SANREM CRSP Semiannual Report 2011

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Sustainable Agriculture and Natural Resource Management

Collaborative Research Support Program

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Executive Summary

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. 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 up and out. Program efforts are competitively driven and organized through a nested landscape systems approach. 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;
- promote the functioning of sustainable resource-based local enterprises in national, regional, and global markets.

The majority of SANREM CRSP research is conducted through its Long-term Research Award (LTRA) programs. The SANREM CRSP Phase IV LTRA activities were initiated last year and this semiannual report describes their accomplishments to date. Each of the projects has established a set of field trials testing their 'best bet' CAPS practices and some initial findings are beginning to emerge. On-farm and on-station research trials are being established nearly simultaneously in most sites. As expected, minimum tillage systems are initially showing lower yields than conventional tillage. Cover crop research is advancing, although some LTRAs are having trouble identifying a viable system to maintain vegetative cover, particularly in the more arid zones. Socio-economic baseline data has been collected in most sites and findings are being analyzed.

The semiannual report also reports on progress of the four cross-cutting research activities (CCRAs) dealing with economic impact analysis, gendered knowledge, soil quality and carbon sequestration, and technology networks, and describes the accomplishments of the management entity (ME) during the first six months of Phase IV.

Phase IV Long-term Research Awards (LTRAs)

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

Plans are in place to initiate enumerator recruitment and pre-testing of the household survey in May following disease- and election-related disruptions which forced postponement of the survey in January. A soil component will be added to the household survey. Research capacity is improving, with local agronomists managing harvests in October and November, and new plot (irrigated) plantings in December. Spring crops will include cultivars selected by farmers and local agronomists from 2010 experiments, as well as local varieties, and several new selections of beans and maize. In addition to cultivars, cover crops for winter/dry season soil coverage were introduced for small plot testing. Beans produced no yield in Maïssade last fall following defoliation by insects and subsequent drought. This year we will focus on introduction of CAPS components using visually effective techniques as well as quantitative measures.

Significant effort has been made by Zanmi Agrikol (ZA) to introduce conservation agriculture concepts to five communities during the dry season. In addition, connections with Faculte d'Agronomie et de Medecine Veterinaire d'Haiti (FAMV), which were disrupted by the earthquake, have been reestablished and strengthened.

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

Conservation agriculture trials have been established in Ecuador and Bolivia. The Ecuador trials are well established, but are nearing the end of the first planting cycle. Establishment of the trials in Bolivia has been hampered by irregular weather (both drought and flooding). The project team has completed training of project technicians from both countries on the Nitrogen Index at the ARS lab in Fort Collins, Co. Graduate students are progressing toward degree completion.

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

During the last six months, data collected from initial surveys, soil analyses, and on-station and on-farm field experiments were analyzed and summarized. Surveys in Ghana documented the current farming systems in the area, major crops cultivated, cropping systems and management, constraints to production, and coping strategies. Eventually a set of CAPS technologies farmers are willing to test in the field was summarized.

Initial soil samples were collected and are being analyzed. Results showed that soils were poor and had low soil organic carbon. Sole crops of maize or soybean produced greater grain yields and crop residue than intercropping in conventional tillage or minimum tillage. There was no

significant difference in maize yield under conventional tillage or no-tillage in the continuous maize cropping system.

Soybean yields were increased with fertilizer application, particularly P, under both conventional and no-till conditions. Soybean growth and yield was not affected by tillage, residue management, or the interaction of tillage x residue management. Residue and grain yields tended to be higher under conventional tillage than under no-till. Maize planted on tied ridges, tied ridges with grass strips and tied ridges with pigeon pea strips produced higher maize residues than maize planted on flat, flat with grass strips, or flat with pigeon pea strips.

In Mali, visits organized with farmers in each site have indicated that minimum/reduced tillage and rotation with a legume crop would be adopted; however, the challenge of permanent ground cover remains ever stronger. Visits to the 'Minimum tillage and cover crop project' of EMBRAPA (Brazil) in Sotuba have shown that *Brachiaria brizantha* could be established as permanent cover crop that can be grazed and still have its deep roots (up to 2.5 m) improve soils. Research designs will be changed to account for *B. brizantha.* In Mali, long term experiments and on-farm tests conducted to assess the impacts of CAPS have indicated that initial soil organic matter content in all sites is below the critical level of 6 g/kg. These soils are nearly compacted, with bulk density values around 1.8 Mg/m^3. Minimum tillage or direct seeding (plus one weeding/fertilizing) produced the same yields as the conventional tillage system. Groundnut hay (2 Mg/ha) and grain (2 Mg/ha) were produced on plots which will be used in rotation with sorghum, millet or maize in the coming rainy season, in contrast to maize/cotton or sorghum/millet rotations.

Collaboration activities have been initiated with CARE International in Mali, on 'Conservation Agriculture / Ecoferme' activities. CARE works in Ségou and Mopti. CARE has suggested integrating their sites into the SANREM CAPS.

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

The University of Tennessee team has ongoing conservation agricultural research in Lesotho and Mozambique. In Lesotho they conducted the baseline household survey in November and December 2010 in the Botha Buthe District in collaboration with the National University of Lesotho (NUL). Their enumerators for this survey were NUL graduates. The survey team interviewed 435 households from ten villages where CAPS had been introduced in some form. They are monitoring carbon sequestration at the field research site in Maphutseng using soil and micrometeorological data to calculate Bowen's Ratio, a ratio that can be used to determine whether soil is a sink or source for carbon dioxide. Basic agronomic research continues at the research site: field studies evaluating fertilizer rate, seeding rate, yield, weed control and management, and winter cover crop selection is ongoing. Throughout much of Lesotho there will be a dismal harvest due to excessive rainfall in December and January. The harvest is expected to be in excess of 7 tons of maize per hectare from our research plots due to early planting and continual soil cover that limits soil erosion. This yield is approximately twenty times greater than the average maize yield in Lesotho.

CIMMYT, our partner in Mozambique, is conducting on-farm demonstrations evaluating varieties, tillage method, fertility level, and cover crop species. Following our visit to Mozambique and discussions in February 2011, the University of Tennessee will provide soil analysis and technical support to their conservation agriculture work in several districts surrounding Chimoio.

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

During the first half of Year 2 the project team remained on schedule in implementing objectives 1, 2, 3 of the CAPS development and implementation project in Kenya and Uganda. For Objective 1, relationships developed during the baseline survey led to development of strong, large stakeholder advisory groups at each of the four study areas. Under Objective 2, they held advisory group meetings last October in which they developed consensus on the nature of the "typical" farming system, its shortcomings, and how CA components could improve upon it. With the advisory groups, they identified on-station and on-farm trial sites and participating farmers. They also discussed requirements for design of an adoptable minimum tillage implement and assessed capabilities of fabrication shops in each area. Under Objective 3, they demarcated all research plots, collected baseline soil samples, and successfully prepared and planted each of their nine treatments at each of the 20 study areas. The six Kenyan and Ugandan graduate students involved in the project have all taken active roles in each stage and will visit all the sites and participating farmers frequently this summer.

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

All baseline data collection and site identifications have been completed and multiple relationships in the perspective locations have been established in this past half year. In India, extensive socio-economic and agricultural baseline surveys were completed in December 2010. This data was validated and analyzed using economic budget principles to develop representative farms for technological assessments.

Results and analysis from surveys and experimental plots determined three CAPS (maize with minimum tillage, maize/cowpea intercrop with minimum tillage, and maize/cowpea intercrop with conventional tillage) and a control (maize with conventional tillage) program. These CAPS were contrasted with the representative farm model (control) in regards to key agronomic and economic indicators, (profit, labor-saving, yield, environmental benefit) and potential economic returns were estimated and compared. These results and CAPS alternatives were presented to Tentuli village farmers at a three-day workshop held in March 2011. Farmers' preference of these CAPS programs with respect to the goal of improved income were then determined using the quantitative Analytical Hierarchy Process (AHP) approach. Results revealed that the farmers really understood the tradeoffs of the CAPS scenarios and were clear on their preferences. Preparation for on-farm CAPS is currently being conducted as twelve field sites have been identified for implementation.

In Nepal, exciting progress has been made with the initiation of the project. Three potential village implementation sites were identified through four village visits, agronomic evaluations, and farmer focus groups in March 2011. The socio-economic and agricultural baseline survey and focus groups were completed in the village of Thumka, Nepal, one of the three implementation villages. Treatments to evaluate selected CAPS options were developed based on farmer feedback, survey data, and agronomic evaluations. It was determined that CAPS strategies of minimum tillage and crop rotation will be the focus for these villages. While living amongst the villagers in Thumka and completing field work, seven farmers at nine sites were identified for initial implementation. Additionally, a weather station was installed and baseline soil sampling was conducted to begin data collection. While initial trials will focus on the selected CAPS strategies, additional strategies have been determined to provide further benefits to targeted agricultural systems.

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

The team has been gathering data in the various biophysical and social science studies it launched in Year 1. For both countries, researcher managed, farmer managed, and 'kitchen' experiments were established. Yields of maize, the main crop for both countries, were lower in conservation agriculture production systems (CAPS) compared with plow-based system. Gross profit margin in CAPS was lower compared with plow-based systems except for maize + cowpea CAPS in the Philippines. Cowpea price was three times higher than maize and cowpea yield was good, which provided a higher partial gross income for maize-cowpea CAPS compared with plow based maize.

Biomass was monitored, and in Cambodia both researcher and farmer managed studies showed that legume cover crop *Stylosanthes guianenses* was poorly developing in Battambang, with soils containing limestone gravels (alkaline soil). This was opposite to the findings in the acidic soils of Kampong Cham. In the Philippines, *Stylosanthes guianenses* produced abundant biomass in the acidic soils of Claveria. Furthermore, *Stylosanthes* biomass yield was significantly higher than *Arachis pintoi*, a slow starter forage legume. Despite the lower yield of CAPS based systems, most participating farmers in both countries were still willing to partner with the team.

Baseline surveys are still being analyzed, and initial findings gleaned. Farm typologies were completed in Cambodia. It was found that 30 percent of the uplands were hydromorphic, which necessitated the need to develop systems based on upland rice cultivation. In the Philippines, baseline surveys were conducted for 60 participants at the research site. It covered the demographic characteristics including the economics of the existing farming systems. There were 28 female and 32 male farmers from lower and upper landscapes, and 24 of the participants were CAPS farmer-cooperators. The survey instrument was translated into a local dialect. Initial data generated from the survey has been encoded for analysis. Initial partnerships with the local government unit in Claveria were also made to start gender-related activities in that area.

In both countries, there was evidence that neighboring farmers who saw conservation agriculture technology at farmer managed plots are starting to copy some form of CA. No-till machines were delivered from Brazil, and tractors were purchased. Training on proper application of pesticides was also conducted.

The second international soil and water assessment tool workshop and conference was successfully held in Ho Chi Minh City in January 2011. More than 100 international attendees, mostly from Southeast Asia, participated. From a previous SANREM project, a book on vegetable agroforestry in Vietnam was released.

Cross-cutting Research Activities (CCRAs)

Economic Impact Analysis CCRA

The Impact Assessment project worked with LTRA-7 to identify CAPS elements and cropping systems to be assessed. Working with MS student Abigail Nguema, several crop rotations and practices currently being tested in the field in Ecuador were identified. Budget data was gathered for those rotations and practices. They recruited (with the Latin American regional program) seven Spanish-speaking undergraduate students who will go to Ecuador this summer to interview farmers in the Chimbo watershed and collect additional budget data on CAPS elements. The project team co-taught (with the Latin American regional program PI) a one credit seminar for the students to prepare them for their research in Ecuador.

The graduate student continued to build the linear programming model for Ecuador that will be used as a template for impact analyses in other regions. This model will be used to assess the optimal CAPS for farms in the sub-watersheds. "Optimal" in the model is defined in terms of profitability of rotation-practice combinations, subject to varying limits on soil erosion. Despite the early stage of our analysis, it seems clear that the CAPS are fairly unique to each regional site and to each sub-watershed in each country. The benefits occur over many years but are relatively small in the early years. The implication is that (a) disseminating CAPS will be a slow process and (b) aggregate impacts of the CAPS developed and promoted in the regional programs are likely to be small even if the impacts are sizable over time in a specific location.

Gendered Knowledge CCRA

The Gender CCRA furthered Phase IV activities for Fiscal Year 2 primarily through analysis of Fiscal Year 1 data and, in consultation with Soils CCRA and Technology Networks CCRA, revisions of the research design and strategy. It also hosted a visiting scholar from Southeast Asia. Three presentations were made at a national conference, and three at Virginia Tech. Graduate Research Assistant (GRA) Keri Agriesti has made satisfactory progress in coursework. Planning is underway for her to carry out fieldwork on gendered knowledge and space in Bolivia from June-August 2011, and for the PI to work with LTRAs in South and Southeast Asia. A workshop on gender and participatory methodologies was held for SANREM students at Virginia Tech.

Technology Networks CCRA

This project is still in the early data gathering phase and is developing collaborative relations with partner LTRAs at their various sites. Preliminary analysis has been conducted on some data from the LTRA-8 site in northwestern Ghana. This led to the drafting and submission of a paper for presentation at the World Congress on Conservation Agriculture later this year. The PI was a participant observer in the household survey conducted by the LTRA-9 team in the Butha Buthe district of northern Lesotho. Master's degree student Jeni Lamb has been collecting data for her thesis and the technology networks study at LTRA-10's Kenya and Uganda sites. This data collection will be completed by the end of April and will provide us with the most complete data set to date (including both farmer and service sector levels). A draft research

strategy for the CCRA was prepared, which takes into account the challenges faced in trying to execute this social science research inclusive of all the LTRAs.

Soil Quality and Carbon Sequestration CCRA

To make meaningful and scientifically verifiable comparisons across all project sites, they are coordinating all soil and agronomic investigations among all 13 developing countries before and after conservation agriculture production systems (CAPS) are implemented. A common minimum dataset was suggested among all LTRAs to measure soil fertility and carbon sequestration changes due to CAPS. They have also obtained USDA soil importation permits so that they can establish a soils library from all project areas. To date, they have Time 0 soil samples from Lesotho and Ecuador. Additionally, they have agreed to support the Gender CCRA to provide soil fertility data in coordination with their work on local gendered knowledge of soil fertility. They have also obtained GPS data and produced GIS maps of several research sites in Ecuador, Lesotho and Nepal. They plan to work with the Economics CCRA to investigate the integration of carbon sequestration into economic models. Ultimately, they 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. A GRA has been identified to help with this goal.

Phase IV Long-term Research Awards (LTRAs)

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

Lead PI: Steve Hodges, Virginia Tech

Host Country: Haiti

Research Progress by Objective

Objective 1: Assess the adaptability of existing agricultural production and livelihood systems for transformation to CAPS.
In October, the team planned to initiate the long-delayed baseline survey of farms in the Central Plateau in January. However, a cholera epidemic initiating in the Central Plateau began to expand, threatening stability and disrupting livelihoods once again. At the same time, there was violence related to political unrest surrounding the elections. Over the next several weeks, they monitored the situation in Haiti. A decision was made to postpone the baseline study until May as the number of individuals in households affected by cholera in the Central Plateau increased, and airports were closed by election protests. Election results were contested, and the runoff delayed until mid-March.

In the interval, the survey instrument design has been completed and approved by the Virginia Tech IRB. The instrument was subsequently translated into Kreyol with the assistance of Haitian agricultural economics intern Kenel Cadet who is completing his undergraduate thesis study at Virginia Tech under the guidance of Dr. Amacher. Further refinement of the translation is in progress by his major professor in Haiti at FAMV. A proposed sampling framework is under discussion with FAMV faculty. They plan to initiate enumerator recruitment and pre-testing in May, with graduate student Nathan Kennedy remaining in Haiti for the duration of the survey. They are currently planning to add a soil testing component to the survey that would provide much needed biophysical data on limiting soil factors matched to household data in the survey area.

Objective 2: Increase agricultural production through development of CAPS.
The focus remains on finding cultivars of beans and corn that will respond in a CAPS environment, on introduction and testing of cover crop suitable for the region and the farmers' situations. Since October and the beginning of the dry season, field work has been limited to harvest of late crops, and plantings of black beans.

