done during the first project year. This will be delayed until March 2011, during the second project year.

Objective 4. Build capacity of farmers, local NGO's, regional universities, and international research organizations to adopt, adapt, disseminate, and scale-up CAPS.

Critical research accomplishments

The research team established working relationships with ICRISAT and has a formal partnership with OUAT.

CAPS framework and SMARTS objectives were presented to the OUAT partners. The SANREM teach is working with them to build capacity through the personnel, equipment, and supplies necessary to establish experimental plots and collect socioeconomic data.

Development impact

A formal partnership was developed with OUAT and with ICRISAT.

Challenges and responses

The research team is making progress as outlined in the timeline. They lost their major NGO partner, Agragamee, due to differences over project objectives and activities. They will be actively seeking a local NGO partner in Keonjhar District during Year 2.

Degree and non-degree training activities

They engaged in mostly non-degree training activities during Year 1 due to recruiting difficulties. However this allowed them to take advantage of the expertise and availability of several former University of Hawaii students to carry out key project activities during the first year of the project. The team provided limited degree training to one student who separated from the university due to personal difficulties. Three students were able to gain experience

through visits to project sites in India, field work installing experimental research plots, collection and analysis of soil samples, interviewing farmers for our household survey, and conducting a literature review on the agricultural situation in Nepal as it relates to CAPS and sustainable agriculture and natural resource management. For Year 2, the team has hired two graduate research assistants and is currently interviewing candidates for a third position.

Publications, presentations, and other SANREM CRSP products

As this was the first year of the project, publications are limited. Two important presentations were made that highlighted the agricultural situation of tribal farmers in Orissa State, India and provided an overview of the research location in Keonjhar District. In addition, a student wrote a report on agriculture in Nepal.

Networking activities

The team was able to network with the following organizations: USAID India mission, OUAT, ICRISAT, and Agramee. We established formal partnerships with OUAT and ICRISAT. USAID India Mission director Mr. Dasgupta was pleased to learn of our project and encouraged us to keep in touch to take advantage of similar agricultural or higher education funding opportunities offered through the India mission. ICRISAT has agreed to send some of its junior researchers to our training sessions in India and to host a symposium during Year 5 to review findings of the project. OUAT is an official partner with its own budget and major research and extension activities. Although Agramee was an early partner in the project, they officially ended the partnership due to differences in our respective interests and lack of agreement on project objectives and major activities.

Project highlights

1. Selected three tribal villages in Keonjhar that would greatly benefit from CAPS
2. Partially completed data collection on farm household production and analysis will begin soon
3. Initial soil data collection and analysis have completed.
4. The experimental CAPS plots are being monitored and data is being collected.

LTRA-12 Conservation Agriculture for Food Security in Cambodia and the Philippines

Principal investigator: Manuel R. Reyes, professor, biological engineering, North Carolina Agricultural and Technical State University

Host countries: Cambodia, Philippines

Research team:

- North Carolina Agricultural and Technical State University: Department of Agribusiness, Applied Economics, and Agriscience Education: Osei Yeboah
- University of the Philippines-Los Baños (UPLD): Gender Center: Maria Helen F. Dayo; College of Engineering and Agro-Industrial Technology: Victor B. Ella
- Royal University of Agriculture: German Development Service: Adrian Marc Bollinger; Department of Agronomy: Hok Lyda, Chuong Sophal
- US Department of Agriculture-Natural Resources Conservation Service East National Tech Support Center: Susan Andrews, Charles E. Kome
- Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD): Stéphane Boulakia, Stéphane Chabierski, Kou Phally, San Sona
- Landcare Foundation for the Philippines: Agustin Mercado

Research progress by objective

Objective 1: Gender

Pinpoint gendered limitations and advantages that can promote adoption of conservation agriculture production systems (CAPS), and determine if CAPS will increase the labor burden on women in Cambodia and the Philippines.

Critical research accomplishments

A structured baseline survey instrument was developed to generate information about the characteristics of the farming households in selected villages and translated into local languages. The characteristics included patterns of gendered tasks by cropping season among others.

In the Philippines, two female and two male enumerators were trained to conduct the survey. In Cambodia two male enumerators were trained to conduct the survey.

In the Philippines, a total of 60 household-respondents were surveyed in Claveria. Encoding of survey data results into Excel files was completed. Summary and analysis is on-going and some results include: 40 percent of respondents were CAPS farmer-cooperators while 60 percent were farmer-non-cooperators with: 53 percent male and 47 percent female; 40 percent come from indigenous tribes and 60 percent are migrants; 68 percent own their land and 32 percent do not

own their land; and 64 percent are members of Landcare while 24 percent are members of women-groups. In Cambodia, 50 in-depth surveys at the farm level were conducted. The surveyed farms represent about 10 percent of the total households and cropped lands of two villages, Boribo and Pechchangvar, and data are still being analyzed.

In the Philippines, with Dr. Christie, a participatory rapid rural appraisal was conducted with the purpose of understanding the farmers' gendered knowledge of agricultural practices, including historical antecedents, and their changing patterns. Some of the initial findings include: (i) while both claimed that they have control over their farm resources, it is still generally the men who have the power to decide how these resources can be used, especially those that are capital-intensive; and (ii) there is a basic division of labor between men and women where field preparation and production are male-dominated and marketing is mostly dominated by women.

In Cambodia, group discussions, with Dr. Dayo, and individual surveys have been conducted with women to try to determine trends in labor sharing between women and men at the farm level. It appeared that: (i) women played an important role in the decision making for household management; (ii) most of the leaders of the community based organizations are women; and (iii) sowing and weeding is often done by women but spraying crops is never done by women.

Development impact

In Cambodia, it is too early to make conclusions, but conservation agriculture may alleviate labor activities where women predominate (sowing and weeding). In CAPS, sowing will be mechanized and weeding will be done by herbicides. Women are usually not responsible for chemical spraying in Cambodia.

In the Philippines, initial arrangements were established with local government to strengthen gender development in the context of CAPS. The CAPS project was discussed with the Mayor of Claveria and a Municipal Social Welfare and Development Officer. It was found that there were a number of women-groups active on various activities in Claveria supported by national government agencies and non-governmental organizations. However, they are not yet aware of the recently enacted (2009) "Magna Carta for Women" in the Philippines. Hence, a workshop was scheduled for women's access to agricultural technology like CAPS in the context of this "Magna Carta."

Challenges and responses

The Year 1 work plan timeline was met. However, more female and male farmers may need to be surveyed for robust cross-cutting gender research results. The 60 surveyed from the Philippines and 50 in Cambodia may not be enough.

Objective 2: Economics

Identify field- and farm-level CAPS that will minimize smallholder costs and risks while maximizing benefits and adoption in Cambodia and the Philippines.

Critical research accomplishments

A baseline survey was conducted which covered economic data/information of the household participants regarding their farming systems, specifically farm inputs as well as market prices and labor costs. For specifics, see the baseline data collection description in the first three paragraphs of the Critical Research Accomplishments section for Objective 1.

A recordkeeping protocol to quantify farm input activities like labor, seeds, fuel, machinery, fertilizer, and herbicide use; and output activities like yield and market prices was developed. In Cambodia, the protocol was specifically tailored for “Olympe,” decision support software to improve farmers’ or groups of farmers’ understanding of their situations and their socio-economic context. Scenarios based on different hypotheses on inputs, labor costs, and product prices combined with yields can be built in Olympe to test resilience of different CAPS.

Farmers, both women and men, were asked their expectations of CAPS and what crop rotations they would recommend. Their inputs, combined with professional judgement of scientists and suggestions of other stakeholders like local government staff, helped choose research managed and farmer managed CAPS.

In the Philippines, as explicitly recommended by SANREM’s External Evaluation Panel, the treatments and approach were significantly changed. Cambodia’s host country coordinator, Stephane Boulakia, provided a lot of guidance and the approach was based on insights from the Cambodian model. The trip of the Philippine scientists in Cambodia was crucial to improving the realignment of the Philippines’ approach.

Researcher Managed Experiments:

Kitchen experiments, which are small researcher-managed, single-plot studies on farmers’ fields, were established in both countries. Kitchen plots are used to evaluate plant varieties that are perceived to be suitable to CAPS because they can produce high biomass and/or improve crop yield. This included forage grasses, sorghum, cassava, legumes, open pollinated maize and many more.

Treatments:

In describing the treatments below, the following notations were used for both countries: ‘//’ is relayed cropping with planting dates varying, ‘+’ is planted side by side with the same planting dates and ‘-’ is followed by.

Cambodia:

In Cambodia, two CAPS researcher-managed demonstration sites were established in Boribo on land considered by farmers as degraded. Each site has four main crop treatments under two fertilization levels. Biological pumps are used in the following experiments. Biological pump is

producing the maximum biomass using deep rooted high biomass cover crops that can extract (hence pump) nutrients from deeper soil depths. Pearl millet (PM, *Pennisetum typhoides*), *Brachiaria ruziziensis* (BR) and *Stylosanthes guianensis* (SG) are used as biological pumps.

For Site 1 the area is 2.0 ha, and it was started by PADAC in 2009, and continued by SANREM/PADAC 2010. Treatments are:

- T1: Maize and soybean rotation. PM/maize + BR in 2009 + BR/soybean (SB) + Sorghum (SM) + SG at two fertilization levels of main crop (i.e., maize and soybean). There is about 60-70 days biomass production of PM, BR, or SG.
- T2: Maize monocropping. PM/maize + SG in 2009 and 2010 at two fertilization levels for maize.
- T3: Maize and cassava in rotation. PM/maize + SG in 2009, and continued by cassava + SG at two fertilization levels of main crop (i.e., maize and cassava).
- T4: Cassava monocropping. Cassava + SG in 2009 and 2010 at two fertilization levels for cassava.

The fertilization levels are: low/ medium level of fertilizers application; in 2009, 69-35-30 on maize, 69-35-60 on cassava, and 23-35-60 on soybean, and medium/high level of fertilizers application 115-85-60 on maize, 92-85-90 on cassava, and 23-85-90 on soybean.

Yields were measured in 2009. The impact of fertilization is typical -- higher fertilization has higher yield. For Brach r. yield in maize was lower (5,070 kg/ha) compared with Stylo g. yield (5,565 kg/ha) in F2. The following were observed from Site 1: (i) Discontinue the use of *Brachiaria ruziziensis* as a cover crop due to significant reduction in maize yield which was also observed in PADAC studies in Kampong Cham; and (ii) poor development of *Stylosanthes guianensis* since soil is alkaline.