Black bean seed weight analysis from the summer were completed at Virginia Tech and returned to Haiti. Cover crop seeds were packaged for plot planting in late July. The team members will travel to Haiti in May for spring planting and evaluation of cover crop residues.

Harvests of crops were complete in November or early December. Plots data will be evaluated collaboratively during the May trip. Black beans (irrigated) were planted at Lachateau in December, and harvested in late March. From 2010 plantings, agronomists and growers selected two black bean cultivars (higher yielding and purple flowers) for increase and on-farm trials. Seeds were distributed to 300 farmers for local testing in December. Additional tests with those seeds and selections and new trials suggested by Dr. Rainey are planned for July and August. Two local bean varieties (one black and one yellow) selected from the market in Las Cahobas have been included in these trials for the coming year. At this point, sites at Corporant and Lachateau are prepared for planting of maize with CAPS practices in late April or May.

Improved cultivars from CIMMYT have been packaged for trial areas, processed, and delivered to the Ministry for distribution to research sites.

Black beans planted during the second rainy season in the Larique community (Maïssade) emerged well, (65 to 95%), but attracted leaf eating insects. After pod formation, drought resulted in no harvestable yields in October. Caritas agronomists felt that black beans were ill-suited for the region and noted that these types of beans are not grown by local farmers.

Objective 3: Increase the capacity of smallholders to adapt and improve CAPS.
Agronomists with Zanmi Agrikol have been active in providing conservation agriculture training to five communities in the lower plateau. Activities include distribution of selected cultivars to 300 farmers in December.

Objective 4: Coordination and Training: Strengthen the human and institutional research and extension capacity for CAPS.
Following the January 2010 earthquake, contacts with FAMV were disrupted. In October, Dr. Moore and Dr. Hodges met with administration and faculty at FAMV to reconnect and seek a stronger involvement. (See October Trip Report). Subsequent to that trip a signed MOA between FAMV and Virginia Tech has been completed, with Dr. P. Duvivier designated as the FAMV liaison for the project.

Significant Training, Capacity Building, and Networking Activities

1. Update degree training students supported:
A PhD student, Nathan Kennedy, is working with Dr. Amacher, and will be overseeing the baseline survey work beginning in May. Due to the delay, he has been able to complete another semester of course work essential to the fulfillment of his degree. Nathan has also worked with the interns to improve his Kreyol language skills.

A master's student, Ryan Steward, began working on the implementation of CAPS with Dr. Thomason in August. He will complete his second semester of course work prior to initiation of field work in Haiti with the new planting season beginning in mid-May.

Two attempts to engage Haitian students in graduate studies work were initiated, and as of this time, they continue to seek likely candidates for graduate work.

Three Haitian undergraduate students, Manasse Mersilus, Giovanni Bien Aime, and Kenel Cadet arrived at Virginia Tech in January, and have been working under the guidance of Dr. Wade Thomason, Dr. Mike Mulvaney, and Dr. Greg Amacher to complete their thesis work. These students brought existing data to the US, and have worked to improve their English language and writing skills. The thesis for each will be completed in English. Although not formally enrolled at Virginia Tech, they have attended several lectures and field visits, interacted regularly with faculty, and assisted in several grant-related activities.

2. Update-short term training events conducted:
Reported short-term training during this interval has been limited to agronomists at Zanmi Agrikol. The agronomists there have trained 890 men and 710 women in the basics of conservation agriculture using five short courses, two seminars, and three field days.

Research Strategy and Development Objectives

1. Describe progress achieving research objectives:
The project team introduced new cultivars, experimental procedures, cover crops, and CAPS concepts. They have asked farmers to test cultivars in their own fields with some success. Cooperating agronomists have made decisions based on experimental data or experiential observations derived from test plots. They have had failures – black beans planted in Maïssade were not harvested after insects and drought destroyed the crop. They have asked local agronomists to do some things that do not make sense to them in a high-risk environment focused on short term benefits (e.g. plant cover crops that do not produce an edible yield). These requests receive low priority if implemented at all. Even straightforward experimental procedures can appear very complicated to new researchers who are unaccustomed to relying on quantitative measures as a basis for decision. We have discovered a profound need for more data on soils, adapted crops, and rotations. The capacity for local agronomists to conduct research has improved, but more is needed.

2. Indicate how this contributes to progress along the development impact pathway:
It is easy to be frustrated by the lack of progress in bringing CAPS components into the testing environment, but we must recognize that appreciation for research as a decision aid and research capacity appears to be at very low level. We must start with fairly simple research that provides readily visible results, and that will bring a perceived benefit to the agronomists and the growers. We are still some distance away from having management decisions being made, even by cooperating agronomists, on the basis of quantitative measurements.

To address our critical need for more data, we are adapting our baseline survey to include collection of field and soils information.

3. Discuss any lessons learned relevant to development goals:
Progress has been made in building the team, but ongoing disruption of travel and the lack of an ongoing or frequent presence undermines trust and slows progress. We hope Nathan's ongoing presence in the Central Plateau and planned, well-communicated visits throughout the planting season this summer will improve the situation. In this regard, it has become very clear since October that face-to-face direct communication is critical in Haiti. While it may be possible to do some research via interpreter, either a shared language or translators with strong technical skills and connections to CAPS will be critical in Haiti.

It is clear that we must spend more time with, and in building capacity of local agronomists and farmers to conduct research. The idea of planting and growing a successful crop without complete turning of the soil is met with strong skepticism at best, even by those who have been trained in CAPS concepts. This seriously limits what we can currently ask and expect cooperators to do. Only as research demonstrates its value will growers be willing to invest in longer term strategies that will eventually reduce risks and improve livelihoods. We must develop easily visible methods that demonstrate the benefit of CAPS. For example, we intend to introduce runoff plots to demonstrate the effects of CAPS on reducing soil erosion.

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

Lead PI: Jeffrey Alwang, Virginia Tech

Host Countries: Bolivia, Ecuador

Research Progress by Objective

Objective 1: Identify and evaluate production practices and farming components that can be assembled into conservation agriculture production systems.

- The team has identified locations for farmer field experiments based on findings from a prior phase of SANREM.
- Ecuador: Experimental design has been established and treatments are in production. There are experiments on farmer fields in the upper (Illangama) and lower (Alumbre) watersheds.
- Bolivia: They have designated four different areas of the Tiraque watershed to establish conservation agriculture (CA) plots that would be planted with the crop sequences agreed upon the previous year. These sites were near the communities of San Kayani (the highest), Cebada Jincana, Wayla Puyru, and 15 de Octubre (the lowest altitude). The altitudes ranged from almost 14,000 ft to 11,000 ft. CAPS experiments include 1) vetch cover crop and inclusion in a potato-quinua-fava bean rotation; 2) supplemental fertility management for the potato phase of the potato-quinua-fava bean rotation; 3) reduced tillage potato trial; and 4) alternative forage options to precede the potato-based systems. The sites were prepared in October, and the team waited for rains in order to seed the fields – it was a La Niña year with unusual rainfall patterns. Through mid-December, there were no rains, with the first rains in the region occurring December 20. Rains very soon caused flooding, and frequent rains prevented planting and washed out crops that had been planted. The only site with viable plants from the cropping sequence (the rest were largely weeds) was the 15 de Octubre site, and since these were planted late, the plants were stunted and provided less than optimal ground cover. Only the 15 de Octubre site would advance to Year 2, while the other 3 sites would all be planted to the Year 1 cropping sequences next October.

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

- Experimental treatments have been established. Several revisions of the experimental design have occurred, but design was finalized during trips to Ecuador in March 2011. They decided to expand investigations of cover crops to intensify potato-pasture

systems in the upper Ecuador watershed to examine means of increasing available potassium in Ecuador and increasing soil fertility in Bolivia.

- Prototype nitrogen index for Bolivia and Ecuador has been released.
- Soil sampling protocols have been worked out to ensure that 0-5 cm and 5-10 cm, as well as 0-25 cm composite samples will be collected and analyzed. Laboratory equipment and supplies were delivered to the team in Bolivia and it was determined that some supplies will be necessary for Ecuador as well. In Bolivia, a hydraulic conductivity apparatus was constructed and tested. Substantial effort has been invested in building capacity for soil analysis in Bolivia (one trip by Stehouwer, 2 trips by Gallagher).
- Baseline soil samples have been completed.
- Team Bolivia has made excellent progress in establishing a small, but adequate soil and plant processing lab. With the appropriate upgrades of their microplate reader, they will be well positioned to do their own labile N and available P measurements. Arrangements to do total C, N and P still need to be made.
- Undergraduate internships for Virginia Tech College of Agriculture and Life Sciences students are ongoing. Alwang, Norton and Bosch are conducting classes on a bi-weekly basis and Amaya is assisting. Seven interns will travel to Ecuador in May-June and conduct research on costs of CAPS practices. Students are currently refining their survey methods and completing a Virginia Tech Institutional Review Board.

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

- Protocol for this research has been designed.
- In Bolivia, SANREM scientists are seeking ways to exploit PROINPA's potential for producing bio-inputs. In particular, Nadezda Amaya will return to Bolivia during June-August 2011 and conduct research that: categorizes potential bio-inputs in terms of their effectiveness in promoting plant growth lowering diseases, etc.; estimates market demand for bio-inputs; and measures costs of production at different scales.

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

No activities to report on.

Significant Training, Capacity Building, and Networking Activities

- Meetings have been held in Bolivia with various USAID projects. These meetings identified areas of collaboration. Meetings were held in both countries with local governments to obtain support and buy-in for SANREM activities

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

Lead PI: P. V. Vara Prasad, Kansas State University

Host Countries: Ghana, Mali

Research Progress by Objective

Objective/Activity 1: Baseline Surveys to Collect Initial Socioeconomic and Biophysical Conditions

- *Progress towards completing critical Annual Work Plan tasks*
  Ghana: Base line surveys were completed in 13 communities from three districts in Upper West region. A total of 358 farmers (157 women) were surveyed and results summarized. This objective is completed.

  Mali: Rapid rural appraisals have been conducted in each of the 'test villages' to evaluate local CAPS. Yet, detailed surveys have to be conducted in 3 of these sites (Ségou, Sikasso, and Mopti). These are scheduled for next May.

- *Changes in research design or methods, obstacles encountered, and actions taken*
  Ghana: No changes, all activities completed.

  Mali: Rapid rural appraisals or 'village meetings' were conducted while waiting for detailed surveys which would provide a complete evaluation of local CAPS.

  Formal complete gender training activities could not be completed, but will be done this year.

- *Significant research findings*
  Ghana: There was strong interest in crop rotations, minimum tillage and water management practices. However, yields in the first year showed that minimum tillage has slightly lower yields than conventional tillage. However, it is known that benefits of minimum tillage are time consuming.

  Mali: The significant finding under this objective is that livestock is part of the cropping systems, therefore crop residues or cover crops are used as forages. Unfortunately, local CAPS have to account for that component.

Objective 2: Develop cropping systems

- *Progress towards completing critical Annual Work Plan task*
  Ghana: Total of 5 on-farm mother tests and baby tests (66 farmers) were harvested and data was analyzed and results summarized.

Mali: A total of 8 on-farm tests (4 agricultural systems of Mali and 52 farmers) have been harvested. Soil samples collected prior to setting each experiment have been analyzed in the laboratory. Crop residues were left as soil cover in some treatments.

- *Changes in research design or methods, obstacles encountered, and actions taken* Ghana: Components of CAPS were tested (minimum tillage, residue management and crop rotations) was tested under on-farm conditions.
  Mali: Components of CAPS (minimum tillage, residue management, possible cover crop) was adapted to local cropping systems (including livestock). This was reflected on the treatments selected for each of the tests.

- *Significant research findings*
  Ghana:

    - Minimum tillage (pre-emergence herbicide and one hand weeding) produced the same yields of maize or soybean as conventional tillage (tractor and manual weeding).
    - Sole cropping of maize and soybean produced greater yields (residue or grain) than intercropping system in all tillage practices.
    - P fertilizer significantly increased yield of soybean under all tillage systems.
    - Maize planted on tied ridges with grass strips or pigeon pea strips produced higher yields than flat, flat with grass strips or flat with pigeon pea strips.
    - There was no clear evidence of effects of crop residue on maize or soybean yield.

  Mali:

    - Minimum tillage or reducing tillage to 2 operations (planting, weeding/fertilizing) produced the same yields of sorghum as the conventional tillage (4-5 operations).
    - Crop residues or biomass used as mulch produced an average of 21 percent yield increase in sorghum over 'no soil cover' treatment.
    - Biomass of millet, sorghum or maize (6 to 11 Mg/ha) were left as crop residues. These would undergo off-season, open grazing.
    - Initial soil organic matter content in all sites is below the critical level of 6 g/kg.

Objective 3: Foster and advance rapid adoption of local CAPS and integrated practices

- *Progress towards completing critical Annual Workplan tasks*
  Ghana:
    - To foster and advance adoption of CAPS by farmers, sub-set of the mother trial treatments were selected by farmers and implemented in their own fields and communities. A total of 66 farmers tested components of CAPs.

Mali:

- Visits to the farmer field tests (52) were organized in each site to foster and advance adoption of CAPS concepts.

- *Changes in research design or methods, obstacles encountered, and actions taken*
  Ghana:
  - There were no major changes on research design. However, selection of fields by farmers for test was variable (poor or good soil fertility; vicinity to animal grazing). Care will be taken to select appropriate site and keep the residue in the soil. Permanent soil cover either through residue or cover crops is a challenge.

  Mali:

  - Visits to the 'Minimum tillage and cover crop project of EMBRAPA' have shown that *Brachiaria brizantha* could be established as permanent cover crop which can be grazed and yet have its deep roots (up to 2.5 m) still improve soils. Research designs will be changed to account for *B. brizantha.*

- *Significant research findings*
  Ghana and Mali:
  - Minimum/reduced tillage and rotation with a legume crop, growing sole crops and following rotation, application of fertilizer and water management practice can help improve yield and would be adopted. However; the challenge of permanent ground cover remains ever stronger.
  - The adaptation *B. brizantha* as a critical, potential solution to the challenge of permanent ground cover will be tested in Mali and possibly in Ghana.

Objective 4: Assess long term effects of CAPS

- *Progress towards completing critical Annual Work Plan task*
  A total of five (Ghana) and eight (Mali) long term experiments were implemented. Initial soil samples were collected and are currently being analyzed.
- *Changes in research design or methods, obstacles encountered, and actions taken*
  No change was brought into research methods, as 'minimum data set' has been collected. However, no 'cover crop' treatment was established. The design will be improved in the coming season with plots of *Brachiaria brizantha*.
- Cost of soil analysis is a greatest obstacle; however, they may be performed with help from the Kansas State soil laboratory and SANREM cross cutting activities. Samples have already been collected to conduct such analysis.

- *Significant research findings*
  Ghana:

    - This is still ongoing. For Sieyiri site, initial soil organic carbon was about 0.6 percent. The soil texture was sandy. Soils are moderately acid (pH 5.7 to 6.2).
    - Results from individual experiments are given in previous section objective 2.

  Mali:

    - Initial soil organic matter content in all sites is below the critical level of 6 g/kg. These soils are nearly compacted, with bulk density values around 1.8 Mg/m3. Soils are strongly to moderately acid (4.8 < pH < 5.9). These soils are deficient in available P (< 7 mg/kg).
    - 'Minimum tillage' or 'direct seeding' (plus one weeding/fertilizing) produced the same yields as the conventional tillage (5 operations on maize in Sikasso).
    - Crop residues or biomass used as mulch produced an average of 26 percent yield increase over 'no soil cover' treatment at the Cinzana Station).
    - Biomass of sorghum (13 Mg/ha) were left as crop residues. These would undergo off-season, open grazing. Remaining biomass will be estimated.
    - Groundnut hay (2 Mg/ha) and grain (2 Mg/ha) were produced on plots which will be used in rotation with sorghum, millet or maize in the coming rainy season, in contrast to maize/cotton or sorghum/millet rotations.

Objective 5: Modeling to predict impacts of CAPS
No task was planned for this year of the project in both Ghana and Mali.

Objective 6: Strengthening capacities – workshops and demonstrations
Field days were organized in October in Ghana. No activities in Mali.