For site 2 the area is 1.5 ha, and it was started in 2010 by SANREM/PADAC. Site 2 includes: (i) new associations with maize in order to combine legume-based biomass production as secondary grains (i.e. rice bean, pigeon pea and soybean); (ii) crop rotation between maize and upland rice that targets extension on small to medium farms which do not produce rainfed lowland rice; and (iii) monocropping of soybean with sorghum as secondary crops, a proven efficient system in a PADAC-CAPS study in Kampong Cham, Cambodia. The treatments are:

- T1: Maize monocropping + rice bean (RB) as secondary crop: PM/maize + SG + RB.
- T2: Maize monocropping + pigeon pea (PP) as secondary crop: PM/maize + SG + PP.
- T3: Maize and rice in rotation + RB and cowpea (CP) as secondary crop: PM/maize + SG + RB and following year PM/maize + SG + CP
- T4: Soybean monocropping + sorghum as secondary crop: PM/soybean + sorghum + SG

In Site 2 soybean and upland rice will be harvested by end of October, maize around mid-November and cassava in January-February 2011.

Philippines:

In the Philippines, one researcher-managed site located in Barangay Rizal was chosen and established with six treatments replicated four times at two fertility levels. There are no measurements yet since plots were established in late August 2010. The treatments were:

- T1 : Maize + *Arachis pintoi* (AP) - Maize + AP. Before planting the weeds were sprayed with glyphosate two weeks before planting. The maize was planted using a dibble stick on 70 cm rows by 20 cm spacing, totalling 72,000 plants per hectare. The *Arachis pintoi* cuttings were planted in single rows between the maize rows spaced at 25 centimeters apart.
- T2 : Maize + SG - Maize + SG. The maize was established similar to T1. The SG seeds were drilled in between rows of maize and thinned to 10-15 plants per linear meter.
- T3 : Maize + cowpea (CP) - Maize + CP. The land was prepared similar to T1, but the maize was established in double rows at 35 cm spacing and 20 cm between plants, followed by two rows of CP at 35 cm spacing with 10-15 plants per linear meter.
- T4 : Maize + rice beans (RB) - Maize + RB. The maize established similar to T1. RB will be established two weeks prior to maize harvest.
- T5 : Cassava + SG - Before planting the weeds were sprayed with glyphosate two weeks before planting. Furrows were spaced at 100 cm and cassava cuttings were planted 50 cm apart, totalling 20,000 plants per hectare.
- T6 : Farmers' practice. Two plowings with an animal-drawn mouldboard plow; two harrowings using an animal-drawn spike-toothed harrow, and furrowed using an animal-drawn mouldboard plow.

Farmer Managed:

A detailed list of farmer cooperators together with their geographic locations for both countries was prepared.

Cambodia:

In Cambodia, 20 families covering 28 ha are implementing 'Biological Pump Pearl Millet or Sorghum' / Maize + SG; four families covering three ha are implementing SG 2009 / Maize + SG; and two families on two ha are implementing 'Biological Pump Sorghum' + SG 2009/Maize + SG. Initial farmer feedback indicated a clear impact of these CAPS on weed control.

Philippines:

In the Philippines, eight different CAPS are being tested, with each CAPS replicated three times for a total of 24 farmers at 1000 m² per farmer covering an area of 2.4 ha. The sites are located in eight different barangays of Claveria. The elevation of the selected sites ranges from 474 m to 986 m above mean sea level. A GIS map was completed which shows the location of each farm.

The treatments are:

- T1. Maize (Mz) + Bagoiu beans (BB) - Mz + BB/ *Crotalaria* (Cr)
- T2. Maize + *Stylosanthes guianensis* (SG)
- T3. Mz + Cowpea (CP) – Mz + CP- Sorghum (Sgh)
- T4. Mz + Peanut (Pnt)/Cassava (Cv)
- T5. Sweet Corn (SwC) + Pnt - SwC + Pnt
- T6. BB + Mz – Mz – Sgh
- T7. Mz + SG – Mz + Cv
- T8. SwC + Pechay (Pc) – SwC + Pc

Note: ‘/’ is relayed cropping with planting dates varying, ‘+’ is planted side by side with the same planting dates and ‘-’, is followed by.

Development impact

In Cambodia, from several discussions with farmers, CAPS for maize is beginning to be perceived as a promising alternative to the destructive plow-based cropping systems. The director of the Provincial Department of Agriculture of Pailin, a neighboring province where about 50,000 ha have been converted from forest to upland cultivation (maize and cassava) since early 2000's, told the Cambodian team that about 10 to 15 percent of the reclaimed land has been already abandoned due to crop productivity decreases. He clearly stated that the proposed CAPS by SANREM-CRSP/PADAC are the only “realistic” way to reverse current “soil-mining” dynamics. These views were also shared by several local private companies involved in maize production and processing, and they were invited to visit SANREM-CRSP farms network.

Challenges and responses

Work plans for this objective were accomplished, although seeding was delayed in the Philippines by two months in the researcher managed and by three months in the farmer managed experiments.

The farm machinery did not arrive on time for planting. In the Philippines, sharp wooden sticks were used to dibble crop seeds, while in Cambodia, existing PADAC machinery were used.

In the Philippines the late onset of rainfall due to El Niño phenomenon delayed the establishment of the researcher- and farmer- managed experiments. The onset of La Niña (heavy and frequent rains almost daily) also hampered the establishment of farmer-managed experiments as well as the establishment of the component research experiments. In Cambodia, the growth of cover crops was stunted due to drought. Despite drought and heavy rains both countries were able to establish researcher and farmer managed sites.

Project fund release was late which caused a delay in some project implementation. Agencies for each country provided advanced funding while paperwork for fund release was being completed.

Objective 3: Technology Network

Quantify the effectiveness of SANREM-supported farmer groups in Cambodia and the Philippines in training knowledge leaders, in being knowledge transmission points, and in facilitating network connections leading to widespread adoption of CAPS; and to find out whether a proposed micro-credit approach, and a method to facilitate access for mechanized direct seed drilling and spraying will be successful in promoting adoption of conservation agriculture in Cambodia.

Critical research accomplishments

A baseline survey was conducted. For details, see the baseline data collection description in the first three paragraphs of Objective 1 'Critical Research Accomplishments' section.

Researcher- and farmer- managed sites established and described in Objective 2 are being used to educate network stakeholders about CAPS. Each stakeholder is a potential knowledge transmission point and can facilitate network connectivity for widespread adoption of CAPS.

Philippines:

CAPS experiments were presented at a field day attended by farmers, who are members of a farmer organization (Landcare) and potential co-operators and collaborators: academies such as University of the Philippines Los Baños (UPLB), Misamis Oriental State College of Agriculture and Technology (MOSCAT), Agusan del Sur State College of Agriculture and Technology (ASSCAT); and line agencies such as the Department of Agriculture and local government units (LGUs) at the municipal and provincial levels.

CAPS and its potential positive impact on food security were explained to local government leaders like Mayor Redentor Salvaleon of the Municipality of Claveria by SANREM researchers. The Mayor expressed support for the project, as this supports his administration's program on agricultural development. A presentation on CAPS and food security was made to USAID Mission staff in the Philippines.

Inputs (fertilizers, herbicides and seeds) have been provided to five female and 19 male farmers, who are the 24 farmers conducting farmer managed studies described in Objective 2.

Dibblers and a two-row no-till planter had been purchased from Brazil.

Cambodia:

Several field visits to introduce CAPS to local farmers and other stakeholders (i.e. USAID Mission in Cambodia, community based organization, local and national government, university faculty, NGOs, agro-industry, banks, and private plow-based contractors) were conducted for progressive extension of the CAPS network.

SANREM-CRSP technicians are closely supported and trained by more experienced PADAC staff to increase positive perception of CAPS and support methodology by farmers in Battambang.

Formation of a farmer organization for CAPS (FOCAPS) has been initiated in small groups which are the future basic units of a large farmer organization. FOCAPS benefits from the pre-existing, community-based organization (CBO) which has about 500 members. Two SANREM target villages were identified. One has 75 of 164 families that are members of the CBO with 11 families implementing CAPS, and the other has 61 of 172 families that are members of the CBO with 15 families implementing CAPS.

Inputs (fertilizers, herbicides and seeds) have been purchased with PADAC non-SANREM funds and “lent” on a free credit basis (0 percent interest) to nine female and 17 male farmers, who are the 26 farmers in the farmer managed study described in Objective 2. This temporarily replaced the originally planned approach with ANZ Bank (Australia and New Zealand Banking Group Limited) wherein ANZ will release a credit to pre-finance farmer inputs with credit risk partly covered by non-SANREM PADAC funds. Negotiation with ANZ is being completed for an additional 124 farmers who will practice CAPS to be provided with low interest loans by ANZ.

A meeting was held with agro industries and FOCAPS to show to the agro industries representatives CAPS and explore the potential supply of produce from the FOCAPS to the agro industries.

A no-till planter and other conservation machineries were purchased from Brazil to trigger the substitution of the current ‘plow-based contractors’ service with services oriented to CAPS implementation.

An organization chart for development of CAPS contract farming. It involves mixing within the farm network a few larger farmers, with higher investment capacity, besides the dominant small to medium holders. The contract farming is based on a tripartite partnership “FOCAPS – Agro Industries – Banking System (ANZ)” at a pilot scale of around 200 ha, corresponding to around 1,000 tons of raw products.

Development impact

CAPS knowledge is being learned and disseminated through seminars, field days, and researcher and farmer managed CAPS study sites. Networks are being established between farmers and farmer groups; and host country USAID missions, local and national government; local, national and regional non-governmental organizations; contractors, banks, agro-industry and markets to build the foundation of widespread adoption of CAPS.

Challenges and responses

Several tasks have been done. However, some were not fully accomplished due to a delay in release of funds. Delays were experienced in machinery purchase, plot establishment, and

formation of farmer organization and implementation of credit approach in Cambodia. To minimize implementation delays, host country partner institutions extended their own funds and improvised solutions like temporarily changing their credit approach and the research team is confident they will catch up in Year 2. Plots are established, machinery is in Cambodia, farmer organizations are being formed, and more farmers have agreed to participate in a CAPS micro-credit approach in Year 2.

The 26 farmers in Cambodia were not a large enough number for ANZ Bank to economically provide microcredit. PADAC bought their agricultural inputs and lent it to the CAPS farmers on a 0 percent interest credit.

Objective 4: Soil Quality

Assess soil quality and measure crop yield and biomass from CAPS and compare them with soil quality and crop yield and biomass from conventional plow-based systems in Cambodia and the Philippines.