Objective 7: Capacity building – short and long (degree) term training
Ghana: Two students were identified for long term training. One student obtained admission at Kansas State and will start a program in the fall in agricultural economics. The second student is also identified, currently in US, and will be starting his research in Fall 2011 but will start his PhD program in Spring 2012.

Mali: No short and long (degree) term training was performed during this year of the project.

United States: As no candidate was identified from Mali for long term training, we identified a US student was interested in activities of CAPS. She will start her program this summer or fall and conduct her research in the US.

Significant Training, Capacity Building, and Networking Activities

Ghana: One field day was organized for training, capacity building and net working of farmers during this semiannual period. The projects of SANREM and INSTORMIL were integrated.
Mali: In addition to collaborations reported with INTSORMIL, USAID, and EMBRAPA, collaboration/integration of activities has been initiated with CARE International in Mali, on 'Conservation Agriculture / Ecoferme' activities. CARE works in Ségou and Mopti. CARE has suggested integrating their sites into the SANREM CAPS.

Research Strategy and Development Objectives

1. Progress in achieving research milestones

- Farmers have shown interest in adopting technologies related to minimum or reduced tillage, crop rotation with a legume crop (such groundnut, soybean or cowpea) and improved soil fertility (application of N, or P) and water management practices (tied ridges or contour ridging). The challenge is still strong about permanently covering soils with either cover crop or crop residues.
- Long term experiments have been initiated to assess impacts of CAPS on soil quality and crop yields. Minimum data set have been collected on 'mother trials'.
- Baby trials initiated as on-farm test in selected villages.
- Farmer's visits were organized to foster and advance adoption of CAPS.
- Networks have been established with other projects in the region working on similar aspects of conservation agriculture.

2. Lessons learned

Research: Implementation of certain CAPS is a challenge due to alternative use of residue, free animal grazing and conflict with animal husbandry. Weed control and availability of herbicide will be critical. There are still several challenges related to permanent soil cover which is being discussed. No serious issues on research with exception of delays in baseline surveys in Mali.

Administrative Problems: Significant delays in some components of research (baseline surveys and cross-cutting activities) in Mali resulted from difficulties in mobilizing the approved funding. The project participants and the accounting systems have failed to upload receipts to the SANREM scholar site. Expenses for the different activities were instead pre-funded from other sources. The Ghana program had similar problems initially but has been resolved. There were also misunderstandings about the overdraft funds. These will be discussed and be resolved at the annual meeting.

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

Lead PI: Neal Eash, University of Tennessee

Host Countries: Lesotho, Mozambique

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 C, decrease risk and vulnerability to drought.

Cover crops have been planted again in Lesotho and will be continually evaluated over the winter and into spring. Last year, the selected cover crop species reduced winter annual weed populations by more than 90 percent. Discussions with collaborators in Mozambique will continue on how to have cross-cutting research between Lesotho and Mozambique once our Lesotho data analysis is complete.

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

This work continues in the current growing season, exploring the interactions between fertilizer rate, plant density, and mechanical and chemical weed control strategies. Following harvest they will evaluate the data to determine how this study should be changed for next season. Initial observations suggest that yields will probably surpass at least 7 t/ha. Discussions with collaborators in Mozambique are continuing regarding cross-cutting research analysis.

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.

Based upon earlier stakeholder discussion, the team is continuing work on cover crop selection for weed suppression, biomass production, grain production, and residue cover. Wheat and rye are the leading grass candidates for the winter cover crops mix; however, the team continues to evaluate several vetch and clover species, medics, lupin, and pink serradella as the legume species. One of the wheat treatments will be harvested for grain (by hand, heads only), whereas the other treatment will be grown as a biomass crop and rolled flat after maturity. The reason for these two wheat treatments is that it will be difficult to get farmers to produce a food or a cover crop such as wheat and not harvest the grain as is the common practice with most cover crops.

Similar cover crop evaluation trials are occurring in Mozambique.

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

Data entry, cleaning, and analysis from the 435 household surveys in the Botha Buthe District is ongoing. These results should address several gender issues, including time allocation and resource access, as well as highlight various economic issues associated with CAS. Issues identified in the baseline survey will be examined further through participatory techniques (i.e. focus groups, etc.) and additional surveying. Upon completion of the baseline activities, they will further refine the adaptive transformation phase activities which will be evaluated in the final project survey in 2014.

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 a second year of data to assist with understanding fertilizer economics in smallholder maize production. During the next year the researchers plan to have several farmer demonstrations that simply evaluate both cover crops and fertilizer use. They plan to set these plots up as binary trials—"is this treatment better or worse than the conventional practice?"—using our one "best guess" fertilizer rate on half the field and our "best guess" cover crop mix on one half the field (but laid out perpendicular to the fertilizer rate). This layout will provide a control plot (-fertilizer, -cover crop), a fertilizer plot (+fertilizer, -cover crop), a cover crop plot (-fertilizer, +cover crop), and a fertilizer and cover crop plot (+fertilizer, +cover crop). In subsequent years the researchers may consider a higher fertilizer rate based on farmer focus group input and overall data analysis.

Significant Training, Capacity Building, and Networking Activities

There are two US master's students working on this project with several Lesotho and Mozambique candidates pending. The team has two poster publications to report. They continue to contact Embassy and USAID personnel during visits to update previous contacts regarding the program as well as meet their new replacements.

Research Strategy and Development Objectives

They continue to broaden understanding of the overall potential of CAPS in Lesotho and Mozambique. The principal lessons learned (or relearned) are the common age-old lessons about Africa– 1) you can never have too much seed or fertilizer on hand prior to the planting season; and 2) early planting is essential for higher yields. In Lesotho, yields will be small this year due to because this season probably had the highest rainfall of any growing season on record—more than 800-mm during December and January. Most of the maize that was not planted in October, November, or prior to the early December rains was never planted. Following analysis of the survey data and evaluation of the results, the researchers will develop a process to elucidate cultural, gender, or economic drivers/barriers to CAS adoption and consider pathways to overcome these two practices that severely limit maize yields. Following analysis of this crop year's data a first iteration of CAPS will be developed for testing as on-farm trials in the coming year.

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

Lead PI: Jay Norton, University of Wyoming

Host Countries: Uganda, Kenya

Research Progress by Objective

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

Critical Research Accomplishments: The project team held advisory group meetings at each location that were well-attended by men and women opinion leaders of each community. They also identified four on-farm sites at each of the four study areas. These farmers, together with research station managers helping with the on-station sites, constitute the core of their advisory groups with which we have frequent contact to discuss, reflect upon, and plan research activities. The broader groups will convene once per year to review activities and discuss broader implications for adoption.

Development Impact: Building local teams at each of the four study areas has involved important capacity building and nurtured contacts among farmers and support players that is improving understanding of soil degradation issues and setting the stage for co-innovation and participatory evaluation of CAPS components.

Challenges and Responses: The biggest challenge has been finalizing compilation and analysis of the baseline survey. Incompatibility with the Access template created at Makerere University with the computers of our Kenyan partners caused data entry problems that have been difficult to resolve. The length and scope of the survey (200 participants with >15 pages) made copying very expensive and difficult so that transporting hard copies to Makerere for entry was delayed. This was accomplished during Lead-PI Norton's early April visit so that AT Uganda now has all the hard copies and is developing the report.

Objective 2: Define the traditional system and develop prototype CAPS for each area that build upon local knowledge, traditional practices, and address agronomic and socio-economic constraints.

Critical Research Accomplishments: There were active, participatory advisory group meetings where the SANREM researchers forged consensus on the typical current system, the shortcomings of that system with respect to soil quality/sustainability, the concepts of CA, how specific CA practices address shortcomings of the current system, and which practices they should attempt to evaluate in on-station and on-farm trials. Interactions during the meetings went far to develop a cohesive team and common understanding of our objectives and roles in the project.

Development Impact: Advisory meetings included training on erosion and soil depletion processes as caused by conventional tillage practices. This gave participants tools to discuss workable solutions for evaluating and implementing CAPS. They also explored capability of local fabrication shops at each of our study areas. We identified one shop in Bungoma, Kenya, capable of fabricating a tillage implement from detailed line drawings. They are working with an engineer to test a prototype of the implement and then plan to have the Bungoma shop build one for each of the four study areas. It could then be duplicated by shops in each study area.

Challenges and Responses: By opening the floor to many ideas for CAPS components at the meetings they ran the risk of having to reject many suggestions. However, they avoided hard feelings by guiding the ideas toward practices likely to improve soil quality, and then setting the stage for working together to integrate those into adoptable farming systems.

Objective 3: Evaluate agronomic, ecological and economic sustainability of CAPS compared to traditional practices.

Critical Research Accomplishments: Graduate student Jeremiah Okeyo spent the spring semester working with contracted research associate Dominic Sikuku and the NGO partners to solidify relationships for on-farm and on-station research plots. Together with NGO partners and local farmers, they delineated plots at all 20 locations, took baseline bulk soil samples to one meter depth from four points at four depth increments in each plot, and took samples for shipment to CCRA PI Mike Mulvaney in February and March. Okeyo and Sikuku supervised planting by NGO partners with local labor after the first rains in late March and early April. Lead-PI Norton assisted with the last part of the planting in April. April meeting of the soil science/agronomy team at Moi University resulted in directive for each student and research associate to each develop one-page concept note on their specific research questions and approaches that will be embedded in the larger research project. Due date is May 10, prior to the SANREM CRSP annual meeting.

Development Impact: The participatory processes of plot layout, sampling, and planting built capacity and relationships that provide the foundation for a successful long-term project. Each participating farmer was given a rain gauge, notepad, and pencil for recording daily rainfall, and trained in reading the Tru-Chek rain gauges. Each of the farmers took a keen interest in this and it seems to have effectively promoted engagement in the project.

Challenges and Responses: The team has been concerned about the large size of the project, with 20 different research sites in four different districts of two countries. With different NGO partners in charge of each area, consistent implementation and monitoring of CA trials could be difficult. By having PhD student Jeremiah Okeyo, who has a great deal of plot research experience working for the CIAT Tropical Soil Biology and Fertility Institute, spend this semester establishing the plots and educating farmers and NGO partners on their management, we have accomplished a level of consistency and engagement better than we could have hoped

for. Also, Dominic Sikuku, an experienced consulting agronomist, is devoted to successful implementation and has developed an agronomic data collection protocol that will bring him to each of the plots every three to four weeks. PhD student Judith Odhiambo will spend the summer on site monitoring trace-gas emissions once per month at each study area. With this and other visits by NGO partners, students, and PIs, we will visit the farmers and on-station sites frequently and maintain a presence for discussion of the work.

Also, while all research establishment work was timely and well-intentioned, some practices were applied unevenly among study sites, and farmer buy-in was not as clear at one study area as at the others. This was due in part to necessity to change most on-farm sites at that area after initial identification in October, so that the farmers had not attended the stakeholder meeting or met the PIs and NGO participants. This was remedied during one-week post-planting visits by Lead-PI Norton, Sikuku, and Okeyo in which we enlisted the farmers to weed the plots and explained the project and their role in the research. We discussed the situation with the responsible NGO partner and they agreed to increased contact and better management. Sikuku is following up to assist them in fulfilling this commitment.

Significant Training, Capacity Building, and Networking Activities

Primary training involved graduate degree education for two PhD students and one MS student at the University of Wyoming, two MS at Moi University, and one MS at Makerere University.

The University of Wyoming SANREM group of PIs, research associates, and graduate students meets regularly to discuss progress and related research. PD Norton participated in Green Revolution 2.0 symposiums at the 2010 Agronomy Society of America meetings in Long Beach, CA, and also discussed collaboration with Southern Africa SANREM CRSP LTRA-9 Lead-PI Neal Eash. We plan to exchange soils samples for common analyses of carbon and nitrogen pools.

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

Lead PI: Catherine Chan-Halbrendt, University of Hawaii

Host Countries: India, Nepal

Research Progress by Objective

Objective 1: Determine the set of CAPS for sustained productivity, labor, soil impact, gender equity and profitability.

For India, the baseline socio-economic survey was completed for the first project implementation village in Kendujhar, India encompassing household and agricultural assets, income, farmer practices, labor use, agricultural inputs, and market transactions. Additionally, harvest was completed for the first season of the CAPS experimental field plots at the Orissa University of Agriculture and Technology (OUAT) Regional Research and Technology Transfer Station (RRTTS). The harvest data was assessed using an analysis of variance (Infostat 2011) to determine the optimal CAPS options for crop rotation and minimum tillage. From the socio-economic surveys, a representative farm household model was developed for the village of Tentuli. Additionally, this survey and experimental plot data were analyzed and the team of socio-economists and agronomists determined the 1 Non-CAPS and 3 CAPS packages for potential implementation in the village of Tentuli.

All eight combinations of treatments (Conventional Tillage w/Sole Cropping; w/Intercropping, w/No soil cover, and w/Soil cover; and Conservation Tillage w/Sole Cropping; w/Intercropping, w/No soil cover, and w/Soil cover) for India will be tested at the RRTTS. The trials will be moved to another location at the station where the soil type more closely matches that of Tentuli Village.

In Nepal, village implementation sites were selected after consultation with Li-Bird (Nepalese partner organization), village visits, and farmer focus groups. Agronomic evaluations and farmer focus groups were conducted in all three implementation sites. As part of the agronomic surveys, Khet (irrigated terrace), Bari (un-irrigated terrace) and Khoria (un-terraced shifting cultivation) holdings were evaluated for cropping schedule, fertility and pest management and primary market for each crop. Treatments to evaluate selected CAPS options were developed based on farmer feedback and are detailed in the March 2011 SMARTS team trip report.

Significant Research Findings:

The representative household model for Tentuli village, India showed an average annual income of 410 USD, farm size of 1.4 ha, a predominantly maize and rice agricultural system, average household size of seven people, and no education.

The experimental CAPS treatments established at the RRTTS, in India, were evaluated for crop yield and the cost of labor and other expenses (Table 1). Treatments consisted of conventional

tillage (CT) vs. no-till (NT), and sole maize cropping (SC) vs. intercropping with cowpea (IC). Results from the experimental field data showed that each of the conservation agriculture treatments were significantly different with the highest yielding treatment being maize/cowpea intercrop with conventional tillage, followed by maize/cowpea intercrop with no till, and maize sole crop with no till (Table 1).

Table 1. Maize and Cowpea Yields (Mg ha^{-1}) from Experimental CAPS Treatments, OUAT Research Station.

Treatment	Maize (SE)	Cowpea (SE)	Value (Rp)
CT-SC	2.25 (0.10)		56,250
NT-SC	1.50 (0.09)		37,500
CT-IC	1.88 (0.09)	1.00 (0.09)	87,000
NT-IC	1.70 (0.09)	0.73 (0.03)	71,700

Objective 2: Explore stakeholder preferences for CAPS to promote adoption

In March, a workshop was held in Kendujhar, India, to present the fundamentals of conservation agriculture to tribal village farmers. Twenty farmers from Tentuli Village attended (10 male, 10 female). The fundamentals of conservation agriculture were presented as a viable alternative to the maize-based agricultural system in Tentuli. OUAT researchers were trained in the Analytic Hierarchy Process (AHP), which was used to survey and assess farmer preferences for different CAPS options, based on both the agronomic and economic data collected. AHP is a quantitative approach for multi-factor decision-making. With the presentation of the objectives of CAPS and its potential impact, farmers were asked about their preferences based on selected criteria regarding improvements in income, crop yield, labor, and environmental benefits. Of the options presented, farmers chose a conventional tillage, intercropped farming system as their most preferred CAPS option.

In Nepal, although the socio-economic survey was completed in the first implementation village, Thumka, at this time, the preliminary data is not conclusive in determining stakeholder preferences. An AHP assessment of farmer preferences will be conducted following the first round of on-farm trials (to be planted during the 2011 crop cycles), baseline soil analyses, and analysis of the baseline socio-economic data.

Significant Research Findings:

Based on the workshop, in India, outcomes and current farmer practices, the following conventional and CAPS treatments were chosen for comparison:

Conventional Tillage: Farmer's practice (cross-plowing)
Conservation Tillage: Plowing only in rows to be sown
Sole-Cropping: Line planting of an improved variety of maize
Intercropping: Addition of cowpea in maize inter-rows
No soil cover: Farmer's practice

Soil cover: Retention of crop residues in the field post-harvest

From the AHP assessment of farmers preferences with respect to improved income, results showed farmer preference for improved yield (33 percent out of 100 percent), followed by increased profit (27 percent), environmental benefit (21 percent), and labor-saving (18 percent), inconsistency=0.01. Further AHP analysis revealed the Tentuli village farmers' preference of the CAPS: maize/cowpea intercrop with conventional tillage (37 percent, inconsistency=0.02).