Critical research accomplishments

Identification and selection of farm demonstration (researcher-managed) and on-farm experimental (farmer-managed) sites as described in Objective 2. No biomass and yield measurements are available yet due to late establishment of researcher and farmer managed sites.

Cambodia:

The CAPS subsample of 15 farms has been randomly chosen among farm households that decided to adopt new CAPS on part of their land. The other subsample consisted of 15 one-ha farms with plow-based farming practices for a total of 30 farms. Within each of these 30 reference plots, four 'permanent' sampling areas of 50 m² (5 m x 10 m) were randomly chosen and marked.

During March 2010, most of the bulk density sub-samples from 30 permanent sampling spots at four depths (0-5 cm, 5-10 cm, 10-20 cm, and 20-30 cm) were measured for a total of about 480 base-line bulk density measurements. Statistical analysis is still being conducted on the measurements. But cursory look at the data shows the typical pattern of increasing bulk density with depth with no significant differences in bulk density from the 30 plots. These bulk density measurements provide good baseline information on the impact of CAPS on an important soil quality parameter, 'bulk-density' with time, and will be used to provide soil carbon measurements on a tons per hectare basis.

Philippines:

Soil sampling for baseline data has been completed for both researcher and farmer managed sites with selected primary data on soil physical and chemical properties processed and analyzed. The soil texture at the researcher-managed site is generally clayey at various soil

depths. For the farmer-managed sites, the soil texture was also clayey for sites situated at lower ecological zones. For the upper ecological zones, on the other hand, the texture ranged from sandy clay loam to sandy for the upper soil horizons (0 to 15 cm) and from sandy loam to sandy clay loam for the lower soil horizons (15 to 30 cm). Sites at the middle ecological zones showed a soil texture of sandy clay and loamy sand for the upper horizons and clay to sandy clay loam for the deeper horizons. The soil bulk density generally increases with soil depth and with elevation. The soil organic matter, nitrogen content and phosphorus content are all generally higher at the upper soil horizons than at deeper horizons layers regardless of site elevation. The concentrations of other cations such as potassium, sodium, calcium and magnesium in the soil exhibited no distinct pattern of variability with soil depth for all elevation zones. All these findings could serve as basis for future assessment of the impacts of conservation agriculture and conventional plow-based systems on soil quality.

The schedule and sampling protocol for monitoring and measurement of selected plant characteristics such as plant height in both researcher-managed and farmer-managed plots was finalized. The first measurement is to be done in late September.

Experimental plots for crop modeling of maize under conservation agriculture and traditional plow-based system have been established at the researcher-managed site. Three plots to serve as replications were established for each treatment (a randomized complete block design) during the last quarter of Year 1. Sampling protocols for biomass and leaf area index have already been established for model calibration purposes. Training on plant characteristics monitoring for crop modeling studies was also done.

The automatic weather station used in SANREM Phase III was moved from the previous study site in Lantapan, Bukidnon to the present research site in Claveria, Misamis Oriental for climatological data collection to be used for both water balance studies and crop modeling studies.

Development impact

CAPS production has started to be perceived as a promising alternative to the destructive plow-based cropping systems, as mentioned on several occasions in discussions with farmers.

Soil samples have been collected for baseline soil quality characterization and also biomass and yield for CAPS and plow-based sites. This can lead to a science-based proof that CAPS improves soil quality, increases biomass and yield and can be used as a tool for governments to provide policies that will enhance CAPS adoption.

Challenges and responses

In Cambodia, the project timeline was substantially covered. Due to delayed arrival of funds (late identification of the technicians, late arrival of machinery, specifically the no-till planter for DMC, imported from Brazil), the pilot network is only covering 33 ha with 26 families in 2010 instead of the target of 50 ha and 50 families. The area not covered (17 ha) in Year 1 will be covered in Year 2 plus the 150 ha and 150 families targeted for Year 2.

In the Philippines, the project timeline was substantially covered except for crop yield measurement and full monitoring of plant height. This was due to the delay in the fund releases causing delays in the project implementation in Year 1. Nevertheless, the activities were fast-tracked when the funds became available. The remaining activities such as monitoring of plant characteristics are currently being implemented while crop yield measurement will be done in the early part of Year 2. Other challenges include the repair of the sensors on the automatic weather station, which will allow for full climatological monitoring. This is currently being addressed.

Degree and non-degree training activities

Non-degree training was provided to 162 males and 113 females from host country. Degree training was provided to host-country citizens (two males and one female).

Publications, presentations, and other SANREM-CRSP products

Four annual reports, a report on "Implementation of a farming system reference network in Battambang, Cambodia," four electronic presentations, and two brochures were completed.

Networking activities

The SANREM Project Kick-Off Meeting, hosted by ICRAF-The World Agroforestry Center, was held on April 26, 2010 in Claveria, Misamis Oriental, Philippines, to launch the project and to meet with partner scientists, farmer collaborators, local government units, and other stakeholders. A total of 105 participants attended the kick-off meeting composed mostly of farmers from Landcare, LGUs and faculty, staff and students of MOSCAT. Of the 105 participants, 60 were men and 45 were women. In this meeting, the host country coordinator gave an overview of the SANREM project and some basics of conservation agriculture to the farmers and other stakeholders.

Reyes and Yeboah visited Cambodia with three Philippine scientists in June 2010 to view the Cambodian CAPS research sites and meet with partner scientists in Cambodia. These visitors and USAID Mission staff were hosted by the Cambodian host country coordinator, Stephane Boulakia.

The SANREM CAPS project was also discussed with the Municipal Social Welfare and Development Officer. It was found that there are a number of women-groups active in Claveria, some of which are supported by NGOs and NGAs for specific programs. However, they are not yet aware of the recently enacted "Magna Carta for Women in the Philippines" (2009). Hence, a one-day seminar-workshop was scheduled on September in Claveria for this purpose, in the context of CAPS. The same activity will be implemented in Lantapan, Bukidnon.

The SANREM-CAPS project was also presented in the inter-agency meeting of Philippine Overview of Conservation Approaches and Technologies (PhilOCAT) Steering Committee Meeting in DA-BSWM Quezon City. PhilOCAT is a country adaptation of WOCAT (World Overview of Conservation Approaches and Technologies) based at Bern, Switzerland. Dr. Helen Dayo serves as the gender specialist.

The Conservation Agriculture Network for South East Asia (CANSEA) sent Mr. Andre Chabanne to plan a training system for engineers, technicians and farmers in Vietnam and Cambodia. For Cambodia, he will design a plan which aims to extend CAPS on 5,000 ha within 4-5 years impacting about 3,000 farmers, and 60 field technicians. Various types of training support will be progressively prepared by SANREM/PADAC and CIRAD. This collaboration will optimize time and resources in training documents' preparation and edition.

Project highlights

Researcher and farmer managed sites were established in Cambodia and the Philippines. In the farmer managed sites 50 farmers are testing CAPS.

Baseline data for each objective were gathered for both countries.

Networks are being established with stakeholders who can implement CAPS adoption when CAPS technology is proven to be successful. Stakeholders are getting involved while CAPS technology is being developed.

Synchronization of the Cambodian and Philippines studies has been done allowing for an excellent cross-cutting partnership that will benefit both countries. Framework for cross-cutting for the four objectives has been established.

In Cambodia a framework has been drafted to implement a contract between farmer organizations in CAPS (production), agro-industry (market) and banks (microcredit). Contracts will be initiated in Year 2 to act on this framework.

Cross-cutting Research Activities (CCRA) program

Economic Analysis and Impact CCRA

Principal investigators: Michael Bertelsen, George Norton

Objective 1: Identify the costs and benefits of CAPS in cropping systems/practices and related animal and forestry sub-systems

Critical research accomplishments

This CCRA worked with LTRA PIs to identify CAPS elements and farming programs to be assessed. An overall approach was developed and discussed with the economists in the LTRAs that involves gathering and analyzing production and cost data, soil loss data, and other information that will allow for assessment of farm-level production system(s) and sequencing of CAPS elements that will minimize smallholder costs and risks while maximizing adoption and economic and environmental benefits. In addition, they interacted with the LTRA PIs on additional impact work that they might wish to perform.

Budget data was also gathered for the CAPS elements to be evaluated in LTRA-7's Ecuador site and to create a template for data collection in other sites.

Development impact

Nothing to report

Challenges and responses

Nothing to report

Objective 2: Identify optimal CAPS and the sequencing of CAPS elements for each cropping system being researched.

Critical research accomplishments

They built a linear programming model for the Latin American site that can be used as a template for analysis in other regions. This model will be used to assess optimal CAPS in at least one cropping system in Year 2.

Development impact

Nothing to report

Challenges and responses

Nothing to report

Objective 3: Identify broader economic and social impacts of wide-scale CAPS adoption

No tasks planned or undertaken this past year.

Objective 4: Identify any policy changes required to enhance CAPS adoption in each cropping system

No tasks planned or undertaken this past year.

Degree and non-degree training activities

Master's student Abigail Nguema is working on her thesis on the project. She began in June 2010 and should finish by June 2011. There was no non-degree training conducted.

Publications, presentations, and other SANREM CRSP products

None

Networking activities

No Networking activities have been conducted outside of building understanding and rapport with each of the Lead-PIs and their host country teams.

Project highlights

- An MS thesis paper is in process entitled "Evaluating the Impact of Conservation Agriculture: A Farm-Level Assessment in the Andean Region." It focuses on farm households in the Chimbo River sub-watershed of central Ecuador.
- A farm-level model is being developed to maximize income subject to various levels of reduction in soil erosion, facilitating an assessment of the likely livelihood improvements attainable through the diffusion and adoption of innovative conservation agriculture techniques. The model tested in the Latin American site will form a template that can help with impact assessment in the other regional programs.

Gendered Knowledge CCRA

Principal Investigator: Maria Elisa Christie

Research progress by objective

Objective 1: Identify gendered practices and participation that shape local knowledge related to agricultural production

Critical research accomplishments

A working paper on technology networks and gendered knowledge was drafted, revised, and published. It described the theoretical foundations for analysis of gendered knowledge and social networks in conservation agriculture research and development, and outlined a methodology for identifying all relevant actors and their relationships in the local agricultural setting for each of the Long-Term Research Activities (LTRAs). The methodology and implementation was the subject of extensive debate within the team and went through various revisions before being finalized in the working paper that was posted on the SANREM website and circulated to all LTRA PIs. Field site visits this year were coordinated with the Tech Net CCRA to develop and implement a series of Focus Group activities.

The methodological work resulted in draft questionnaire items to be included in LTRA baseline surveys as well as a structure and dynamics of focus group exercises and other participative activities. Site level introduction of this work began in Haiti in collaboration with the Technology Networks CCRA, but fieldwork was impeded by the earthquake. Our first focus group activity was implemented in two communities in Mali with the LTRA-8 team. Outcomes included a listing of potential actors identified for the battery of network actor questionnaire items and initial findings regarding women's and men's perceptions of soil quality based on landscape interpretation. A translated version of the questionnaire was left with the Mali team and shared with the Lead PI. The same focus group activity was initiated at the Ghana site of LTRA-8 as well two weeks later.

The Gender CCRA used a series of qualitative research techniques including: focus group discussions, structured and unstructured interviews, participant observation, participatory mapping, and interpretation of photographs and soil samples. It uses the Gender Dimensions Framework (GDF) developed primarily by Deborah Rubin and Deborah Caro of Cultural Practice that incorporates the following four dimensions: access to and control over key productive assets (tangible and intangible, including knowledge); beliefs and perceptions; practices and participation; and legal frameworks in addition to the cross-cutting dimension of power. Activities addressing these dimensions were carried out during each field visit and training. Different activities provided different information, some related to Objective 1 and others to Objective 2.

Field exercises were carried out in Ecuador in April, Uganda in June, and the Philippines in July. In all, the gender CCRA was presented to the regional teams. In Ecuador, this was in the

format of a presentation at the kick-off meeting and participation of the Ecuador team only in a 4-day workshop. In Uganda, a full day gender workshop was held to introduce the CCRA and its methodology, followed by a day of field activities gathering data using the Focus Group Activity Chart developed in conjunction with the Technology Networks CCRA. In the Philippines, a similar format was used to work with farmers in two villages.

The East Africa team (LTRA-10) was trained in a qualitative methodology approach to gendered knowledge and access to assets with regard to soils and animals and has incorporated this into their research. Training and research was carried out in the Philippines with LTRA-12 and plans made for conducting research on poultry and conservation agriculture with a regional focus in Year 2.

Development impact

The primary development impact was the potential for scaling up due to working with partner institutions and collaborating groups that have impact beyond the scope of SANREM and will reproduce the training and empowerment techniques in other projects. In Uganda, the PI and East Africa (LTRA-10) team worked with the Kapchorwa Commercial Farming Association (KACOFA) in Kapchorwa town. The organization has over 3,000 members; their goal is to improve farmer livelihoods through commercial farming. Approximately 20 KACOFA members and field facilitators were among the group of 21 men and 12 women trained by the CCRA PI during a full day workshop with farmers. They will be able to scale up the research methodology and women's empowerment techniques in their other work. A local organization, Atari Soil and Water Conservation, from Kaplak Parish, and staff from the World Food Program also participated in the training. In the Philippines as well, training with ICRAF team members will have greater development impact through other ICRAF projects.

Challenges and responses

Despite some change in focus of the CCRA due to discussions with LTRA PIs, much fieldwork was carried out that served as a basis for revisions and allowed us to test and revise the methodology to be used in the coming years. Considerable time was invested in reformulating the project and methodology.

The fieldwork in Mali showed that it will be difficult to obtain consistent, comparable data across sites with qualitative research methods even with closely coordinated efforts. Extra care and time must be taken to train teams to carry out similar exercises. It is clear that flexibility will be needed for adaptation to the conditions and timing in various host-country research sites. In addition, better coordination with local teams and between local teams and communities is required to schedule activities at a time that is convenient for the community members and when women will be available to participate.

Objective 2: Demonstrate how men and women’s knowledge, beliefs and perceptions provide constraints and opportunities for CAPS.

Critical research accomplishments

In addition to working closely with the Technical Networks CCRA on the Focus Group activities (development and implementation), the project began work with the Soils CCRA to develop a focus on soils knowledge, beliefs, and perceptions for the coming years; discussions were held on overlapping methodologies and future site visits.

The goal of this research was to show differences in men and women’s knowledge, beliefs, and perceptions with regard to soils. Differences can be used as indicators of agricultural education received by farmers and can reinforce expressed gender roles in agriculture which would contribute to these differences. Researchers used a portion of the time during focus group discussions to evaluate farmer’s perceptions of soils. Men and women were separated for discussions and then brought back together to present their conclusions to the whole group. Researchers showed them four pictures of landscape soils and let them analyze two samples from near the workshop location. Note-takers recorded the men and women farmers’ descriptions of the photos and soil samples.

Results were gathered, aggregated, and sex-disaggregated data was organized by location to show the descriptive variables used by men and women farmers in SANREM workshop location. These results show that men use more technical language than the women when describing soil, which coincides with the higher number of men who receive agriculture extension education compared to women. Men described soils in terms of labor (e.g., plowing) more frequently than women, whereas women described more minute features that require up-close observation of soil to recognize (e.g., weeding). Together, these gender-correlated factors show the gendered division of labor. In some communities, men used more categories of description than women, which may also be a result of women’s timidity when sharing results in the focus group discussions.

Development impact

Assessment of soil knowledge and terms used by local populations paves the way for a more targeted approach to working with farmers on CAPS.

Challenges and responses

The greatest challenge was methodological, whereby even with training, researchers did not grasp the importance of recording exact language used by farmers. Also, researchers often used leading questions rather than sticking to the prompts when asking farmers to describe soils or soil photographs. Future training needs to spend more time on this qualitative method or results will be invalid and poorly recorded, thus rendered useless. In addition, working with indigenous populations in all regions means that the double translation (to French in West Africa, Spanish in Latin America – then to English) will lose important information. This too requires training to understand the importance of using ethnographic quotes if we are to gain

understanding of farmer's traditional knowledge. It also requires using skilled translators and recorders. Follow-up by host country teams is necessary and must be part of the PI site visit to collect the data in final form. This requires spending more time on trips to allow for wrap-up.

Challenges encountered during data collection included the use of soil samples with which the farmers were unfamiliar and use of photos of bare soils. A temporarily bare soil in a photograph – which lacks the context of season, plot preparation, and harvest – may be interpreted as being barren by a farmer, or vice versa. This skews data if some farmers' describe perceptions of soil quality based on the surface being temporarily cleared versus an infertile or barren soil.

Challenges encountered during data analysis include missing transcriptions by note-takers (Ecuador: Allumbre and Kenya), the lack of sex-disaggregation of data (Ecuador: Illangama), and summarization by note-takers who did not record dialogue verbatim.

Objective 3: Propose recommendations that build on gender findings for CAPS

Critical research accomplishments

Work on this objective will not commence until after the first round of data collection at each of the LTRA sites has been completed and analysis of the gendered practices and knowledge have been initiated.

Degree and non-degree training activities

A GRA in Geography was selected and contracted for the upcoming academic year; she has been working on developing a literature review on gendered spaces and political ecology and has initiated collaboration with LTRA-7 for thesis research in Bolivia. A senior undergraduate student is working to analyze existing soil beliefs and perceptions data from fieldwork and is developing a literature review of ethnopedology, gender, and local knowledge of soils. She has initiated contact with the Southeast Asia team for research in the Philippines. Another Master's student worked as an intern to identify and summarize literature on gender and crop-livestock interaction, and entered findings in the SKB. A PhD student in Geography prepared a literature review on participatory mapping that will be used in a future article on this topic with SANREM data and supports the gendered knowledge approach of this CCRA.

159 people have been trained in gender and participatory research methodology workshops directly addressing CAPS (75 men and 84 women).

As part of the initial introductions and capacity building efforts, the gender CCRA has been introduced to host country teams in four LTRAs: the Andes (LTRA-7); West Africa (LTRA-8); Eastern Uganda and Western Kenya (LTRA- 10); Cambodia and the Philippines (LTRA-12).

Publications, presentations, and other SANREM CRSP products

SANREM CRSP working papers:

Lamb, J., K.M. Moore, and M.E. Christie. 2010. [Research Framework for Technology Network and Gendered Knowledge Analyses](#). No. 01-10.

Christie, M.E. (2010) "Teaching module: Gendered knowledge." Women in International Development Program, Office of International Research, Education and Development, Virginia Tech.

Christie, M.E. (2010) "Teaching module: Gendered space." Women in International Development Program, Office of International Research, Education and Development, Virginia Tech.

Presentations to LTRA teams:

Christie, M.E. 2010. Cross-Cutting Gender Research in Conservation Agriculture. Workshop presentations: LTRA-6, Port-au-Prince, Haiti (12 January 2010); LTRA-8, Cinzana, Mali (13 March 2010); LTRA-7, Guaranda, Ecuador (April 11, 2010); LTRA-10, Mbale, Uganda (25 June, 2010).

Christie, M.E. 2010. Gendered Knowledge Cross-Cutting Gender Research in Conservation Agriculture. SANREM Annual /Kickoff Meeting. Blacksburg, VA (5 May 2010).

Moore, K.M. 2010. Cross-Cutting Gender Research in Conservation Agriculture. Workshop presentation: LTRA-8, Wa, Ghana (29 March 2010).

Networking activities

The Gender CCRA PI also conducted several meetings with gender and development specialists Deborah Rubin and Deborah Caro of Cultural Practice in Washington DC for discussion of research methodology.

Project highlights

Qualitative research methodology has been tested in five countries and adapted to local conditions, with improvements to the overall approach.

Collaboration with Technology Networks and Soils CCRAAs has begun and brings a multidisciplinary perspective to gender in CAPS.

Technology Networks CCRA

Principal Investigator: Keith Moore

Research progress by objective

Objective 1: Identify agricultural stakeholders' knowledge and beliefs which inform production practices.

Critical research accomplishments

A SANREM CRSP Working Paper (01-10), "[Research Framework for Technology Network and Gendered Knowledge Analyses](#)" was drafted, describing the theoretical foundations for identifying farmers and agricultural community member technological frames of reference (mindsets). Specifically, ideal-type mindsets were developed for perspectives concerning conventional agriculture, risk-averse agriculture, and conservation agriculture. The methodology was the subject of extensive debate within the team and went through various revisions before being finalized in the working paper that was posted on the SANREM website and circulated to all LTRA PIs. The working paper provides a methodology to elicit this information through the baseline surveys at LTRA sites.