Objective 3: Implement preferred CAPS on-farm for validation, impact on farm household welfare leading to policy recommendation

On-farm research trials in India will include the following treatment combinations:

Control: Maize sole crop, conventional tillage, no soil cover
Conventional: Line planting of improved maize, no soil cover
Soil Cover: Maize sole crop, crop residue retention
Intercropping: Intercropping maize/cowpea, no soil cover
Full CAPS: Intercropping maize/cowpea, crop residue retention

Twelve adjacent field sites for on-farm trials in Tentuli were selected for implementation, each belonging to a separate household, and each meeting the requirements for the experimental treatments. The agronomists of the team introduced and trained OUAT faculty and staff on how to set up and use to collect data on weather station equipment, soil sampling equipment, and ion-exchange resin bags. An in-country project coordinator was hired in this half year who will coordinate, organize, and manage all activities at RRTTS.

In Nepal, initial on-farm trials are recommended to focus on Thumka (primary) and Khola Gaun (secondary) villages. Nine sites have been identified and approved by the respective landholders in Thumka. Treatments will focus on two of three CAPS strategies (minimum tillage and crop rotation) and are to be implemented with the assistance of Li-Bird during the 2011 crop cycles. In preparation for on-farm trial implementation, soil sampling was conducted in Thumka to collect baseline soil composition and structure data. Additionally, a weather station was installed to collect site-specific data on soil moisture, rainfall, photo-synthetically active radiation, air temperature and relative humidity for the duration of the project.

Objective 4: Use Participatory Action Research (PAR) approach to promote reflection, evaluation, and continuous improvement of implemented CAPS.

Proposed changes to research design or methods.
The original CAPS treatments established at the RRTTS in 2010 were changed based on the farmer workshop in March. A no-till option was considered impractical for farmers and unlikely to be adopted outside of the research trials. As well, the cover crop chosen to improve soil cover was dropped in favor of crop residue retention because of the importance of the mustard crop to farmer livelihoods. The location of the RRTTS plots was moved to a set of fields

that have a soil type more representative of that found in the villages. Finally, they decided to focus on Tentuli village for 2011 in order to maximize the number of participating farmers in both the workshop and on-farm trials. Their new objective is to include an additional village each year, again maximizing the number of participating farmers in new villages, while maintaining and expanding the number of participating farmers in existing villages.

In Nepal, while initial trials will focus on CAPS strategies (minimum tillage and crop rotation), additional strategies with potential benefits to targeted agricultural systems were identified. These are: 1) improved manure/compost production and application; 2) incorporation of horticultural crops (e.g. tomato) into crop rotation and intercrop systems.

Objective 5: Build capacity of farmers, NGO's, and universities in country

For India, Two UH students were trained and involved in the socio-economic surveying and analysis of field data. One UH student was trained how to use AHP and conducted the AHP workshop in India. The results of the project to date will be presented by these students in a University of Hawaii symposium (April) and in a graduate-level economics course. Furthermore, a paper on the research findings has been accepted into the IFAMA June 2011 conference and is currently under review for journal publication.

Two Nepali research associates were trained in conducting this socio-economic survey. Capacity building was developed for Li-Bird associates and a University of Hawaii graduate student in soil sampling methodology, as well as installation of and data collection from the weather station. This will contribute not only to personal development of research skills for these individuals, but will also aid in the conducting of surveys, soil sampling, and data collection for the remaining years of the project.

Significant Training, Capacity Building, and Networking Activities

For India, Two UH students were trained and involved in the socio-economic surveying and analysis of field data. One UH student was trained how to use AHP and conducted the AHP workshop in India. The results of the project to date will be presented by these students in a University of Hawaii symposium (April) and in a graduate-level economics course. Furthermore, a paper on the research findings has been accepted into the IFAMA June 2011 conference and is currently under review for journal publication.

Special Events:

- Workshop: "Sustainable Management of Agro-Ecological Resources for Tribal Societies" in Kendujhar, India. Refer to Form 18 for selected posters/presentations.
- Seminar: "Use of Field Leaching Studies for Pesticide Registration in Hawaii" at the College of Agriculture at OUAT in Bhubaneswar, India. Presented by Dr. C. Ray.

Networking Activities:

- Meeting with D. Chakrabarti, Kendujhar Collector & District Magistrate, in India.

- Dr. M. Mulvaney, Assistant Program Director of SANREM CRSP (OIRED), joined the SMARTS team's nine-day trip in Nepal.
- Hannah Bent and Ben Cohen, Nepal-based Fulbright Scholars, were introduced to the project and shared their initial research findings.
- Meeting with Dr. W. M. Patterson, Director of the General Development Office for USAID Nepal, at the United States Embassy in Kathmandu, Nepal.

Research Strategy and Development Objectives

Progress achieving research milestones. In most cases, our progress in both countries is on target. The team has deepened working relationships with our local partners and we see this as a definite plus in implementing the future activities.

Progress along the development impact pathway. Since they are close to being caught up to the timeframe of the proposed research strategies and activities, they are able to begin our planning for research on gender and technology network issues. The gender planning activity will begin this summer and hopefully the gathering of field data will commence in Fall 2011.

Lessons learned relevant to developmental goals. We have learned that picking the right partners is extremely important in the success of the project. We noticed the dynamics of university vs. NGO partnerships to be very different. The university's relationship with the community seemed to be more formal and thus resulted in less contact time with the farmers. On the other hand, the NGO relationship with the community seems to be the opposite, thus aiding in the social environment when we conduct work with the in-country counterparts in the community. It was realized that staying in the community, such as our stay in the Hiklung village of Nepal, creates a better and trusting relationship with the farmers.

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

Lead PI: Manuel Reyes, North Carolina Agricultural and Technical State University

Host Countries: Cambodia, the Philippines

Research Progress by 'GETS' Objectives

Goal: To show that conservation agriculture (CA) principles, minimal soil disturbance, continuous mulching ,and diverse species rotations constitute the best 'tool box' to create sustainable permanent cropping systems for annual crop production under wet tropical conditions in Cambodia and the Philippines and CA will reverse soil degradation, increase crop yield and profits and reduce the labor burden on women.

Objective 1: Gender

Pinpoint gendered limitations and advantages that can promote adoption of CAPS, and determine if CAPS will increase labor burden on women in Cambodia and the Philippines

A structured baseline survey instrument was developed to generate information about the characteristics of the farming households in selected villages. Survey data was entered into excel files. The characteristics included patterns of gendered tasks by cropping season, among others. Continuing descriptive analysis and frequency distribution are still on-going. Once completed, this will be packaged into a socio-economic baseline report for CAPS-Philippines, which will be used in conducting the economic impact analysis for CAPS intervention in the research site. This may include improved crop yields, decreased input requirements, increased smallholder farm income, and others that can be associated directly or indirectly to CAPS adoption.

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

In Cambodia, diagnostic rural appraisal on the two targeted villages established farms typology that set the basis for the farms reference network for socio-economic monitoring. The surveys have also highlighted that about 30 percent of the agricultural upland became hydromorphic during the second part of the rainy season, which is not suited for maize cultivation; hence the project started developing systems based on upland rice cultivation. In the Philippines, partial profit analysis in researcher managed plots was conducted with maize-cowpea showing a better profit than plow-based maize. In farmer managed plots, data on farm inputs like labor, seeds, fuel, machinery, fertilizer, and herbicide, pesticides and outputs like yield and market prices are being collected for each farmer. Each farmer was trained in record keeping.

Objective 3: Technology Networks
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.

In the Philippines, the survey data is still being analyzed and data entry was just completed. The team is looking at the stakeholders from whom our partners are getting their resources, be it physical, info or other. The data is being analyzed in order to enhancing scaling-up of CAPS thorough an understanding of knowledge transmission points and network connections.

Objective 4: Soil Quality
Assess soil quality and measure crop yield and biomass from conservation agriculture production systems and compare them with soil quality and crop yield and biomass from conventional plow-based systems in Cambodia and the Philippines

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

Researcher managed:
Cambodia: Researcher managed demonstration plots were established and monitored at two places in Boribo village on black soil with limestone. These demonstration plots aim at adjusting the cropping systems (initially designed in Kampong Cham province on acid oxysol) to local conditions; they are also a showcase of CAPS technologies shown to farmers. CAPS were implemented on 0.2 to 0.4 ha plots split in 2 levels of fertilizer application rates. Two cultivars of maize hybrids were sown to select new varieties to replace the "old" cultivars, whose yield is 25 percent less than new hybrids. Yields of maize, rice, soybean and cassava were measured under the cropping systems shown below. Biomass samples were also collected and are currently being analyzed.

Boribo 1 initiated in 2009

- Bi-annual rotation Maize // Soybean
- Monocropping of Maize on Stylosanthes cover
- Bi-annual rotation Maize // Cassava
- Monocropping of Cassava on Stylosanthes cover (negative reference)

Boribo 2 started in 2010

- Monocropping of Maize on Stylosanthes + Vigna umbellata cover
- Monocropping of Maize on Stylosanthes + Cajanus cajan cover
- Bi-annual rotation Maize // Rice
- Monocropping of Soybean on Stylosanthes + Sorghum cover

It is expected that the introduction of new cultivars of maize, upland rice, and soybean combined with the progressive soil improvement should lead to better yield in 2012. The poor development of *Stylosanthes guianensis* on this type of soil was evident and other possible legume cover crop species are being tested.

Philippines: Researcher-managed demonstration plots were composed of six different cropping patterns and land management practices including the farmer's practice which serves as control in two fertility levels. Soil sampling was done in December 2010 during the harvesting period of the first corn crop. Both undisturbed and disturbed soil samples were collected at three depths (0-5 cm, 5-10 cm and 15-30 cm) and are still being analyzed. The cropping patterns are:

- T1- Maize + Arachis pintoi (AP) - Maize + AP
- T2- Maize + Sytlosanthes guinanensis (SG)- Fallow
- T3- Maize + Cowpea (CP)- Upland rice + CP
- T4- Maize + Rice beans (RB) - Maize + RB
- T5- Cassava + Stylosanthes guianensis
- T6. Farmer's plow based practice

The following was found:

- Conventional maize system yielded better in grain yield and total dry matter yield compared with the other CAPS.
- Maize with cowpea yielded the lowest maize yield due to very close spacing between rows.
- The moderate fertility level (60-30-30) had higher yield across all CAPS compared to low fertility level (0-30-0).
- Maize + Stylo had the highest biomass.
- Monoculture maize had the highest grain yield followed by maize + rice beans.
- Stylosanthes grown with cassava as well as with maize yielded significantly better than the *Arachis pintoi* planted in association with maize.
- Stylosanthes planted with cassava grew better than stylosanthes planted with maize.

Determination of corn yield, biomass, leaf area index and other plant characteristics were specifically done in two plots for evaluation of a crop model under conservation agriculture and plow based systems.

It is evident to farmers that although yield was more in plow-based maize, soil erosion was far more in plow based compared with CAP based systems. Furthermore, team members explained to farmers that during initial years of CAPS it is expected that yield of main crop will be lower compared with plow based systems.

Farmer Managed:
Cambodia: Maize crops yields on the farmer managed plots were lower when compared with plow-based system. This is due to: delayed sowing of maize because no-till machinery did not arrive on time delaying sowing of bio-pump millet grown on the first part of rainy season, and with new technicians, an overdose and too late application of herbicide to control broadleaves and sedge weeds. Yields and gross profit margins of 26 CAPS and 14 plow-based farmers were collected.

Philippines: Eight different CAPS were established and being tested. CAPS were selected by farmers. Each cropping pattern was planted by 3 farmers making a total of 24 farmers directly involved in this study. The cropping patterns were:

- Maize (Mz)+ Baguio beans (BB) - Mz + BB/ Crotalaria (Cr)
- Maize + Stylosanthes guianensis (SG)
- Mz+CP – Mz+CP- Sorghum (Sgh)
- Mz+Peanut (Pnt)/Cassava (Cv)
- Sweet Corn (SwC) + Pnt - SwC + Pnt
- BB + Mz – Mz – Sgh
- Mz + SG – Mz + Cv
- SwC + Pechay (Pc) – SwC + Pc

Each farm consists of 1000 m^2 and represents a replication. Farmers were provided the necessary inputs for the experimental area such as lime, seeds, fertilizers and herbicide. In return, the farmer co-operators will provide and document the amount of labor and other inputs used in the experiment that would form basis in the later analysis. Each farmer also established 1000 m^2 plow-based plots. Results are still being tabulated and analyzed.

Kitchen studies:
Kitchen small plot studies were established in both countries. In the Philippines the following evaluations were conducted laid out in randomized complete block design.

- 8 varieties of cassava not yet harvested.
- 5 varieties of open pollinated corn. Two varieties had better grain and biomass yield than traditional varieties.
- 5 varieties of sorghum. Two varieties had promising grain and biomass yield.
- 6 kinds of fodder grasses. *Pennisetum purpureum* was top performer for both plant height and total aboveground biomass, and followed by *Setaria splendida*. These two forage grass are erect type and are suitable for cut-and-carry system or to be planted as grass strip for soil conservation measures on sloping lands. *Brachiaria rhuzinensis* is another alternative forage grass which is not an erect type, and which is also adapted to acid soil.
- 5 kinds of herbaceous legumes. *Stylosanthes guianensis* and *Crotolaria juncea* outperformed the rest of the herbaceous legumes evaluated. *Arachis pintoi* yielded approximately 3 times lower than the Stylosanthes 5 months after planting.

- 8 cultivars of sweet potato. Newly introduced PSB16 and Lingatos yielded better in both aboveground biomass and roots compared to local check varieties Ka Alma and Miracle. These 4 varieties are now planted in wider scale to be able to produce cutting planting materials for possible inclusion in the CAPS experimentation.
- 7 cultivars of upland rice. Under acid poor soil, IR55419-04 and NCIRC9 were having comparable grain yield and total dry matter yield against IR30716-B-1-B-1-2 which is currently used in CAPS experiments
- 2 cultivars of cowpea. Two cultivars have almost equal yield but have differences in biomass.

In small plot 'kitchen' studies, forage grasses, legumes, sorghum, cassava, sweet potato, upland rice, and open pollinated maize were evaluated regarding suitability for CAPS. Varieties were identified which have promising prospects for CAPS and will be further tested in research and farmer managed trials. Monitoring of soil quality and plant growth characteristics was also done in the Philippines.

In preparation for extensive soil moisture monitoring, two time domain reflectometry (TDR) instruments purchased in the USA and delivered to both countries were tested.

Significant research findings

- During the first cropping, the conventional maize system yielded better in grain yield and total dry matter yield compared with the other CAPS. Maize with cowpea yielded the lowest due to very close spacing between rows at 30 cm.
- The moderate fertility level (60-30-30) had higher yield across all CAPS compared to low fertility level (0-30-0)
- Interplanting maize and cowpea had low maize yield compared with plow-based maize but provided higher gross sales than plow based maize due to good yield of cowpea beans which was sold at a higher price
- Stylosanthes grown with cassava as well as with maize yielded significantly better than the *Arachis pintoi* planted in association with maize
- Need for space in 2 agro-ecosystems strict upland and hydromorphic upland

Changes in research design or methods, obstacles encountered, and actions taken.
No major changes in the research design were done for the Philippines. In Cambodia there was a reduction of the pilot extension surface in 2011 compared to initial goals; only 65 ha (including 7 ha of upland rice for family food supply) with 27 families instead of 125-150 ha initially targeted. This reduction is mainly due to the technical problems encountered in farmers' plots in 2010 (33 ha with 27 families). Despite this difficulty, few farmers have decided to stop collaboration with the project and most of them have increased surface managed with CAPS.

In 2011, the initiated farmers' organizations with the support of AVSF are not strong enough to collectively access improved credit for inputs (fertilizers, herbicide, cover crops seeds) purchase.