The methodological work resulted in a draft 20-item Likert-scale questionnaire module (a battery of questionnaire items characterizing the three perspectives) to be included in LTRA baseline surveys. Through discussions with the LTRA teams, the Likert-scale questionnaires have been modified to highlight local elements that characterize conventional, risk-averse, and conservation agriculture frames of reference. This CCRA implemented their first focus group activity in Mali with the LTRA-8 team. A French version of the questionnaire items was left with the Mali team and shared with the Lead PI. The same focus group activity was initiated at the Ghana site of LTRA-8 two weeks later. A focus group was held in Kenya with LTRA-10 partners (from both Kenya and Uganda). This led to incorporation of the technology network survey modules in half of the survey sites in Kenya and Uganda. Data entry is currently underway in the West and East African sites.

In addition to the focus on technological change, identifying the knowledge, beliefs and perceptions of project stakeholders is critical to developing a picture of food security amongst smallholders in study sites. The Master's research to be conducted in conjunction with LTRA-10 is currently developing measures that describe the social and behavioral dimensions of food security through the development of a local consumption strategies index and food basket of agricultural and food products commonly consumed to assess dietary quality.

Development impacts

Social networks reinforce ideals, norms, and behaviors in agricultural production processes. An initial understanding of the knowledge, beliefs and perceptions currently held by smallholders in the study sites provides a foundation to enhance capacity for smallholder CAPS development and scaling up.

The Master's research conducted in conjunction with LTRA-10 will also contribute to the overall research theme of "increasing food security of smallholders through the introduction of CAPS" through a focus on food security. This research aims to identify synergies between the twin objectives of technological change and enhancing food security.

Challenges and responses

Site level introduction of this work began with the LTRA-6 team in Haiti (in collaboration with the gendered knowledge CCRA) but was cut short by the earthquake. Socio-economic research has been put on hold at the Haiti sites until social conditions stabilize. Developing effective translations of the Likert scale questionnaires, which preserve the meaning of the statements, has also been a challenge. Translations of the 20-item battery of Likert statements have been made into French for the Mali site. Furthermore, these items have been and will be adapted to the local cultural understandings and back-translated to confirm appropriateness and accuracy.

Objective 2: Quantify and describe structure and resource flows of agricultural sector networks.

Critical research accomplishments

The working paper cited above under Objective 1 also outlined a methodology for identifying all relevant actors and their relationships in the local agricultural setting for each of the LTRAs. The working paper includes a section on the theoretical foundations for social networks associated with agricultural production and provides a methodology to elicit this information through focus group activities. By identifying a list of potential actors with whom resources and knowledge are exchanged, focus group work allows for the development of a site specific instrument to map local agricultural production networks to be included in the baseline survey. Following a procedure similar to the agricultural production networks focus group activity, a process is being developed to create a survey module based on access to food products to be utilized the Master's research with LTRA-10.

The same initial progress was made for work on the agricultural sector networks shaping production relations as for Objective 1. The LTRA-8 research teams in Ghana and Mali, and the LTRA-10 research teams in Kenya and Uganda, have included social network questionnaire modules in their baseline surveys. Data entry is currently underway in the West and East African sites. Partial inclusion of this approach has been made for LTRA-12 (Cambodia and the Philippines). While adaptations have been made to account for local conditions, a uniform methodological approach ensures that the underlying comparability across sites will not be compromised. LTRA-6 (Haiti) and LTRA-9 (Lesotho) are in the planning stages. Plans for LTRA-7 (Ecuador) and LTRA-11 (India and Nepal) are still under discussion.

Development impacts

By studying networks at the SANREM sites, the Technology Networks CCRA will identify characteristics that enable smallholder CAPS development and scaling up. LTRA partners may

use these findings to determine the key relationships for successful CAPS adaptation. For example, the combination of data on shared mindsets and network relationships will help to identify farmers who are opinion leaders and may be most successful in a trainer of trainers model.

In the Master's research, measuring the similarities between agricultural production and food acquisition networks will provide an enriched dataset for understanding the vulnerability of smallholder households to food insecurity whilst undergoing technological change. It is anticipated that this research will have broad implications for other projects seeking to synergize connections between technological change and the overall project objective of increasing food security.

Challenges and responses

Introducing the concept of social networks and the value of this information to each of the LTRAs has been difficult. In the first instance, this was a challenge because most LTRAs do not have a social scientist who is familiar with the research using social networks to study technological change processes. More importantly, the LTRAs did not plan for the additional data collection modules in their baseline surveys. Consequently, easier to understand descriptions of the technology network research have been drafted and extensive discussions have been conducted with each of the LTRA Lead-PIs and their teams.

Objective 3: Determine opinion leaders and supporting relationships needed to facilitate technological change.

Work on this objective will not commence until after the first round of data collection at each of the LTRA sites has been completed and analysis of the local networks and technological frameworks have been initiated.

Degree and non-degree training activities

A female Graduate Research Assistant has been recruited and is working on a Master's degree in Agricultural and Applied Economics with her thesis focusing on the relationship between technology networks and food security. During the visits to Haiti, Mali, Ghana, and Kenya, short-term training was conducted with local partners and participants (110 men and 65 women). The training involved introducing the concepts of conservation agriculture, technology networks, and gendered knowledge and practices to targeted village level partners.

Publications, presentations and other SANREM CRSP products

Presentations:

Dillaha, T.A., C.B. Heatwole Shenk and K. Moore. 2010. Conservation agriculture and ecosystem services. In: Proceedings of the 21st Century Watershed Technology Conference: Improving Water Quality and Environment, Earth University, Costa Rica, 21-24 February 2010. St. Joseph, MI: American Society of Agricultural and Biological Engineers.

Moore, K.M. 2010. Reconstructing Agricultural Production for Food Security in Haiti. Panel presentation: Lessons from the past, challenges ahead for the new Haiti. Phi Beta Delta International Honor Society. Graduate Life Center Auditorium, Virginia Tech. 10 February 2010.

Moore, K. M. and J. Lamb. Introduction to CCRA-8: Technology Networks for Conservation Agriculture. SANREM CRSP Annual Meeting. 5 May 2010.

Moore, K. M. 2010. SANREM CRSP Overview. Workshop presentation: LTRA-6, Port-au-Prince, Haiti (12 January 2010); LTRA-8, Cinzana, Mali (13 March 2010) and Wa, Ghana (29 March 2010); and LTRA-10, Manor House, Kitale, Kenya (19 July 2010).

Moore, K.M. 2010. SANREM CRSP Cross-Cutting Research Activities. Workshop presentation: LTRA-6, Port-au-Prince, Haiti (12 January 2010); LTRA-8, Cinzana, Mali (13 March 2010) and Wa, Ghana (29 March 2010); and LTRA-10, Manor House, Kitale, Kenya (19 July 2010).

Moore, K.M. 2010. Developing Approaches for Smallholder Adaptation of Conservation Agriculture. Workshop presentation: LTRA-6, Port-au-Prince, Haiti (12 January 2010); LTRA-8, Cinzana, Mali (13 March 2010) and Wa, Ghana (29 March 2010); and LTRA-10, Manor House, Kitale, Kenya (19 July 2010).

Moore, K.M. 2010. Cross-Cutting Gender Research in Conservation Agriculture. Workshop presentation: LTRA-8, Wa, Ghana (29 March 2010).

SANREM CRSP working papers:

Lamb, J., K.M. Moore, and M.E. Christie. 2010. [Research Framework for Technology Network and Gendered Knowledge Analyses](#). No. 01-10.

Papers presented:

Lamb, J. and K. M. Moore. 2010. "From Technology Transfer to Adaptive Management: Knowledge Networks for Technological Change in Agriculture." Presented at the Rural Sociological Society Annual Meeting. Atlanta Georgia. August 2010.

Networking activities

No Networking activities have been conducted outside of building understanding and rapport with each of the Lead-PIs and their host country teams.

Project highlights

This CCRA completed a working paper describing the theoretical foundation and a methodological approach for studying the role of social networks in technological change.

They also presented and received positive feedback regarding a theoretical paper on the relationship between social networks and technological change at the Rural Sociological Society Annual Meeting.

Initiation of a Master's thesis in Agricultural and Applied Economics entitled: Social Networks and Food Security: Household Level Impacts of Access to Food and Agricultural Production Resources in Kenya and Uganda.

Soil Carbon and Soil Quality CCRA

Principal investigator: Michael Mulvaney

Research progress by objective

Quantify soil organic carbon (SOC) fractions in host country project areas before CAPS implementation.

Critical research accomplishments

- The CCRA PI (Mulvaney) is currently in the process of obtaining a USDA permit to import foreign soils. The process is expected to take several months. In the meantime, SANREM is equipped to receive imported soils through the A&L Laboratories in Richmond, VA, who will allow them to use their permit until approval is given.
- A cross-referenced database was developed to determine those soil parameters that are common among two or more LTRAs. Mulvaney has notified LTRA PIs who proposed common parameters so that they may contact each other in order to determine the feasibility of utilizing a common methodology. This will facilitate direct comparisons of common data among host country sites.

Development impact

A soils library from project research sites located within a single laboratory will allow scientifically rigorous comparisons of soil quality at time zero during CAPS implementation. Analysis of the soils library may lay the foundation to allow those adopting CAPS in the developing world to earn carbon (C) credits as part of a future C trading market. Additionally, it will provide the baseline to which future changes in SOC can be compared. Furthermore, it will allow measurement of other soil quality parameters as needed, such as water holding capacity, pH, and C turnover measurements.

Challenges and responses

- After responses from the Technical Committee (TC) during the SANREM CRSP annual meeting, a streamlined minimum dataset was developed. This document is currently in the review process within the Management Entity (ME), although they hope to disseminate it to the PIs to solicit their input in the near future.
- The importation of soil samples is an unknown. It is very expensive to ship, but once it reaches a US port of entry, customs officials have been known to destroy samples on the spot for unclear reasons. The CCRA PI will investigate the possibility of contracting an importation agent to handle customs processing.
- Due to the intrinsically slow nature of soil morphology and pedogenesis, five years may not be long enough to determine which CAPS elements improved soil quality. For example, conservation tillage, which is used as an experimental treatment in all of the LTRAs, is known to sequester C at a rate of approximately 0.1% per year after conversion from conventional tillage practices. After four years, an increase in soil C

in surface horizons to about 0.4% can be expected, which may be too small of a change to detect in these experiments, given normal variation in soil C across fields and landscapes. However, some regions may have greater C sequestration potential, depending upon the amount of biomass applied to the soil surface, slope, rainfall patterns, relief, temperature, and biota. After careful deliberation among the biophysical scientists, this project is attempting to circumvent this potential problem by sampling soils, in part, at shallow depths. This will give the researchers every chance to identify significant differences in C sequestration among experimental treatments, although the outcome is uncertain.