Like in 2010, all these inputs will be pre-financed by the PADAC project and retailed to farmers on a free credit basis.

Significant Training, Capacity Building, and Networking Activities

- Farmer field days in Philippines and Cambodia
- Participation to the Kick-off meeting of Harvest program (USAID funded) on 24th February
- Two M.S. graduate students conducted thesis in Cambodia completed degrees. One Cambodian and three graduate students from the Philippines are being supported. Lastly, one Cambodian and a Filipino graduate student were recruited and will commence Ph.D. studies at North Carolina A&T State University, fall 2011.
- SWAT modelling conference and workshop

Research Strategy and development objectives

Through observations and group discussions with farmers, it appears that farmers outside the pilot extension network started to adapt and adopt practises based on conservation agriculture principles. This spontaneous move triggered by the project is highly encouraging and marks the real interest of farmers in the proposed approach. It has also to be closely monitored and possibly oriented to avoid adoption of non-sustainable system. In Cambodia, for the cropping season 2011, some farmers groups supported by the project have already requested the possibility to rent the project's no-till planter to sow in their plots, besides the pilot extension network.

Cross-cutting Research Activities (CCRAs)

Economic Impact Analysis

Lead PIs: Mike Bertelsen and George Norton, Virginia Tech

Research Progress by Objective

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

Task 1: Work with regional programs to identify CAPS elements and farming programs to be assessed.

- Worked with the Andes project to identify CAPS elements and cropping systems to be assessed. Several crop rotations and practices currently being tested in the field were identified.

Task 2: Gather budget data for the CAPS elements to be evaluated in one site (Ecuador) and create a template for data collection in other sites

- Working with a graduate (MS) student, gathered budget data for the CAPS elements to be evaluated in the Ecuador site. Recruited (with the Andes project) seven Spanish-speaking undergraduate students who will go to Ecuador this summer to interview farmers in the Chimbo watershed to collect additional budget data on CAPS elements. Co-taught (with the Andes project Lead-PI) a one credit seminar for the students to prepare them to go and conduct research in Ecuador.

Task 3: Interact with regional programs on additional impact work that they wish to perform

- No major interactions during this six-month period with the other regional programs on the additional impact work they wish to perform. That will be a focus over the next six months.

Objective 2: Identify optimal CAPS in each cropping system being researched and sequencing of CAPS elements

Task 1: Build linear programming model in the Andes site that will be used as a template for analysis in other regions as well. This model will assess optimal CAPS in at least one cropping system in Year 2.

- Working with the MS graduate student, continued to build the linear programming model for Ecuador that will be used as a template for impact analysis in other regions. This model will be used to assess the optimal CAPS in that country as well as provide a template. “Optimal” in the model is defined in terms of profitability of rotation-practice combinations, subject to varying limits on soil erosion.

Objective 3: Estimate the impacts of CAPS systems in targeted LTRA areas.

No activity planned in year 2

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

No activity planned in year 2

Significant Training, Capacity Building, and Networking Activities

Degree training: Masters student Abigail Nguema is completing her thesis on the project. She began on the project in June 2010 and should finish by July 2011. Seven undergraduates have been trained in a one credit seminar course who will be conducting research in Ecuador during the summer.

Research strategy and development objectives

Progress in achieving milestones

Draft of impact model nearly completed with data for most of the coefficients gathered. Once the model is completed, tested, and documented for Ecuador, it will be ready for modifying and testing in other regional programs.

Progress along the development impact pathway

Lessons learned: Despite the early stage of our analysis, it is already clear that the CAPS are fairly unique to each regional site and indeed to each sub-watershed in each country. The benefits occur over many years but are relatively small in the early years. The implication is that (a) disseminating CAPS will be a slow process; and (b) aggregate impacts of the CAPS developed and promoted in the regional programs are likely to be small even if the impacts are sizable over time in a specific location.

Gendered Knowledge CCRA

Lead PI: Maria Elisa Christie, Virginia Tech

Research Progress by Objective

Objective 1: Document differences in men and women's knowledge, beliefs, and perceptions of soil quality

Data from FY2010 on gendered soils knowledge, beliefs, and perceptions, as well as practices and participation from Focus Group Discussions (FGD) were organized and analyzed. This was based on fieldwork in Mali, Philippines, Ecuador, Uganda, Kenya, and Ghana. For this research, gender disaggregated data was gathered by dividing men and women into different groups to describe photos and soil samples. They were then prompted to describe the soil quality, say which soil is better for growing, and explain how they arrived at these conclusions. Other participatory methods were used for activities during the FGD.

The qualitative methodology to collect gendered soils knowledge, beliefs and perceptions of soil quality was adapted to include gender space and gendered landscapes. Using participatory mapping, this methodology collects data on gendered space in order to document how men and women's soil knowledge relates to labor, time allocation, and access to assets, including information and technology. This revised methodology will help us further relate gendered knowledge and gender roles to CAPS.

The CCRA collaborated with the Soils CCRA to create a semi-structured questionnaire, transect and soil sampling strategies for working with LTRAs. Research sites have been selected in Bolivia and the Philippines. For future research, we will use these sites to collect soil samples selected by men and women along transects in correlation with unstructured interviews and soil description and identification exercises.

Literature reviews on gendered knowledge and landscapes, political ecology, and conservation agriculture were prepared as a part of future student research in Bolivia and research in the Philippines. The CCRA also undertook a literature review on ethnopedology, the study of local soil knowledge systems, in order to better understand local analysis and practices with soil. Identification and review of previous project work from PROINPA and other regional sources is in progress. In coordination with the Andes (LTRA-7) student research has been arranged for Bolivia for June-August 2011. Field work in the Philippines initially planned for FY2011 has been pushed to FY2012 in order to build on lessons and revisions to methods based on the Bolivia fieldwork this summer.

The CCRA generated and disseminated knowledge products through three presentations made at a national conference, and three at Virginia Tech. Funding was leveraged from Virginia Tech's Women and Minority Artists and Scholars Lecture Series to bring Dr. Deborah Rubin to speak at the university. Funding was also leveraged from Virginia Tech's Department of Geography for two student presentations at the American Association of Geographers conference.

Significant research findings of data from FY2010 include that men and women describe soils differently using the following categories: physical properties (color, texture, stickiness, etc.), soil fertility indicators (crop health, weather, organic matter, animal, etc.), and labor related properties (plowing, stickiness, pests, erodibility, etc.). Furthermore, the results of preliminary research aimed at creating a methodological design for the future. The information held in local knowledge from men and women can be shared with researchers to provide them with a snapshot-style body of information that illustrates the past and present of a landscape, while explaining the dynamic forces that have acted as agents of change, and can be harnessed to better serve sustainable land practice initiatives. Therefore, a research design and methodology that incorporates ethnopedology, gender analysis, and participatory geographic techniques, such as participatory mapping, is important for upcoming fieldwork.

Objective 2: Document the gendered nature of crop-livestock interaction with respect to the conservation objective of maintaining the crop residue cover on the soil
The qualitative research methodology was revised to focus on the gendered nature of crop-livestock interactions in relation to gendered soil knowledge, beliefs, and perceptions as well as practices, participation, and gendered landscapes. The collection of this data will occur June-August 2011 in Bolivia. This data will be used to analyze gendered access to and control of assets (livestock, information), and develop maps of gendered landscapes of soils knowledge and access to assets.

An annotated bibliography on gender and crop-livestock interaction was created. This information was used to inform methodology and student field work.

Furthermore, a semi-structured questionnaire on soils knowledge and crop-livestock interaction was designed and sent to the Southern Africa team (LTRA 9). Also, presentations and working papers were generated and disseminated for knowledge products.

Significant Training, Capacity Building, and Networking Activities

A Graduate Assistant (GA) was recruited for the coming academic year and will be working on a Masters' degree in Geography with her research focusing on participatory mapping and techniques. The current Graduate Research Assistant (GRA), Keri Agriesti, is in her first year of a Masters' degree in Geography, with her thesis focusing on gendered soils knowledge and gendered landscapes for conservation agriculture production systems (CAPS) in Bolivia. Her fieldwork will be conducted during June-August 2011.

Short-term training events include a Gender Workshop in December 2010 for students and faculty leaving for field work, including SANREM students now in Kenya (Jeni Lamb) and Haiti (Nathan Kennedy), and Keri Agriesti (Leaving for fieldwork in Bolivia, June 2011). The CCRA also created online gender and development, gendered knowledge, and space teaching modules, including readings, reading summaries, and presentations. These will be available to the SANREM network later this Fiscal Year.

Research Strategy and Development Objectives

The research strategy for the Gender CCRA (*Gendered Perspectives for Conservation Agriculture: Local soil knowledge and crop-livestock interaction*) has been revised after much discussion. The strategy is to use qualitative, case study-based research carried out by the PI and graduate students in collaboration with individual LTRAs, the Soils CCRA, and the Technology Networks CCRA. Its overarching research goal is to identify gender-related factors that contribute to the success or failure of conservation agriculture production systems (CAPS). It will consider how gendered access and control of land and livestock correlates with men and women's knowledge, beliefs, and perceptions of soil fertility. It will gather data on men and women's knowledge, beliefs and perceptions about the soil in SANREM test plots, and from other sites in the community to which men, and women have gender-differentiated access. It will work with the Soils CCRA to link beliefs and perceptions about soil quality—based on descriptors in local languages—with scientific knowledge about soils. With the Technology Networks CCRA, it will build on quantitative, survey data about sources of information and attitudes (technological frames) concerning agricultural production practices at the household level, and collaborate to map knowledge networks using qualitative methods.

Progress to achieving these research milestones include research design and methodology, student fieldwork design, collaboration with Soils CCRA and Technology Networks CCRA, and coordination with the South Asia, South East Asia, and Latin America and Caribbean LTRAs. This work and collaboration contributes to our planning process and field work to achieve our development goals. The planning is underway and the research will be carried out in the second-half of this fiscal year.

Analysis of Focus Group Discussions (FGD) in FY2010 (Mali, Philippines, Ecuador, Uganda, Kenya, Ghana) on gendered soils knowledge, beliefs, and perceptions, as well as practices and participation provided insight to our research methods and trainings. Analysis of the data and field work showed miscommunication of research intentions, lack of clarity of information from farmers, and mistranslation of indigenous knowledge into Western science constructs. Drawing upon these concepts, we have learned that qualitative research methods need to incorporate more non-verbal participatory methods (such as participant-observation) as well as more time for training researchers and research assistants on how to listen to farmers without prompting answers and how to document data so as not to lose too much in the translation and filtering through the researchers' frame of reference.

Technology Networks CCRA

Lead PI: Keith M. Moore, Virginia Tech

Research Progress by Objective

Objective 1: Identifying the knowledge and attitudes (technological frames) concerning agricultural production practices held by actors in the network.

Technological frame data was collected at the household level by the LTRA-8 team for the northwestern Ghana site by the LTRA-9 team for northern Lesotho and by the LTRA-10 for their sites in Kenya and Uganda. The Ghana data was shared with the CRRA this winter. After preliminary review, technological frame items were subjected to principal components factor analyses separately for men and women respondents. The resulting factors did not align tightly with expectations for Conservation Agriculture, Conventional Agriculture, or Risk Averse Agriculture technological frames, but local variants of conventional and Risk Averse agriculture were identified. These were analyzed with respect to the extent of contact with extension agents.

The analysis concluded that extension agent contact has little influence over the technological perspective of farm men and women. However, there was considerable diversity among both farm men and farm women over whether "tillage causes land degradation." A positive view of investment in modern capital intensive technologies was found to be inversely related to the perception that "tillage causes land degradation," consistent with the Conventional Agriculture technological frame. Farm women's perspectives echo these relationships. There is a significant group of Risk Averse farm men and farm women who would be amenable to the ideas of Conservation Agriculture. These findings were submitted in a paper for presentation at the World Congress of Conservation Agriculture.

The CCRA-PI participated in some of the data collection interviews conducted by the LTRA-9 team in Butha Buthe Province, Lesotho. This data will become available for CCRA analysis within the coming months. An issue was noted during data collection in the Lesotho highlands: respondents appeared to easily fall into simple yes/no response sets, rather than making more refined distinctions on the attitudinal/knowledge items. It is hoped that as the data collection moved down the mountain toward more commercial areas, response sets might become more discriminating.

Household level technological frame data collected by LTRA-10 in the four research sites of Kenya and Uganda is also being shared with the CCRA. These data have entered in multiple formats and some data management and cleaning may be needed. Technological frame data is also being collected on the service sector agents in Kenya and Uganda by master's student Jeni Lamb.

Objective 2: Describe the structure of information and physical resource flows between these actors.

Data on the structure and quality of relationships between farmers and other members of the agricultural production network was also collected by each of the LTRA teams at the same time as the technological frames data. However, only data on extension agents was retrievable from the Ghana data base. Interviewers did not seem to understand the logic of the questions; consequently, little remains to further advance the analysis at this site without an additional household level survey.

Data on the structure and quality of relationships at the other sites (LTRA-9 and LTRA-10) has just been received or is on its way. Review and analysis of these data will be conducted during the coming months.

Objective 3: Determining critical network pathways and opinion leaders facilitating technological change among farmers and their service sector partners.

Other than occasional site level observations, no data have been collected for analysis on this objective.

Significant Training, Capacity Building, and Networking Activities

Master's degree student Jeni Lamb drafted and defended her thesis proposal during the Fall Semester 2010. After her successful defense of the proposal, she left to conduct primary data collection in Kenya and Uganda in collaboration with LTRA-10 in-country partners. This data collection is nearly completed. She has been learning to adapt to on-the-ground conditions for data collection and survey management. These are important field research skills and understandings that one only gets through the conduct of an actual field work project. A considerable number of contacts and networking has occurred at the research sites as this is part and parcel of the technology networks research endeavor.

The Lead-PI has also met with officials from USAID/Uganda and USAID/South Africa (for Lesotho). Network connections were also established with NGO and government partners at the Lesotho and Uganda sites.

Research Strategy and Development Objectives

The research is proceeding according to the revised schedule whose necessity became apparent during early months of implementation. The Lead-PI and graduate student in collaboration with LTRA (8-9-10) site teams are not able to cover as much territory as envisioned with the initial proposal to work in all seven LTRA projects. A reduced strategy has been designed to focus on completing data collection on both household (farmer) and service sector samples for sites in Uganda, Kenya, Lesotho, and Haiti. Discussion with LTRA-8 PIs will be needed to develop the best plan for moving forward in Ghana and/or Mali. At this point, in depth data collection and analysis is not envisioned for sites in South and Southeast Asia. Some preliminary work with the LTRA-7 team in Ecuador is planned for this summer.

Soil Quality and Carbon Sequestration CCRA

Lead PI: Michael Mulvaney, Virginia Tech

Research Progress by Objective

Objective 1: Quantify soil organic carbon (SOC) fractions in host country project areas before and after CAPS implementation.

Critical Research Accomplishments

- A USDA permit to import foreign soils and an extension of the time we are allowed to maintain those soils has been obtained.
- A GRA has been identified to assist in data collection and laboratory analyses. The volume of data and analyses to be conducted necessitates the hiring of qualified technical personnel.
- Bulk density data has been collected, and Time 0 soil sample collection has been initiated. Soil samples from the Matphutseng site (LTRA-9) have been obtained.
- Assistance was provided to LTRA-7 and LTRA-9 during the installation of researcher managed trials in Ecuador and Lesotho, respectively. Assistance was also provided to LTRA-11 during the installation of on-farm trials in Nepal.
- A cross-referenced database has been used to determine those soil parameters that are common among two or more LTRAs. We have 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.
- They are currently in possession of Time 0 soil samples from Lesotho and Ecuador.

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. This may lay the foundation to allow those adopting CAPS in the developing world to earn C credits as part of a future C trading market. Additionally, it will provide the baseline to which future changes in SOC and soil fertility can be compared.

Challenges and Responses

- *Incomplete dataset*. While they anticipate receiving Time 0 soil samples from all the project sites, it is possible that LTRAs or their project partners will not be able to send us soil samples from their project sites and/or may collect the samples in an inappropriate manner. The Soils CCRA has offered to pay for shipping costs associated with this objective. If needed, and if the budget allows, they will travel to the sites to collect samples themselves or assist the LTRAs in sample collection. In addition, they are dependent on the LTRA project partners to determine grain yield, above-ground biomass, and percent ground cover. It may be assumed that they will likely have an unbalanced dataset, in which case we intend to handle those data using non-parametric statistical methodology.

- *Soil importation*. The importation of soil samples has not been problematic so far, but customs officials have been known to destroy samples on the spot for unclear reasons.
- *Carbon sequestration rates*. A global data analysis from 276 paired treatments indicated that an average of 0.57 ± 0.14 Mg C ha-1 yr-1 was sequestered after changing from conventional tillage to no-till, except in wheat-fallow rotations where no change was found (West and Post, 2002). The study noted that an additional 0.20 ± 0.12 Mg C ha-1 yr-1 can be sequestered by including rotations (except changing from continuous corn to a corn-soybean rotation, which resulted in non-significant treatment differences in SOC accumulation). In our CAPS systems, which employ both minimum tillage and crop rotations, we might therefore reasonably expect to sequester approximately 0.77 Mg C ha-1 yr-1, such that after three years we may accumulate approximately 2.3 Mg C ha-1 yr-1. However, the authors note that C sequestration rates reach a maximum in about 5-10 years after conversion from conventional agricultural practices, so after three years of our CAPS trials, we may reach C sequestration rates that are approaching their maxima, thereby increasing our chances of finding significant differences in SOC between treatments.

Objective 2: Identify cropping systems or elements that improve soil fertility, reduce erosion, and increase C sequestration.

This objective necessitates the implementation of "best-bet" (researcher-recommended) CAPS trials at project locations. Currently, the LTRAs are in the initial stages of identification of cropping system that will be included in "best-bet" CAPS trials. No data is available to implement this objective.

Challenges and Responses

- *Project implementation*. 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. We will gather additional information from farmer-managed trials as they are implemented, as our budget allows. In many cases, the data available from farmer-managed trials may be sufficient to allow incorporation of these data into the dataset. Certainly we can run comparisons of on-farm trials as a separate dataset to determine which components of CA are the most feasible for certain soil types, climates, slopes, etc.
- *Dataset ownership*. In order to make these comparisons, we are dependent on datasets collected by LTRA partners. In some cases, they may be less than willing to share data with the ME, especially if we are not directly involved in the research at the ground level.

Objective 3: Relate successful CAPS components to site specific environmental conditions, including the socioeconomic and biophysical environments to determine what combinations of environmental conditions enable success of CAPS.

Critical Research Accomplishments

- The team is currently supporting the Gender CCRA PI to provide soil fertility data in support of gendered knowledge of soil fertility.
- Collaborated on a literature review of ethnopedology with the Gender CCRA.
- Supported presentation of research findings at the Association of American Geographers in Seattle, WA.
- Currently in the planning phase for the correlation of soil fertility data with socioeconomic household survey data in Haiti in order to determine, in part, the impact of soil fertility on economic efficiency.

Challenges and Responses

The scale of soil sampling in Haiti is a challenge. We estimate that some 1250 individual fields will require sampling. We are currently in the planning phase and will iron out these and other challenges.

Significant Training, Capacity Building, and Networking Activities

The Soils CCRA PI has been awarded adjunct status with the Department of Crop, Soils, and Environmental Sciences (CSES) at Virginia Tech. They have identified a qualified applicant for the Soil Quality CCRA GRA position.

The Soil Quality CCRA PI has been asked to serve on the graduate student committees of two degree-seeking students at Virginia Tech. One student, Ryan Stewart (male, US citizen), is working on his Masters of Science in the Department of CSES under the direction of one of our project LTRA agronomists, Wade Thomason. The other student, Nathan Kennedy (male, US citizen), is working on his PhD in the Department of Forest Resources and Environmental Conservation under the direction of Gregory Amacher. Mr. Kennedy will investigate the potential for carbon payments for CAPS implementation in Haiti, among other projects.

The PI is currently serving as the Program Chair for 2nd International Conservation Agriculture Workshop and Conference in Southeast Asia at the Royal University of Agriculture, Phnom Penh, Cambodia to take place on July 4-7, 2011.

They have assisted in building the capacity of the soils laboratory at INIAP in Ecuador to conduct soil saturated hydraulic conductivity studies, as well as other soil physical properties.

Research Strategy and Development Objectives

A comprehensive report on our research strategy was recently submitted to the ME.

Management Entity Activities

The SANREM CRSP Management Entity has been supporting the early implementation of Phase IV Long-Term Research Awards (LTRAs) and Cross Cutting Research Activities (CCRAs) during the first half of Fiscal Year 2011. Sustainable agricultural and natural resource management innovations, policies, and practices continue to be tested and the results disseminated through professional publications, extension documents, and various reports to partner organizations. Early findings of these recently initiated projects are minimal, but there is still a steady flow of information resources being published on Phase III accomplishments. During this six-month period, Program Director Theo Dillaha resigned and returned to his academic department. Interim Program Director Michael Kelly has been managing program activities since January 2011. Also, Program Coordination Assistant Jane Lee resigned and has been replaced by Christina Brannan, who started work at the end of November 2010. Program activities have continued to move forward without disruption.
Highlights of these supportive activities include the following:

- All LTRAs and CCRAs have submitted and the ME has reviewed and provided feedback on their Research Strategies, adjusted with reference to early implementation experience.
- Three Graduate Research Assistants (GRAs) are completing their course work and are in various stages of data collection and analysis for their Master's theses for the Economic Impact Analysis, Gendered Knowledge, and Technology Networks CCRAs.
- The *SANREM CRSP 2010 Annual Report* was prepared and submitted to USAID.
- The SANREM CRSP has replaced their logo with a more upbeat, modern design.
- The SANREM CRSP website was updated and redesigned, and its organization and functionality improved.
- A PERSUAP has been approved by USAID/Washington for the LTRA-9 sites in Lesotho and Mozambique.
- PERSUAPs have been drafted for LTRA-10 sites in Kenya and Uganda and LTRA-7 sites in Ecuador and Bolivia.
- The Assistant Director assisted LTRA-7 in reinforcing the INIAP Soils Laboratory in Ecuador.
- Eighty-eight (88) new information resources were entered into the SANREM Knowledgebase (SKB).
- Thirty-five (35) new SKB entries originated from SANREM-funded activities.
- Thirty-two (32) SANREM-generated information resources were submitted to the Development Experience Clearinghouse.
- Three Research Briefs and one Policy Brief have been published.
- Two SANREM newsletters were published (December 2010 and February 2011).
- Twenty (20) missions have been taken by US-based PIs to work with host-country counterparts at SANREM research sites.

- The Associate Director accompanied Lead-PI Steve Hodges of LTRA-6 to Haiti to help in establishing an MOU with the State University of Haiti.
- The Soil Quality CCRA conducted missions to sites of LTRA-9 in Lesotho, LTRA-7 in Ecuador, and LTRA-11 in Nepal to collect soil samples and observe the establishment of research trials.
- Technology Networks CCRA conducted missions to LTRA-9 sites in Lesotho while baseline data collection was occurring and to LTRA-10 sites in Uganda where the Technology Network graduate student was collecting data for her Master's thesis.
- SANREM CRSP co-sponsored the 2011 Soil and Water Assessment Tool (SWAT) Southeast Asia Conference in Ho Chi Min City, Vietnam.
- SANREM CRSP received an Associate Award from USAID/Ethiopia for a training of trainers project to integrate community-based watershed planning and other environmental issues to improve rural roads construction.

Appendices

Long-term Degree Training

Table 2: Long-term degree trainees

Student Name	Sex (M/F)	Nationality	Discipline	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	Agricultural Economics	Ecuador	N	Jun 2010	Jul 2011	MS	Y	N	CCR A-6	Bertelsen	Virginia Tech
Albert Alwang	M	USA	Economics	Ecuador	N	May 2011	July 2011	BS	N	N	7	Alwang/Norton /Bosch	Virginia Tech
Anna Testen	F	USA	Plant Pathology	Bolivia/ Ecuador	N	Aug 2010	Dec 2012	MS	Y	Y	7	Backman	Penn State
Annah Latane	F	USA	Agricultural Economics/ French	Ecuador	N	May 2011	July 2011	BS	N	Y	7	Alwang/Norton /Bosch	Virginia Tech

Student Name	Sex (M/F)	Nationality	Discipline	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
Bertrand Ricard	M	French	Agro-economy	Cambodia	N	Apr 2010	Oct 2010	MS	N	Y	12	Chabierski, Boulakia, Penot	Institut Regions Chaudes - Montpellier, France
Cecilia Turin Canchaya	F	Peruvian	Rural Sociology	USA	N	Aug 2007	Dec 2010	PhD	Y	Y	4	Gilles	Universidad Nacional Agraria La Molina (BS, Animal Science, MS Rural Extension-Larenstein University, NL)
Chhoeum Chankakada	M	Cambodian	Agro-economy	Cambodia	N	Apr 2010	Oct. 2010	MS	Y	N	12	Chabierski, Boulakia, Penot	Royal University of Agriculture-Phnom Penh, Cambodia
Cynthia Lai	F	US Resident	Social Economics	India, Nepal	N	Sep 2009	Aug 2011	MS	Y	N	11	Chan-Halbrendt	University of Hawaii-Manoa
Emily Pfeufer	F	USA	Plant Pathology	Bolivia/ Ecuador	N	Aug 2010	Dec 2014	PhD	Y	Y	7	Gugino	Penn State
Erine Thornburgh	F	US	Agronomy	US	N	Summer 2011	Fall 2013	MS	Y	N	8	Prasad / Garrett	Kansas State University

Student Name	Sex (M/F)	Nationality	Discipline	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	Global	N	Sep 2007	May 2012	PhD	Y	Y	1	Ostrom	Indiana University
George Mahama	M	Ghana	Agronomy	Ghana and US	N	Spring 2012	Spring 2014	PhD	Y	N	8	Prasad / Staggenborg	Kansas State University
Hilary Kessler	F	USA	Plant Pathology	Ecuador	N	Aug 2010	Dec 2014	PhD	Y	Y	7	Gugino/Backman	Penn State
Iddrisu Yahaya	M	Ghana	Ag. Economics	Ghana and US	N	Fall 2011	Spring 2014	PhD	Y	N	8	Dalton / Prasad	Kansas State University
Isaac Chepkrui	M	Uganda	Agricultural Economics	Uganda	N	Aug 2010	May 2012	MSc	Y	N	10	Bernard Bashaasha	Makerere University
Jennifer Lamb	F	USA	Agricultural Economics	Global	N	May 2010	May 2012	MS	Y	N	CCR A-8	Moore	Virginia Tech
Jeremiah Okeyo	M	Kenyan	Soil Science	Kenya	N	Aug 2010	Jun 2014	PhD	Y	Y	10	J. Norton	University of Wyoming

Student Name	Sex (M/F)	Nationality	Discipline	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
Jess Martin	F	USA	CSES-International Agriculture	USA	N	Aug 2010	Aug 2011	BSc	Y	N	CCR A-7	Christie	Virginia Tech
Jessica Boatwright	F	USA	Agricultural Economics	Ecuador	N	May 2011	July 2011	BS	N	N	7	Alwang/Norton /Bosch	Virginia Tech
Judith Odhiambo	F	Kenyan	Soil Science	Kenya & Uganda	N	Jan 2011	Dec 2014	PhD	Y	N	10	U. Norton	University of Wyoming
Jyotsna Krishnakumar	F	Indian	Socio-economic	India/Nepal	N	Jan 2010	Oct 2010	MS	N	Y	11	Radovich	University of Hawaii-Manoa
Katherine DuBreuil	F	USA	Agricultural Economics	Ecuador	N	May 2011	July 2011	BS	N	Y	7	Alwang/Norton /Bosch	Virginia Tech
Keri Agriesti	F	USA	Geography	US/Bolivia	N	Aug 2010	May 2012	MSc	Y	N	CCR A-7	Christie	Virginia Tech
Kim Bothi	F	Canadian	Sociology	Zambia	N	Aug 2005	Dec 2010	PhD	Y	Y	2	Buck/Travis	Cornell
Lauren Moore	F	USA	International Studies	Ecuador	N	May 2011	July 2011	BS	N	N	7	Alwang/Norton /Bosch	Virginia Tech
Lyda Huk	M	Cambodian	Energy & Environment	Cambodia	N	Aug. 2011	May 2014	PhD	Y	Y	12	Reyes	North Carolina A&T State University

Student Name	Sex (M/F)	Nationality	Discipline	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
Matt Bruns	M	USA	Soil Science	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	Peck	University of Wyoming
Nadezda Amaya	F	Bolivian	Agricultural Economics	Bolivia	N	Aug 2010	Aug 2013	PhD	Y	Y	7	Alwang	Virginia Tech
Nathan Kennedy	M	USA	Natural Resource Economics	Haiti	N	Mar 2010	May 2013	PhD	Y	N	6	Amacher	Virginia Tech
Patrick Samba Oluka	M	Kenyan	Soil Science	Kenya & Uganda	N	Aug 2010	Jan 2013	M.Sc	Y	N	10	Okalebo	Moi University, Kenya
Patrick Ward	M	USA	Agricultural Economics	Global	N	Jan 2009	Aug 2011	PhD	Y	Y	Policy	Shively	Purdue
Paul Tarnate	M	Filipino	Land/Water Res Eng	Philippines	N	Nov 2006	Oct 2011	MS	Y	N	12	Ella	University of Philippines Los Baños
Pharnice Adikinye Ongonga	F	Kenya	Soil Science	Kenya	N	Jan 2010	Jan 2013	MSc	Y	N	10	Okalebo	Moi University, Kenya

Student Name	Sex (M/F)	Nationality	Discipline	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
Rafael Padre	M	Filipino	Land/Water ResourceEng	Philippines	N	Jun 2008	Apr 2012	PhD	Y	N	12	Ella	UPLB
Robert Gaffney	M	USA	Agricultural Economics	Ecuador	N	May 2011	July 2011	BS	N	N	7	Alwang/Norton /Bosch	Virginia Tech
Romina Manalo-Bondad	F	Filipina	Land/Water ResourceEng	Philippines	N	Nov 2006	Apr 2011	MS	Y	Y	12	Ella	UPLB
Ryan Stewart	M	USA	Crop & Soil Environmental Sciences	Haiti	N	Aug 2010	Sep 2012	MS	Y	N	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
Trevor Simmons	M	USA	Crop &Soil Environmental Sciences	Ecuador	N	May 2011	July 2011	BS	N	N	7	Alwang/Norton /Bosch	Virginia Tech
Tyneth Ly	M	Cambodian	Agro-economy	Cambodia	N	Mar 2011	Jul 2011	MS	Y	N	12	Chabierski, Boulakia	University of Agriculture - Hanoi, Vietnam
Wendy Jones	F	USA	Soil Science	Lesotho	N	Jan 2010	Dec 2011	MS	Y	N	9	Eash/Walker	University of Tennessee

Short-term Training

Table 3. Short-term training (October 2010-March 2011)

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		
Cambodia						
Short course (Cambodia)	17-19-Nov-2010	13 Farmers organization members, 4 technicians, 2 Community Based Organization member	12	7	AVSF	Capacity building in FO management and marketing of products
Exchange visit (Cambodia)	16-18-Dec-2010	10 farmers of RM met 40 farmers from Kampong Cham	7	3	PADAC / AVSF	Farmers' organizations development / DMC technologies in Kampong Cham
Meeting Farmers – grain trading companies (Cambodia)	26-Jan-2011	Farmers' representative - 2 private companies of Pailin province	5	3	PADAC / AVSF	Prospective on contract farming development
Short course (Cambodia)	28-29-Mar-2011	Farmers	12	5	PADAC	Herbicides proper use
Ecuador						
Short course	Sep-Oct 2010	INIAP (Monar, Escudero), PROINPA (Saavedra)	2	1	Dr. Delgado (ARS)	Training on development and calibration of nitrogen

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		
						index
Workshop, Ecuador	1-Dec-2010	Project stakeholders, Chimbo	83	25	INIAP-UEB-GPB	Demonstrate current research on CA and natural resource management.
Workshop, Ecuador	2-Feb-2011	Teachers and students in Loja	33	10	INIAP	Integrated natural resource management: experiences in the Chimbo River.
Workshop, Ecuador	15-Feb-2011	Farmers, Illangama, Ecuador	5	3	INIAP	Integrated crop management for Conservation Agriculture
Seminar	21-Feb-2011	5th yr. Students in the Universidad de Bolívar	20	10	R.W. Flowers, Florida A&M Univ.	Discussed SANREM project and objectives and biomonitoring for water and soils.
Workshop, Ecuador	1-Mar-2011	Project technicians	7	2	Virginia Tech and Penn State University (Mulvaney and Gallagher)	Training on new methods for soil sampling.
Seminar	9-Mar.-2011	INIAP personnel of EE Pichilingue	11	13	R.W. Flowers, Florida A&M University	Raise awareness of the channeled apple snail and the African land snail, two very invasive species in western Ecuador.
Ghana						
Field Day	10-Oct-2010	Farmers , Extension Agents, NGOs	32	25	K-State, P.V.V. Prasad, J.B.Naab, SARI, Ghana at	Field days to show farmers of the region (host village and nearby villages) mother trials on minimum tillage.