Identify cropping systems or biophysical elements of cropping systems that improve soil fertility and increase C sequestration.

Critical research accomplishments

- This objective necessitates the implementation of “best-bet” (researcher-recommended) CAPS trials at project locations. Currently, the LTRAs are in various stages of CAPS implementation. Most projects are in the initial stages of identification of those parameters that will be included in best-bet CAPS trials, although some projects are already several years into their trials.
- The research team intends to collect data on the cropping systems used in project areas, such as crops rotated, soil type, slope, aspect, parent material, climate, and biomass at each project site.

Development impact

The identification of those cropping systems or elements of cropping systems that produced increases in productivity and soil fertility will allow researchers, extension agents, and producers to identify which of those elements apply to them, and correlate those elements to cultural practices that will improve fertility and productivity in their areas. This information is crucial to make practical recommendations to a wider audience.

Challenges and responses

- Although several sites have already implemented CAPS trials, the main challenge at this point is to have all of the LTRAs implement researcher-recommended CAPS trials on researcher-managed plots. After CAPS on researcher-managed plots are tested and approved, the recommendations may be extended to farmer-managed fields. Additional information from farmer-managed trials will then be gathered as they are implemented, as our budget allows.
- Relate successful CAPS components to site-specific environmental conditions, including socioeconomic environments: What combinations of conditions enable success of CAPS?

Critical research accomplishments

- The Soils CCRA is collaborating with the Gender CCRA PI to assess gendered knowledge of soil fertility, and relate that knowledge to gendered space within project areas.
- Collaboration with LTRA economist partners is being developed to investigate the feasibility of carbon payments under a carbon trading scheme, should CAPS prove to increase SOC compared to traditional practices.

Development impact

Knowledge of how gendered perceptions, beliefs and knowledge as well as access to assets will improve understanding of soil management practices and how it may be effectively utilized for successful CAPS implementation at the field scale.

Challenges and responses

The Soil Quality CCRA PI will facilitate research objectives from the socioeconomic CCRAs as they pertain to soil quality, fertility, and agronomic practices. As such, the Soil Quality CCRA PI will depend heavily on the experimental design and methodology implemented by the socioeconomic CCRA and LTRA PIs.

It is expected that the first shipments of soils samples related to this activity will be received in early 2011, contingent upon soil permit authorization.

Degree and non-degree training activities

The ME agronomist has been awarded adjunct status with the Department of Crop, Soils, and Environmental Sciences (CSES) at Virginia Tech. This will allow disbursement of funds to support a degree seeking student within CSES. The project is currently seeking qualified GRA applicants.

Publication, presentations, and other SANREM CRSP products

Articles Published in Refereed Publications: 1

Electronic Publications: 3

Networking activities

The ME hosted Dr. Virendra Pal Singh, from the International Centre for Research in Agroforestry (ICRAF) on July 20, 2010. The seminar was entitled "Innovative Approaches and Good Practices for Securing Sustainable Livelihoods."

Project highlights

- Built a Time 0 soil library from all LTRA project sites
- Developed a cross-referenced database for all proposed agronomic parameters to be measured by LTRAs
- Developed a research plan to determine gendered knowledge of soils in coordination with other CCRAs

- Determined a common minimum dataset to coordinate data collection at all LTRA sites with regard to agronomic and soils data

Appendixes

A. Training participants

Table 13: Long-term degree trainees

Student Name	Sex (M/F)	Nationality	Discipline	SANREM Thesis/ Research	Country(s) Supported	Sandwich Program (Y/N)	Start Date	End Date	Degree	SANREM CRSP (Y/N)	Non-SANREM CRSP (Y/N)	LTRA	SANREM CRSP Advisor/PI	University(s) Degree Granting Institution First
Abigail Nguema	F	USA	Ag Economics	Impact Analysis	Ecuador	N	Jun 2010	Jul 2011	MS	Y	N	7	Norton	Virginia Tech
Anna Testen	F	USA	Plant Pathology		Bolivia/ Ecuador	N	Aug 2010	Dec 2012	MS	Y	Y	7	Backman	Penn State
Cecilia Turin Canchaya	F	Peruvian	Rural Sociology	Pasture Management	USA	N	Aug 2007	Dec 2010	Ph D	Y	Y	4	Jere Gilles	Universidad Nacional Agraria La Molina (BS, Animal Science, MS Rural Extension-Larenstein University, NL)
Emily Pfeufer	F	USA	Plant Pathology		Bolivia/ Ecuador	N	Aug 2010	Dec 2014	Ph D	Y	Y	7	Gugino	Penn State

Student Name	Sex (M/F)	Nationality	Discipline	SANREM Thesis/ Research	Country(s) Supported	Sandwich Program (Y/N)	Start Date	End Date	Degree	SANREM CRSP (Y/N)	Non-SANREM CRSP (Y/N)	LTRA	SANREM CRSP Advisor/PI	University(s) Degree Granting Institution First
Forrest Fleischmann	M	USA	Public Policy	Forest Decentralization (tentative)	Global	N	Sep 2007	May 2012	Ph D	Y	Y	1	E. Ostrom	Indiana University
Jennifer Lamb	F	USA	Agricultural Economics	Technology Networks for Conservation Agriculture	Global	N	May 2010	May 2012	MS	Y	N	CCR A-8	K.M. Moore	Virginia Tech
Jeremiah Okeyo	M	Kenya	Soil Science	Soil quality	Kenya	N	Aug 2010	Jun 2014	Ph D	Y	Y	10	Jay Norton	University of Wyoming
Jess Martin	F	USA	Crop & Soil Environmental Science - International Agriculture		USA	N	Aug 2010	Aug 2011	BS	Y	N	CCR A-7	Dr. Maria Elisa Christie	Virginia Tech
Keri Agriesti	F	USA	Geography	Gendered Knowledge	Global	N	Aug 2010	May 2012	MS	Y	N	CCR A-7	Marie Elisa Christie	Virginia Tech
Kim Bothi	F	Canadian	Sociology	Natural Resources	Zambia	N	Aug 2005	Dec 2010	Ph D	Y	Y	2	Buck/Travis	Cornell

Student Name	Sex (M/F)	Nationality	Discipline	SANREM Thesis/ Research	Country(s) Supported	Sandwich Program (Y/N)	Start Date	End Date	Degree	SANREM CRSP (Y/N)	Non-SANREM CRSP (Y/N)	LTRA	SANREM CRSP Advisor/PI	University(s) Degree Granting Institution First
Lyda Huk	M	Cambodian	Energy & Environ.		Cambodia	N	Aug. 2011	May 2014	Ph D	Y		12	Manuel R. Reyes	North Carolina A&T State Univ
Matt Bruns	M	USA	Soil Science	N Fertility	Lesotho	N	Jan 2010	Dec 2011	MS	Y	N	9	Eash/Walker	University of Tennessee
Moses Obbo Owori	M	Uganda	Agricultural Economics		Uganda	N	Aug 2010	Jun 2012	MS	Y	N	10	Dannele Peck	University of Wyoming
Nadezda Amaya	F	Bolivia	Agricultural Economics		Bolivia	N	Aug 2010	Aug 2013	Ph D	Y	Y	7	Alwang	Virginia Tech
Nathan Kennedy	M	USA	Natural Resource Economics		Haiti	N	Mar 2010	May 2013	Ph D	Y		6	Amacher	Virginia Tech
Pharnice Adikinye Ongonga	F	Kenya	Soil Science	Soil quality/ agronomy	Kenya	N	Jan 2010	Jan 2013	MS	Y	N	10	Robert Okalebo	Moi University, Kenya
Rachel Melnick	F	USA	Plant Pathology		Ecuador/Bolivia	N	Jun 2006	Dec 2010	Ph D	Y	Y	7	Backman	Penn State
Rafael Padre	M	Filipino	Land/Water Res Eng		Philippines	N	June 2008	April 2012	Ph D	Y		12	Victor Ella	UPLB

Student Name	Sex (M/F)	Nationality	Discipline	SANREM Thesis/ Research	Country(s) Supported	Sandwich Program (Y/N)	Start Date	End Date	Degree	SANREM CRSP (Y/N)	Non-SANREM CRSP (Y/N)	LTRA	SANREM CRSP Advisor/PI	University(s) Degree Granting Institution First
Romina Manalo-Bondad	F	Filipina	Land/Water Res Eng		Philippines	N	Nov 2006	April 2011	MS	Y		12		UPLB
Ryan Stewart	M	USA	Crop & Soil Environmental Sciences		Haiti	N	Aug 2010	Sep 2012	MS	Y		6	Thomason	Virginia Tech
Tin Herawati	F	Indonesian	Family and Consumer Science		Indonesia	N	Aug 2008	May 2011	PhD	Y	Y	5	Trikoesoemaningtyas	Bogor Agricultural University
Tisna Prasetyo	M	Indonesian	Horticulture	Soil Quality	Indonesia	N	2008	2010	MS	Y	N	5	Anas D. Susila	Bogor Agricultural University
Wendy Jones	F	USA	Soil Science	Carbon Sequestration	Lesotho	N	Jan 2010	Dec 2011	MS	Y	N	9	Eash/Walker	University of Tennessee
TBA	M	Haiti	CSES		Haiti	N	Jan 2011	May 2013	MS	Y		6	Thomason/Hodges	Virginia Tech
TBD	TBD	Uganda	Agricultural Economics		Uganda	N	TBD	TBD	MS	Y		10	Bernard Bashasha	Makerere University
TBD	TBD	TBD	Soil Science	TBD	TBD	N	TBD	TBD	TBD	Y	N	CCR A-9	Mulvaney	Virginia Tech
TBD	M	Ghana	Ag. Economics			N	Fall 2011		PhD	Y	N	8	Dalton / Prasad	Kansas State University
TBD	M	Ghana	Agronomy			N	Fall 2011		PhD	Y	N	8	Prasad / Staggenborg	Kansas State University