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	11-Oct-2010	Farmers, Extension Agents, NGOs	21	9	K-State, P.V.V. Prasad, J.B.Naab, SARI, Ghana at Nandoum	Field days to show farmers of the region (host village and nearby villages) mother trials on water conservations techniques.
Haiti						
Short course	06-11/12/10	Farmers of Morne-Michel	100	100	ZA	Basic Agricultural Conservation Knowledge
Short course	06-11/12/10	Farmers of Cange	25	25	ZA	Basic Agricultural Conservation Knowledge
Short course	06-11/12/10	Farmers of Bois-Joly	90	110	ZA	Basic Agricultural Conservation Knowledge
Short cours	06-11/12/10	Farmers of Balandry	100	100	ZA	Basic Agricultural Conservation Knowledge
Short cours	07-09/02/11	Farmers of Domond	25	25	ZA	Basic Agricultural Conservation Knowledge
Seminar	15/02/11	Farmers of Balandry	100	100	ZA	Soil Conservation
Seminar	16/02/11	Farmers of Morne Michel	200	100	ZA	Soil Conservation
Field day	17/02/11	Farmers of Bois-Joly	200	100	ZA	Soil Conservation
Field day	18/02/11	Farmers of Cange	25	25	ZA	Soil Conservation

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	18/02/11	Farmers of Domond	25	25	ZA	Soil Conservation
Short course	06-11/12/10	Farmers of Morne-Michel	100	100	ZA	Basic Agricultural Conservation Knowledge
Hawaii						
Training	11-Dec-2010	MS Graduate student, Honolulu, HI	0	1	University of Hawaii-Manoa	Train new UH graduate student on how to conduct Socio-economic baseline survey
Seminar	19-Jan-2011	University of Hawaii-Manoa, Dept. of Natural Resources and Environmental Management Graduate level class, Honolulu, HI	11	7	University of Hawaii-Manoa	Raise understanding of the significance of CAPS and the economics of analyzing CAPS through SMARTS case study focusing on Tentuli, India data
Seminar	24-Jan-2011	University of Hawaii-Manoa, Departments within the College of Tropical Agriculture and Human Resources and the public of Honolulu, HI	15	13	University of Hawaii-Manoa	Introduce the conceptual framework and methodology of the economics of CAPS and its implementation
Training	7-Feb-2011	University of Hawaii-Manoa staff, Honolulu, HI	0	1	University of Hawaii-Manoa	Training on Expert Choice Software for Analytical Hierarchy Process data analysis
Seminar	28-Feb-2011	University of Hawaii-Manoa, Dept. of Natural	11	7	University of Hawaii-Manoa	Introduce a quantifiable approach soliciting

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		
		Resources and Environmental Management Graduate level class, Honolulu, HI				preferences of CAPS through the Analytical Hierarchy Process (AHP), theory and Case Study using Tentuli, India data
Training	9-Mar-2011	University of Hawaii-Manoa, Honolulu, HI	0	1	University of Hawaii-Manoa	Train on use/set up of weather station and soil equipment
India						
Field Day: Focus Group	14-Dec-2010	Farmers in Tentuli Village, India	10	7	University of Hawaii-Manoa	Introduce proposed CAPS activities in farmers' fields and LTRA 11 project objectives
Training	14-Dec-2010	OUAT Staff in India	4	1	University of Hawaii-Manoa	Train interpreters on how to conduct household socio-economic and agricultural baseline survey
Workshop	15-Mar-2011	University of Hawaii-Manoa, Tentuli Farmers, OUAT in India	31	18	ICRISAT	Introduce ICRISAT research on Long-Term Conservation Agriculture (CA) experiment on the Black Soil watershed
Workshop	16-Mar-2011	Tentuli Farmers, OUAT Staff/Students, University of Hawaii-Manoa, in India	31	18	University of Hawaii	Introduce the concept of CAPS and its agronomic and environmental benefits
Workshop	16-Mar-2011	OUAT Staff/Students, University of Hawaii-Manoa, in India	15	6	University of Hawaii	Train OUAT staff/students on a method of data collection of farmers'

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		
						preference using the Analytical Hierarchy Process.
Workshop	17-Mar-2011	Tentuli Farmers, Staff interpreters, University of Hawaii-Manoa, in India	24	16	University of Hawaii	Determine farmers preference using an AHP survey
Seminar	21- Mar-2011	College of Agriculture, OUAT, in India	20	5	University of Hawaii	Train OUAT students on the "Use of Field Leaching Studies for Pesticide Registration in Hawaii"
Field Day	22-Mar-2011	Tentuli Farmers, OUAT Staff, in India	0	5	University of Hawaii	Identify, select, and set up field plots in the village of Tentuli
Short course: Training	23-Mar-2011	Tentuli Farmers, OUAT Staff, in India	0	4	University of Hawaii	Training on weather station equipment, attached sensors to the datalogger, and programmed the logging routine
Kenya						
Workshop, Bungoma	18-Oct-2010	Bungoma stakeholders' advisory group	20	2	University of Wyoming, SACRED Africa	Training on soil depletion issues and CAPS components
Workshop, Kitale	21-Oct-2010	Kitale stakeholders' advisory group	14	13	University of Wyoming, Manor House Agric. Centre	Training on soil depletion issues and CAPS components

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		
Lesotho						
Workshop	19-Nov-2010	Survey Enumerators	3	5	University of Tennessee & National University of Lesotho	To prepare enumerators to successfully apply the household survey
Field Training, Matphutseng	3-Feb-2011	Student	0	1	Soils CCRA, Virginia Tech	Selecting and squaring research plots
Field Training, Matphutseng	4-Feb-2011	Students	1	1	Soils CCRA	Instructed how to obtain composite and intact soil cores and use a clinometer
Field Training, Roma	14-Feb-2011	Students	2	0	Soils CCRA	Instructed how to obtain composite and intact soil cores and use a clinometer
Field training (Santa Catalina)	28-Feb-2011	INIAP staff	4	1	Penn State/Virginia Tech	Bulk density and deep soil sampling
2010/2011 Growing Season Field Days	4-Mar-2011	St. Patrick's High School students	26	17	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	4-Mar-2011	Farmers from Liphiring	10	5	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos 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		
2010/2011 Growing Season Field Days	14-Mar-2011	Maphutseng Lead-Farmers	9	5	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	14-Mar-2011	Farmers from Maphutseng	2	3	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	18-Mar-2011	Maphutseng Primary School Students	19	30	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
GPS data collection	21-Mar-2011	U of H GRA	0	1	Mulvaney/Virginia Tech	Achieve proficiency in GPS data collection
Training on CA Principles and Practices	21/25-Mar-2011	Ministry of Agriculture & Food Security in Mohale's Hoek - Extension Officers	0	13	Growing Nations Training Team	Demonstrate CA Systems: Principles, Practices & Demonstrations
Training on CA Principles and Practices	21/25-Mar-2011	Farmers from T.Y and Leribe	1	2	Growing Nations Training Team	Demonstrate CA 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 Visit	23-Mar-2011	ICRAF Mission	7	0	Dr. Marake	Field day with the view to explore agroforestry in CAS for future collaboration
Weather station data collection	23-Mar-2011	Li-BIRD staff; U of H GRA	3	1	Crow/ U. of Hawaii	Achieve proficiency in weather station data collection and download
Bulk density soil sampling protocols	23-Mar-2011	Li-BIRD staff; U of H personnel	2	2	Mulvaney/Virginia Tech	Achieve proficiency in soil bulk density data collection
2010/2011 Growing Season Field Days	25-Mar-2011	Other Farmers from Liphiring	14	3	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	28-Mar-2011	Group 1, Maphutseng Farmers	11	2	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	29-Mar-2011	Group 2, Maphutseng Farmers	11	11	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on

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		
						fertilizer management
2010/2011 Growing Season Field Days	30-Mar-2011	Group 3, Maphutseng Farmers	4	12	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	31-Mar-2011	Group 4 Maphutseng Farmers	4	1	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	1-Apr-2011	Makhakhe Primary School	31	49	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos on weeding, cover crops, cereal crop production & field trials on fertilizer management
2010/2011 Growing Season Field Days	1-Apr-2011	Farmers from Marakabei	7	10	Growing Nations & NUL partnership	Show case the state of CA systems versus conventional agriculture: Demos 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		
Nepal						
Seminar	20-Mar-2011	University of Hawaii-Manoa, LI-BIRD, in Pokhara, Nepal	6	6	Local Initiatives for Biodiversity Research Development (LI-BIRD)	Mini seminar titled, "LI-BIRD at a Glance" focusing on current projects and research by LI-BIRD
Training	21-Mar-2011	University of Hawaii-Manoa, LI-BIRD Staff	1	4	University of Hawaii-Manoa	Train LI-BIRD staff on how to conduct household socio-economic and agricultural baseline survey
Focus Group	22-Mar-2011	Farmers in Thumka Village, Nepal	11	1	University of Hawaii-Manoa	Introduce and explain proposed CAPS implementation activities in farmers' fields and LTRA 11 project objectives
Short Course: Training	23-Mar-2011	LI-BIRD Staff, Thumka Farmers in Nepal, University of Hawaii-Manoa	3	1	University of Hawaii-Manoa	Train LI-BIRD staff and Thumka Village farmers on how to use/set up weather station
Philippines						
Farmers' training on conservation agriculture with trees	15-Jan-2011	Upland farmers	12	25	ICRAF- LFPI	To learn and develop skills on conservation agriculture and agroforestry

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		
Farmers' Field Day	18-Jan-2011	Farmers, Local government units, Academe, Line agencies	36	22	ICRAF- LFPI	To share progress and accomplishments of CAPS project To get feedbacks from farmers' co-operators on their experiences and problems in implementing CAPS
Student field tour	26-Feb-2011	Students from Caraga State University	25	16	ICRAF- LFPI	To learn and develop skills on conservation agriculture and agroforestry
Uganda						
Workshop, Kapchorwa	14-Oct-2010	Kapchorwa stakeholders' advisory group	22	7	University of Wyoming, AT Uganda	Training on soil depletion issues and CAPS components
Workshop, Tororo	16-Oct-2010	Tororo stakeholders' advisory group	11	6	University of Wyoming, AT Uganda	Training on soil depletion issues and CAPS components
United States of America						
Workshop	Dec-2010	Students and faculty	8	9	Virginia Tech	To prepare students and faculty for field research and train on gender 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		
Vietnam						
Workshops on Map Windows, Introductory SWAT, and Advanced SWAT	Jan 4-5, 2011	Scientists and students from Cambodia, Vietnam, Thailand, China and Germany	60	42	NCA&T State University, Texas A&M, Idaho State University, Nong Lam University, Chiang Mai University, UNESCO-IHE-Institute of Water Education	To introduce MapWindows a free GIS software to Southeast Asian users To train new SWAT users and users trained through earlier SANREM sponsored training in Southeast Asia
Second International SWAT-Conference in Southeast Asia	Jan 6-7, 2011	Scientists and students from Cambodia, Vietnam, Thailand, China, United Kingdom, Netherlands and Germany	55	34	Organized by NCA&T, Nong Lam University in partnership with several universities and institutions from many countries	To present latest research and application of SWAT, especially in Southeast Asia To launch SANREM book on: Vegetable agroforestry and cashew-cacao production in Vietnam.
Field trip Mekong Delta	Jan. 8, 2011	Scientists and students from Cambodia, Vietnam, Thailand, China and Germany	11	9	Organized by NCA&T, Nong Lam University and CanTho University	To learn about hydrology of Mekong Delta To see the devastating impact of climate change in Mekong Delta To see and learn from water control structures in Mekong Delta

SANREM CRSP Publications, Presentations, and Other Products

Table 4. Publications, presentations, and other products produced since 10/1/2010

Categories	*Bibliographic Citations**
Articles Published in Refereed Publications	Garrett, K.A., G.A. Forbes, S. Savary, P. Skelsey, A.H. Sparks, et al. 2011. Complexity in climate-change impacts: An analytical framework for effects mediated by plant disease. Plant Pathology 60(1): 15-30. Mulvaney, M.J., A.J. Price and C.W. Wood. 2011. Cover crop residue and organic mulches provide weed control during limited-input no-till collard production. Journal of Sustainable Agriculture 35(3): 312-328. Ostrom, E. 2008. The challenge of common-pool resources. Environment 50(4): 8-21. Price, L.L. 2007. Locating farmer-based knowledge and vested interests in natural resource management: The interface of ethnopedology, land tenure and gender in soil erosion management in the Manupali watershed, Philippines. Journal of Ethnobiology and Ethnomedicine 3:30. Thibeault, J.M., A. Seth and M. Garcia. 2010. Changing climate in the Bolivian Altiplano: CMIP3 projections for temperature and precipitation extremes. Journal of Geophysical Research 115(D8).
Books/Book Chapters	Barrera, V.H., J. Alwang and E. Cruz (eds.). 2010. Experiencias de manejo integrado de recursos naturales en la subcuenca del río Chimbo, Ecuador. Quito, Ecuador: INIAP - SANREM CRSP - SENACYT; Editorial ABYA-YALA. (Spanish) Momsen, J. 2010. Gender and Environment. In: Momsen, J. Gender and Development, 102-135. Thanh Ha, D., L. Van Du, L. Thanh Loan, N. Kim Loi, N. Duc Thanh, P.H. Duc Phuoc, D. Midmore, D. Catacutan, M. Palada, M. Reyes, R. Cajilig, K. Kunta and S. Sombatpanit (Eds.). 2011. Vegetable Agroforestry and Cashew-Cacao Systems in Vietnam. Bangkok, Thailand: World Association of Soil and Water Conservation (WASWAC).
Theses and Dissertations	Amaya Urquieta,N.R. 2009. Effects of access to information on farmer's market channel choice: The Case of Potato in Tiraque Sub-watershed (Cochabamba - Bolivia).MS Thesis. Blacksburg, VA: Virginia Tech.

Categories	*Bibliographic Citations**
	Célleri Aguilar, M.M. 2008. Análisis de la cadena productiva de la leche y sus derivados, en la microcuenca del Río Illangama, Provincia Bolívar - Ecuador. Undergraduate Honor's Thesis. Guaranda, Ecuador: Universidad Estatal de Bolívar, Facultad Ciencias Agropecuarias, Recursos Naturales y del Ambiente. (Spanish) Claros Zeballos, J.C. 2009. Evaluación agroeconómica de cinco cultivos alternativos para la zona alta de provincial tiraque, Cochabamba, Bolivia. Undergraduate Honors Thesis. Cochabamba, Bolivia: Universidad Mayor de San Simón, Facultad de Ciencias Agrícolas y Pecuarias. (Spanish) Henry, A. 2008. Root traits for sustainable low-input agro-ecosystems. PhD diss. State College, PA: Pennsylvania State University. Melnick, R.L. 2010. Endophytic Bacillus Spp. of Theobroma cacao: Ecology and potential for biological control of cacao diseases. PhD dissertation in Plant Pathology. University Park, PA: Penn State University. Morocho, E.E.C. 2008. Evaluación de la pérdida del suelo por erosion hídrica de tres sistemas de producción en la microcuenca de la quebrada Chilcapamba, Canton Chillanes, Porvincia Bolívar. Undergraduate Honor's Thesis. Guaranda, Ecuador: Universidad Estatal de Bolívar, Facultad Ciencias Agropecuarias, Recursos Naturales y del Ambiente. (Spanish) Núñez Ramos, R.E. 2008. Optimización de los modelos de hogares rurales con base en las formas de sustento en la subcuenca del río Chimbo, provincial Bolívar-Ecuador. Undergraduate Thesis. Guaranda, Ecuador: Universidad Estatal de Bolívar, Facultad Ciencias Agropecuarias, Recursos Naturales y del Ambiente. (Spanish) Rivera, M.M.G. 2008. Caracterización socio-económica y ambiental de los sistemas de producción en la subcuenca del Río Chimbo. Provincia Bolívar-Ecuador.MS thesis. Bolivar, Ecuador: Universidad Estatal de Bolívar. (Spanish) Romero, R.P. 2009. Establecimiento de pequeñas empresas agropecuarias rurales sostenibles en comunidades de la provincial Tiraque Bolivia. MS thesis. Cochabamba, Bolivia: Escuela Europea de

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	Negocios en Aragón. (Spanish) Villca, J.C.H. 2009. Determinación deescorrentía y erosion bajo: Deferentes tipos de cobertura vegetal en la zona de Villa Flores-Tiraque. Master's Thesis. Tiraque, Bolivia: Universidad Mayor de San Simón. (Spanish)
World Wide Web Sites and Documents	Christie, M. E. (2010). "CCRA-7: Gendered Perspectives for Conservation Agriculture." Phase IV: Conservation Agriculture Production Systems (CAPS) CCRAs, from http://www.oired.vt.edu/sanremcrsp/professionals/research-activities/phase4/ccras/ccra7/.
Papers/Seminars Presented	Barrera, V., E. Cruz, J. Alwang, L. Escudero and C. Monar. 2010. Experiences in integrated management of natural resources in the sub-watershed of the Chimbo River, Ecuador. Halbrendt, J. and T. Idol. "Introduction to SANREM/SMARTS Project". Presentation in: the Sustainable Management of Agro Ecological Resources for Tribal Societies Workshop; RRTS & KVK Research Station, Kendujhar, Odisha, India. 2011. Lai, C. and C. Chan-Halbrendt."Economics of Environmental Degradation Intervention & Conservation Agricultural Practices in Tribal Villages in India". Presentation in: Department of Natural Resources and Environmental Management Seminar Series; University of Hawaii at Manoa, Honolulu, HI. 2011. Lai, C and C. Chan-Halbrendt. "Analytical Hierarchy Process, Theory and Case Study: India". Presentation in: the Department of Natural Resources and Environmental Management, Economic Analysis of Natural Resource Management Graduate level class; University of Hawaii-Manoa, Honolulu, HI. 2011. Ray, C. "Use of Field Leaching Studies for Pesticide Registration in Hawaii". Presentation in: the College of Agriculture; Orissa University of Agriculture and Technology, Bhubaneswar, Odisha, India. 2011. Rubin, Deborah. (2011a). Gender Dimensions Framework Application. Women, Environment, and Development Class (Women and Minority Artists and Scholars Lecture Series (WMASLS)), Virginia Tech. Rubin, Deborah. (2011b). Gender, Markets, and Development in Africa: Women in Development (WID).

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	Women and Minority Artists and Scholars Lecture Series (WMASLS), Virginia Tech.
Electronic Presentations	Amaya, N., J. Alwang and M.E. Christie. 2010. Are potato markets gendered? An analysis of gender networks in the potato marketing chain in the Jatun Mayu watershed of Tiraque, Bolivia. Presented at the Gender Networks Symposium, Virginia Tech, Blacksburg, VA, 15 November 2010. Bailey, B.A. and R. Melnick. 2010. Entophytes and plant/microbe interactions. Presented at PROINPA, Cochabamba, Bolivia, July 2010. Barrera, V.H. 2010. Análisis de vulnerabilidad en los rubros de soberania alimentaría y cambio climática. Presented to USAID-Ecuador, August 2010. (Spanish) Barrera, V.H. 2010. Causas y consecuencias del cambio climático en la agricultura. Presented to the board of experiment station directors, INIAP, Litoral Sur, Ecuador, 1 September 2010. (Spanish) Barrera, V., E. Cruz, J. Alwang, L. Escudero, and C. Monar. 2010. Finding means to promote the integrated management of natural resources in the Chimbo River sub watershed, Ecuador. Presentation made at ASABE annual meetings, EARTH University, Costa Rica, February 2010. Barrera, V.H. 2009. Manejo de los recursos naturales en la agricultura de pequeña escala en zonas de alta pendiente. Presented at the USDA/FLACSO workshop, "Fortaleciendo la competitividad a través de las prácticas de extensión agrícola en el Ecuador", Quito, Ecuador, December 2009. (Spanish) Cartagena Ayala, Y. 2010. El suelo y la relación con la aplicación de los abonos orgánicos. Presented at a conference on organic agriculture for producers, Bolivar, Ecuador, 6 July 2010. (Spanish) Christie, M.E. and H. Puspitawati. 2010. Mapping gender networks in Bogor District, West Java: Farmers accessing markets for their agricultural products. Presented at the Gender Networks Symposium, Virginia Tech, Blacksburg, VA, 15 November 2010. Cruz, E. 2010. Gestión Integrada de Cuencas como mecanismo para el manejo y conservación de los recursos naturales dentro de la subcuenca del río Chimbo. Presented at the dean of the faculty of natural resources, Universidad Estatal de Bolívar, Guaranda, Ecuador, July 2010. (Spanish)

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	Ella, V.B., J. Keller, M.R. Reyes and R. Yoder. 2010. Improving the water distribution uniformity of a low-cost drip irrigation system using adjustable pressure-loss lateral takeoff valves. Presented at the 2010 Annual International ASABE Meeting, Pittsburgh, Pennsylvania, 23 June 2010. Halbrendt, J. and T. Idol. "Introduction to SANREM/SMARTS Project". Presentation in: the Sustainable Management of Agro Ecological Resources for Tribal Societies Workshop; RRTS & KVK Research Station, Kendujhar, Odisha, India. 2011. Lai, C. and C. Chan-Halbrendt. "Economics of Environmental Degradation Intervention and farmland management". Presentation in: the Department of Natural Resources and Environmental Management, Economic Analysis of Natural Resource Management Graduate level class; University of Hawaii-Manoa, Honolulu, HI. 2011. Lai, C and C. Chan-Halbrendt. "Analytical Hierarchy Process, Theory and Case Study: India". Presentation in: the Department of Natural Resources and Environmental Management, Economic Analysis of Natural Resource Management Graduate level class; University of Hawaii-Manoa, Honolulu, HI. 2011. Lai, C. "Economics of Environmental Degradation Intervention & Conservation Agricultural Practices in Tribal Villages in India". Presentation in: Department of Natural Resources and Environmental Management Seminar Series; University of Hawaii at Manoa, Honolulu, HI. 2011. Lai, C. and C. Chan-Halbrendt. "Farmers' Preference: Workshop and AHP Analysis". Presentation in: the Sustainable Management of Agro Ecological Resources for Tribal Societies Workshop; RRTS & KVK Research Station, Kendujhar, Odisha, India. 2011. Mulvaney, M.J. 2010. Effects of high biomass cover crops and organic mulches on soil properties and collard yield three years after conversion to no-till. Presented at the ASACSSA-SSSA International Annual Meetings, Long Beach, CA, 3 November 2010.
Posters	Agriesti, K. and M. E. Christie (2011). Political Ecology, Gendered Landscapes, and Sense of Place: Local Soil Knowledge and Access to Agricultural Resources in Smallholder Farming Communities in Cochabamba District, Bolivia. Annual Meeting of the Association of American Geographers. Poster

Categories	*Bibliographic Citations**
	Presentation. Seattle, WA, Virginia Tech Office of International Research Education and Development. Eash, N.S., F.R. Walker, D. Lambert, M. Wilcox, M. Marake, R. Wall, A. Basson, W. Bruns, and M. Bruns. Developing sustainable subsistence smallholder conservation agriculture systems in Lesotho. FAO Conference, Johannesburg, 8-10 Feb. 2011. Gomez, L., A. Jumpponen, M.A. Gonzales, J. Cusicanqui, C. Valdivia, P. Motavalli, M. Herman and K.A. Garrett. 2010. Pyrosequencing to determine the influence of fallow period on soil microbial communities in the Bolivian Highlands. Poster. Poster presented at the American Phytopathological Society Annual Meeting, Charlotte, NC, 7-11 August 2010. Halbrendt, J., Lai, C. Chan-Halbrendt, C., Idol, T., Ray, C., and C. Evensen. 2011. An Integrative Approach for Introducing Conservation Agricultural Practices to Tribal Societies in India. 23rd Annual College of Tropical Agricultural and Human Resources and College of Engineering Research Symposium, Honolulu, Hawaii. Halbrendt, J., Idol, T., Chan-Halbrendt, C., and C. Lai. 2011. Poster Presented at: the Sustainable Management of Agro Ecological Resources for Tribal Societies Workshop, RRTS & KVK Research Station, Kendujhar, Odisha, India, 14-17 Mar 2011. Lai, C., Halbrendt, J. and C. Chan-Halbrendt. 2011. Poster Presented at: the Sustainable Management of Agro Ecological Resources for Tribal Societies Workshop, RRTS & KVK Research Station, Kendujhar, Odisha, India, 14-17 Mar 2011. Larochelle, C. and J. Alwang. 2010. Market participation and marketing performance: A case study of Bolivian potato farmers. Poster. Poster presented at the American Applied Economics Association Annual Meeting, Denver, CO, 25-27 July 2010. Martin, J. and M. E. Christie (2011). Space and Place through Soil: Participatory Mapping, Ethnopedology, and the importance of Local & Gendered Knowledge. Annual Meeting of the Association of American Geographers. Poster presentation. Virginia Tech Office of International Research Education and Development. Seattle, WA.

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Magazine & Newspaper Articles	The New Indian Express. "US varsity, OUAT join hands for SMARTS" (page 4). Bhubaneswar, March 27, 2011.
Reports	Howard, P. 2001. Women in the plant world: The significance of women and gender bias for biodiversity conservation. Briefing produced for the International Union for Conservation of Nature. International Union for Conservation of Nature (IUCN).
Abstracts	Eash, N.S., F. Walker, D. Lambert, M. Wilcox, M. Marake, P. Wall. 2010. Developing sustainable subsistence smallholder conservation agriculture systems in southern Africa. ASA, Long Beach, November 2010. Halbrendt, J., Lai, C. Chan-Halbrendt, C., Idol, T., Ray, C., and C. Evensen. 2011. An Integrative Approach for Introducing Conservation Agricultural Practices to Tribal Societies in India. 23rd Annual College of Tropical Agricultural and Human Resources and College of Engineering Research Symposium, Honolulu, Hawaii. Lai, C., Halbrendt, J., Chan-Halbrendt, C., Idol, T., Ray, C., Evensen, C., and P. Roul. 2011. Comparative Economic Analysis of Conservation Agricultural Practices in Tribal Villages in India. 23rd Annual College of Tropical Agricultural and Human Resources and College of Engineering Research Symposium, Honolulu, Hawaii. Lai, C., Halbrendt, J., Chan-Halbrendt, C., Idol, T., Ray, C., Evensen, C., and P. Roul. 2011. Comparative Economic Analysis of Conservation Agricultural Practices Tribal Villages in India. 21stAnnual International Food and Agribusiness Management Association. Frankfurt, Germany.

Acronyms and Abbreviations

ACT	African Conservation Tillage network
AHP	Analytic Hierarchy Process
ASABE	American Society of Agricultural and Biological Engineers
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AT	Appropriate Technology, Haiti
AVRDC	World Vegetable Center (formerly Asian Vegetable Research and Development Center)
BARC	Bangladesh Agricultural Research Council
BIFAD	Board for International Food and Agricultural Development
BMP	Best Management Practice
CAPRi	CGIAR Systemwide Program on Collective Action and Property Rights
CCRA	Cross-Cutting Research Activity
CF, CFU	Conservation Farming, Conservation Farming Unit
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agrocultura Tropical, Ecuador
CIMMYT	International Maize and Wheat Improvement Center
CIP	Centro Internacional de la Papa (International Potato Center)
CIPCA	Centro de Investigación y Promoción del Campesinado
CIRAD	Centre de Cooperation International en Recherche Agronomique pour le Development, National University of Lesotho
CPA	Community Participatory Assessments
CRC	Collaborating Research Centers
CRSP	Collaborative Research Support Program
DABAR	Department of Agriculture-Bureau of Agricultural Research, the Philippines
DEM	Digital Elevation Model
DRIFT	Diffuse Reflectance Fourier Transform Infrared Analysis
EGAT	USAID Bureau for Economic Growth, Agriculture and Trade
ERP	External Review Panel
ESPOCH	Escuela Superior Politcnica de Chimborazo, Ecuador
ESRI	Environmental Systems Research Institute
FAMV	Faculte d'Agronomie et de Medecine Veterinaire, Universite d'Etat d'Haiti
FAO	Food and Agriculture Organization of the United Nations
FFH	Food for the Hungry, Title II USAID
GEF	Global Environment Facility
GIS	Geographic Information System
GMO	Genetically Modified Organisms
GPB	Gobierno de la Provincia de Bolivar, Ecuador
GPS	Global Positioning System
GRA	Graduate Research Assistant
IARC	International Agricultural Research Center

ICM	Integrated Crop Management
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-arid Tropics
IDE	International Development Enterprise
IER	Istitut d'Economie Rurale du Mali
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
INIAP	Instituto Nacional Autónomo de Investigaciones Agropecuarias, Ecuador
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IPNI	International Plant Nutrition Institute
IRB	Internal Revue Board
IRRI	International Rice Research Institute
ISU	Iowa State University
KACOFA	Kapchorwa Commercial Farmers Association
KENDAT	Kenyan Network for Dissemination of Appropriate Technology
KSU	Kansas State University
LFPI	Landcare Foundation of the Philippines, Incorporated
LGU	Local Government Unit
LTRA	Long-Term Research Award
MARD	Ministry of Agricultural Research and Development
ME	Management Entity
MHAC	Manor House Agricultural Center
MOSCAT	Misamis Oriental State College of Agriculture and Technology
MOU	Memorandum of Understanding
MRV	Measurement, reporting, and verification
MSI	Minority-Serving Institution
NAC	National Advisory Council
NARS	National Agricultural Research Service
NCA&T	North Carolina Agricultural and Technical State University
NCI	Net Complementarity Index
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
NIR	Near Infrared
NRM	Natural Resource Management
OUAT	Orissa University of Agriculture and Technology
PA	Participatory Appraisal
PADAC	Projet d'Appui au Developpement de l'Agriculture du Cambodge
PAR	Participatory Action Research
PES	Payments for Environmental Services
PI	Principal Investigator
PMCA	Participatory Market Chain Approach
PR	Participatory Research

PRA	Participatory Rural Appraisal
PROINPA	Promoción e Investigación de Productos Andinos
PROMIC	Programa Manejo Integral de Cuencas
RMA	Rapid Market Appraisal
RUA	Royal University of Agriculture, Cambodia
SA	Sustainable Agriculture
SANREM	Sustainable Agriculture and Natural Resource Management
SARI	Savanna Agricultural Research Institute
SEA	Southeast Asia
SENACYT	Secretaria Nacional de Ciencia y Technologia, Ecuador
SENAGUA	Secretaria Nacional del Agua, Ecuador
SIGAGRO	Sistema de Información Geográfica Agropecuaria
SKB	SANREM Knowledgebase
SNA	Social Network Analysis
SRTM	Shuttle Radar Topography Mission
SWAT	Soil and Water Assessment Tool
TC	SANREM CRSP Technical Committee
Title XII	Title XII Amendment to the International Development Food Assistance Act of 1975 and subsequent amendments
TraiNet	On-line USAID system for tracking training activities for foreign nationals)
TSBF	Tropical Soil Biology and Fertility Institute
UNDP	United Nations Development Program
UPLB	University of the Philippines-Los Baños
USAID	United States Agency for International Development
USAID/W	USAID's Washington headquarters
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VT	Virginia Tech
WAC	World Agroforestry Center
WFP	World Food Program
WVC	World Vegetable Center