Student Name	Sex (M/F)	Nationality	Discipline	SANREM Thesis/Research	Country(s) Supported	Sandwich Program (Y/N)	Start Date	End Date	Degree	SANREM CRSP (Y/N)	Non-SANREM CRSP (Y/N)	LTRA	SANREM CRSP Advisor/PI	University(s) Degree Granting Institution First
TBD		Filipina	Agri Economics		Philippines	N	Jun 2011	Apr. 2013	MS	Y		12	Helen Dayo	UPLB
TBD	F	Filipina	Sociology		Philippines	N	Jun 2011	Apr. 2014	Ph D	Y		12	Helen Dayo	UPLB
TBD		Filipina	Agri Economics		Philippines	N	Jun 2011	Apr. 2013	MS	Y		12	Helen Dayo	UPLB
TBD	F	Filipina	Sociology		Philippines	N	Jun 2011	Apr. 2014	Ph D	Y		12	Helen Dayo	UPLB
TBD		Filipina/no	Energy & Environ.		Philippines	N	Aug. 2011	May 2014	Ph D	Y		12	Manuel R. Reyes	North Carolina A&T State Univ
TBD		Indian	NREM		USA	N	Jan 2011		Ph D	Y		11	Idol	University of Hawaii
TBD		Nepalese	NREM		USA	N	Sep 2011		Ph D	Y		11	Radovich	University of Hawaii
TBD		Indian/US	NREM		USA	N	Jan 2011		Ph D	Y		11	Chan-Halbrendt	University of Hawaii
TBD		US	NREM		USA	N	Jan 2011		Ph D	Y		11	TBD	University of Hawaii

Table 14: Non-degree training activities

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Bolivia						
Seminar	July 26, 2010	PROINPA Staff	20	15	USDA/ARS	Disseminate information about biological controls
Cambodia						
Short course	September 22-24, 2010	Farmers members of Farmers Organization developed by the project	12	5	AVSF	Train farmers on FO management and basic concept of Marketing
Field day	September 22, 2010	Farmers, officers of the Provincial Department of Agriculture of Battambang and Pailin Province	13	11	PADAC, SANREM (AVSF sub- contract) staff	Introduce DMC technologies
Field day	September 23, 2010	Farmers	19	5	PADAC, SANREM (AVSF sub- contract) staff	Introduce DMC technologies
Field day	September 29, 2010	Farmers	17	5	PADAC, SANREM (AVSF sub- contract) staff	Introduce DMC technologies
Field day	September 30, 2010	Farmers	17	5	PADAC, SANREM (AVSF sub- contract) staff	Introduce DMC technologies

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Field day	October 2, 2010	Farmers organization (marketing responsible) and representative of 2 local Agro-industries	4	3	PADAC, SANREM (AVSF sub- contract) staff	Introduce DMC technologies, first contact between FO and potential Maize buyers for 2010's harvest
Ecuador						
Workshop	October 23, 2009	Farmers	23	6	INIAP	Learn pasture management techniques and improved milk production
Workshop	November 19, 2009	Farmers	18	4	INIAP	Improve water management in production systems.
Workshop	November 19, 2009	Farmers	18	4	INIAP	Improve water management in production systems.
Workshop	December 8, 2009	Students in local schools	40	27	INIAP	Inform stakeholders and professionals about research results
Workshop	December 9, 2009	Students in local schools	26	32	INIAP	Train on means of NRM and environmental conservation
Field day	March 13, 2010	Students UTA and farmers	26	32	INIAP	Inform stakeholders and professionals about research results
Gender workshop	April 7-10, 2010	SANREM Ecuador team and strategic partners (governmental, NGO, and university)	12	12	Virginia Tech (CCRA PI) and Elena Cruz of LAC team (LTRA – 7)	Increase understanding of gender and USAID requirements and present participative methodologies aimed at increasing women's participation in CRSP research.

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Workshop/Focus Group Activities	April 8, 2010	Farmers from Culebrillas, Illangama watershed (Ecuador)	12	15	Virginia Tech (CCRA PI)and Elena Cruz of LAC team (LTRA – 7)	Introduce and investigate the concepts of access to agricultural inputs and technology networks, and gendered knowledge and practices.
Workshop/Focus Group Activities	April 9, 2010	Bola de Oro, Alumbre watershed (Ecuador)	8	8	U Virginia Tech (CCRA PI)and Elena Cruz of LAC team (LTRA – 7)	Introduce and investigate the concepts of access to agricultural inputs and technology networks, and gendered knowledge and practices.
Workshop	April 11- 13, 2010	Partners SANREM	18	6	INIAP	Demonstrate to research partners SANREM achievements and guide discussions about subsequent year planning
Workshop	April 14, 2010	Professionals and partners	36	8	INIAP	Inform stakeholders and professionals about research results regarding NRM
Workshop	July 21, 2010	Professionals UEB	10	4	INIAP	Inform stakeholders and professionals about research results
Ghana						
Project Inception Workshop	Dec. 3, 2009	All collaborators and partner institutes in Ghana	40	15	Kansas State, P.V.V. Prasad, SARI, NGOs	Introduce and explain project objectives and methodologies

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Focus Group	March 30, 2010	Men and women villagers in New Nyoli, Ghana	6	11	SANREM ME in collaboration with SARI researchers and Lassia Tuolo agents	Introduce and investigate the concepts of conservation agriculture, technology networks, and gendered knowledge and practices.
Workshop	April 21- 22, 2010	Extension agents in Wa, Ghana	8	8	Kansas State University, T. Dalton, and SARI/Wa	Training on conducting baseline surveys
Seminar	April 23, 2010	SARI scientific staff	30	8	Kansas State University	Overview of SANREM project
Haiti						
Workshop	January 11-12, 2010	University of Haiti agriculture faculty and students	58	4	CSES Dept and SANREM ME Virginia Tech	Introduce CAPS project and research design and implementation issues in the Central Plateau.
Research Site Selection, Corporant	March 15, 2010	Zanmi Agrikol Agronomists and technicians	7	3	Virginia Tech	Train agronomists to square, GPS, and stake out the experiments, take soil samples, do soil percolation test, and take soil bulk density.
Research Site Selection, Lachateau	March 16, 2010	Zanmi Agrikol agronomists and technicians	6	3	Virginia Tech	Train agronomists to square, GPS, and stake out the experiments, take soil samples, do soil percolation test, and take soil bulk density
Workshop at Wozo Plaza Hotel, Mirebalais	March 16, 2010	Gillaine Warne, Director of Zanmi Agrikol and Zanmi Agrikol Agronomists	5	3	Virginia Tech	Explain the research protocol (randomization, replication, seeding, data collection, and harvest techniques) for black bean, maize, and conservation agriculture research plots.

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Research Site Selection, Maïssade	March 17, 2010	Catitas Agronomists	4	2	Virginia Tech	Train agronomists to square, GPS, and stake out the experiments, take soil samples, do soil percolation test, and take soil bulk density
Workshop at Caritas Office, Hinche	March 18, 2010	Catitas Agronomists	4	2	Virginia Tech	Explain the research protocol (randomization, replication, seeding, data collection, and harvest techniques) for black bean, maize, and conservation agriculture research plots.
Research plot handling and data collection	July 19-20, 2010	Zanmi Agrikol agronomists and enumerators	2	1	Virginia Tech	Research data quality assurance
Kenya						
Focus Group	July 20, 2010	Men and women villagers in Naisombu, Kenya	11	11	SANREM ME in collaboration AT Uganda, Manor House AC, and SACRED	Introduce and investigate the concepts of conservation agriculture, technology networks, and gendered knowledge and practices.
Lesotho						
Training on CA Principles and Practices with practical training	September 9, 2009	Pastors Group 1	20	4	Growing Nations /NUL Partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Training on CA Principles and Practices with practical training	October 14-19, 2009	Growing Nations Team & Pastors Group 1	17	5	Growing Nations /NUL Partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
Training on CA Principles and Practices with practical training	November 23-27, 2009	Pastors Group 1	13	4	Growing Nations /NUL Partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
2009/ 2010 Growing Season Field Days	Feb 24, 2010	Maphutseng valley farmers	5	7	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
2009/ 2010 Growing Season Field Days	Feb 26, 2010	Catholic Relief Services	13	11	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
2009/ 2010 Growing Season Field Days	Feb 26, 2010	Lesotho Agricultural College Lecturers	8	1	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
Training on CA Principles and Practices with practical training	Feb 29 – March 4, 2010	Pastors Group 1	10	4	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
2009/ 2010 Growing Season Field Days	March 3, 2010	Bethesda High School students	65	80	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
2009/ 2010 Growing Season Field Days	March 3, 2010	Bethesda High School Teachers	3	6	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
2009/ 2010 Growing Season Field Days	March 8, 2010	Botha-Bothe District Farmers	3	5	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
2009/ 2010 Growing Season Field Days	March 9, 2010	Block Farmers, MAFS Officers, World Vision, FAO, AFM, CRS	41	18	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
2009/ 2010 Growing Season Field Days	March 16, 2010	NGOs: WFP, Transformation Resource Center, World Vision	15	9	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
2009/ 2010 Growing Season Field Days	March 17, 2010	Ministry of Education & Training Southern Districts	4	1	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Training on CA Principles and Practices with practical training	April 12-16, 2010	Pastors Group 1	10	4	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
2009/ 2010 Growing Season Field Days	April 22, 2010	Parents of Maphutseng Primary School	22	51	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management
Training on CA Principles and Practices	May 4, 2010	Maphutseng Farmers Group 1	10	10	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	May 17, 2010	Maphutseng Farmers Group 1	10	10	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
2009/ 2010 Growing Season Field Days	May 27, 2010	Ministry of Agriculture & Food Security in Mohale's Hoek - Extension Officers	3	10	Growing Nations & NUL partnership	Showcase the state of Conservation agriculture systems versus conventional agriculture: Demonstrations on weeding, cover crops, cereal crop production & Field trials on fertilizer management

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Training on CA Principles and Practices with practical training	May 31- June 4, 2010	Pastors Group 1	13	4	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
Training on CA Principles and Practices with practical training	June 8- July 1, 2010	Pastors Group 2	4	5	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
Training on CA Principles and Practices	June 9-11, 2010	Group 1 & 2 Maphutseng Farmers	20	17	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	June 21- 23, 2010	Maphutseng Farmers Group 2	10	7	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	June 21- 23, 2010	Dare care School Teachers	0	6	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	June 28- 30, 2010	Maphutseng Farmers Group 1	10	10	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Field Day cum Training	July 1, 2010	Lesotho Geography & Environment Movement, Officers of the High School Curriculum Department of Botswana & Lesotho's Ministries of Education & Training	30	60	Growing Nations /NUL Partnership	Raise awareness of CAS in environmental management & need to incorporate into school curricula
Training on CA Principles and Practices with practical training	July 5-9, 2010	Pastor Group 1	13	4	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
Training on CA Principles and Practices	July 23-25, 2010	Church Leaders in Maphutseng Consistory	6	12	Growing Nations Training Team	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	July 26-28, 2010	Maphutseng Farmers Group 4	5	6	Growing Nations /NUL Partnership	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	August 3, 2010	Mpharane Farmers in Mohale's Hoek	10	7	Growing Nations /NUL Partnership	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	August 20 -24, 2010	Maputsoe – Ecumenical Pentecostal Church Group	9	0	Growing Nations /NUL Partnership	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Training on CA Principles and Practices	August 27, 2010	Sebapala Farmers – New Revelation Movement	2	3	Growing Nations /NUL Partnership	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	August 27-29, 2010	Church Leaders Maphutseng Consistory 2	3	7	Growing Nations /NUL Partnership	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	September 3-5, 2010	Day Care School Teachers 2	0	7	Growing Nations /NUL Partnership	Demonstrate Conservation Agriculture Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices with practical training	September 6-10, 2010	Pastors Group 1	11	4	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
Training on CA Principles and Practices with practical training	Sept 13-17, 2010	Pastors Group 2	11	7	Growing Nations /NUL partnership	Enhance the capabilities of trainers and promoters of conservation agriculture in the communities
Mechanization Field Day	September 17, 2010	Country Wide attendance: Farmers, MAFS Officers, NGOs, WFP, FAO	104	90	Growing Nations /NUL Partnership	Demonstrate different equipment for CAS both mechanized & manual technologies
On-Farm Training in each location	September 22, 2010	Mpharane Farmers -on site	10	25	Growing Nations Team	
On-Farm Training in each location	September 22, 2010	Ha Mootsinyane	30	10	Growing Nations Team	

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
On-Farm Training in each location	September 22, 2010	Ha 'Mantsase	10	10	Growing Nations Team	
Mali						
Project Inception Workshop	Dec. 7, 2009	All collaborators and partner institutes in Mali	18	5	Kansas State, P.V.V. Prasad, IER, NGOs	Project objectives and methodologies
Focus Group	March 14, 2010	Men and women villagers in Fambougou, Mali	13	22	SANREM ME in collaboration with IER researchers and PRECAD agent	Introduce and investigate the concepts of conservation agriculture, technology networks, and gendered knowledge and practices.
Focus Group	March 15, 2010	Men and women villagers in Bouaware, Mali	22	17	SANREM ME in collaboration with IER researchers and PRECAD agent	Introduce and investigate the concepts of conservation agriculture, technology networks, and gendered knowledge and practices.
Workshop	May 16, 2010	Extension Agents	13	1	Kansas State, T. Dalton, IER	Training on conducting baseline surveys
Philippines						
SANREM Phase 4 Kick-Off Meeting and Farmers' Field Day	April 26, 2010	Farmers, academe, students, agricultural technicians, policy-makers, researchers, practitioners	60	45	UPLB ICRAF-LFPI	<ul style="list-style-type: none"> • Present the SANREM CAPS project to stakeholder • Gather feedback from farmers about proposed CAPS project • Present CAPS-related technologies on farm

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
SANREM Farmer-Cooperators' Workshop	June 17, 2010	Farmers, researchers	13	7	NCAT UPLB ICRAF-LFPI	<ul style="list-style-type: none"> • Present CAPS project to potential farmer-cooperators (FC) • Gather feedback from potential FCs about proposed CAPS project (esp researcher's improved cropping systems) • Identify potential improved cropping systems
Focus Group Discussion on Gender Cross-Cutting Agenda (CCRA) of "Crop-Livestock Complementation"	July 15, 2010	Farmers, IP leaders, policy-makers, researchers	8	13	Virginia Tech UPLB ICRAF-LFPI	<p>In the context of CAPs:</p> <ul style="list-style-type: none"> • Identify women's roles, types of resources needed and from whom • Conduct gendered access, control and labor mapping • Complete socio-economic activity profile • Discuss environmental beliefs and perception using soil samples and pictures

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
Focus Group Discussion on Gender Cross-Cutting Agenda (CCRA) of "Crop-Livestock Complementation"	July 16, 2010	Farmers, IP leaders, policy-makers, researchers	11	19	Virginia Tech UPLB ICRAF-LFPI	In the context of CAPs: <ul style="list-style-type: none"> Identify women's roles, types of resources needed and from whom Conduct gendered access, control and labor mapping Complete socio-economic activity profile Discuss environmental beliefs and perception using soil samples and pictures
Gender workshop	July 17, 2010	Philippines HC team (LTRA – 12)	0	2	Virginia Tech (CCRA PI)	Increase understanding of gender and USAID requirements and present participative methodologies aimed at increasing women's participation in CRSP research.
Uganda						
Gender workshop	June 25, 2010	Kenya and Uganda HC team (LTRA – 10)	3	3	Virginia Tech (CCRA PI)	Stress importance of gender equity and research for SANREM and provide tools for implementation
Workshop/Focus Group Activities	June 26, 2010	Farmers from Kaplak village and Parish, Kapchorwa District KACOFA members and field facilitators; farmers	21	12	Virginia Tech (CCRA PI)	Train partners and collaborators in use of participatory techniques addressing gender issues; provide farmers (especially women) with opportunities and skills in map-making, self-reflection and presentations

Program type (Workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants		Training Provider (US university, host country institution, etc.)	Training Objective
			Men	Women		
USA						
Seminar	Jan 22, 2010	University faculty and students	7	4	University of Tennessee	Explanation of CAPS in subsistence agriculture
Short course	September 2010	INIAP (Monar, Escudero), PROINPA (Saavedra)	2	1	Dr. Delgado (ARS)	Training on development and calibration of nitrogen index

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SANREM CRSP leveraged funding, FY 2010

Table 15 SANREM CRSP leveraged funding

Brief description or title of activity being funded or supported¹	Activity leader Name	Activity leader institution	Funding period (start year end date)²	Source of funds or support³	Non-tracked funding or support contributing to SANREM activities⁴, \$	Funding or support for non-SANREM activities resulting from SANREM activities⁵, \$
Visiting Indonesian Scholar Support: Ms. Juang Kartika for Review of Literature on Perennial Peanut (<i>Arachis pintoi</i>) as Potential Cover Crop in the Tropics	Manuel R. Reyes	North Carolina Agricultural and Technical State University (NCA&T)	January 2010 -- December 2010	Indonesian government	\$5000	
Graduate student support from Vietnam government, student will pursue M.Sc. and thesis is on: 'APEX model evaluation of Long-Term Organic and Conventional Vegetable Production under Conservation and Conventional Tillage Systems in North Carolina'	Manuel R. Reyes	NCA&T	January 2010 -- December 2010	Vietnamese government		\$27,369

Brief description or title of activity being funded or supported¹	Activity leader Name	Activity leader institution	Funding period (start year end date)²	Source of funds or support³	Non-tracked funding or support contributing to SANREM activities⁴, \$	Funding or support for non-SANREM activities resulting from SANREM activities⁵, \$
Soil Quality and Crop Productivity under Direct Seeding Mulch-based Cropping Systems	Manuel R. Reyes	NCA&T	March 2010 –March 2011	French Embassy	\$11,480	
Graduate studies in plant pathology at Penn State University	Backman	Penn State	2010-2011	Penn State scholarship (1 full, 1 partial)	\$65,000	
Graduate studies in agricultural economics at Virginia Tech	Alwang	Virginia Tech	2010-2011	Department of AAEC	\$40,000	
Conservation agriculture and natural resource management in Saraguro, Provincia de Loja, Ecuador	Barrera	INIAP	2010-2012	SENACYT, Govt of Ecuador	\$500,000	
Great Plains Sorghum Improvement and Utilization Center	Prasad	Kansas State	Aug 2010 - July 2011	USDA-NIFA	\$53,000	
INTSORMIL - CRSP	Prasad	Kansas State	Oct 2010 - Sep 2011	USAID	\$80,000	
USAID - Mali Mission - Research	Prasad	University of Nebraska	Oct 2010 - Sep 2011	USAID	\$40,000	
USAID - Mali Mission - Training	Prasad	Purdue University	Oct 2010 - Sep 2011	USAID	\$150,000	

Brief description or title of activity being funded or supported¹	Activity leader Name	Activity leader institution	Funding period (start year end date)²	Source of funds or support³	Non-tracked funding or support contributing to SANREM activities⁴, \$	Funding or support for non-SANREM activities resulting from SANREM activities⁵, \$
Ogallala Aquifer Program	Prasad	K-State	Oct 2010 - Sep 2011	USDA - NIFA	\$45,000	

USAID common indicators for SANREM CRSP

Table 16: USAID Common Indicators

Indicator	Documentation (list each relevant item by indicator category)
Beneficiaries	
Increases in smallholder income	
Improved nutrition of smallholder families (increase in caloric and protein intake)	
Health benefits (reduction in malnourishment)	
Number of rural households benefiting directly from interventions	120 farm households
Number of partner organizations and active institutional members of those partner organizations	27 partner organizations including over 3,000 active members
Number of agriculture related firms benefiting directly from interventions	2 agriculture related firms
Number of producer organizations, water user associations, trade and business associations, and community based organizations assisted/benefiting	3 producer organizations
Number of women's organizations/associations assisted/benefiting	4 women's associations
Number of new public-private partnerships assisted/benefiting	2 public-private partnerships
Training	
Male participants in short-term training	567 men in short-term training
Female participants in short-term training	322 women in short-term training
Male participants in long-term training	15 men in long-term training
Female participants in long-term training	19 women in long-term training
Technologies	
Increase in crop yields	
Decrease in production costs	
New technologies/management practices under research	46 new CAPS technologies are under investigation
Technologies or management practices being field tested	33 CAPS technologies are being field tested

Technologies made available for transfer	3 technologies are available for transfer
Hectares under new technologies	43.4 hectares under CAPS technologies
Number of farmers adopting new technologies	54 farm households are adopting CAPS technologies
Number of processors adopting new technologies	
New surveillance systems	
Policy Development	
Policy studies undertaken	2
Policy studies disseminated	2
Number of institutions/organizations assessed	1
Number of institutions/organizations undertaking capacity/competency strengthening as a result of SANREM assistance	8
Number of institutions/organizations mature/viable in the competency areas strengthened as a result of SANREM assistance	2
Number of policy reforms/regulations administrative procedures presented for legislation/decreed as a result of SANREM assistance	1
Number of policy reforms/regulations administrative procedures prepared with SANREM assistance passed/approved	1
Number of policy reforms/regulations administrative procedures passed for which implementation has begun with SANREM assistance	1
Number of policies/regulations/administrative procedures drafted and presented for public/stakeholder consultation as a result of SANREM assistance	
Number of policies/regulations/administrative procedures analyzed as a result of SANREM assistance	

