Sustainable Agriculture and Natural Resource Management
Collaborative Research Support Program

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CGIAR Challenge Program on Water and Food (CPWF)
International Centre for Research in Agroforestry (ICRAF)
International Crops Research Institute for the Semi Arid Tropics (ICRISAT)
The International Institute of Tropical Agriculture (IITA)
International Livestock Research Institute (ILRI)
International Rice Research Institute (IRRI)

Private Sector
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Executive Summary

The FY 2005 Annual Report for year 1 of SANREM CRSP Phase III describes activities conducted by the CRSP from 1 October 2004 through 30 September 2005 under United States Agency for International Development Leader-With-Associate Cooperative Agreement No. EEP-A-00-04-00013-00.

The first year of the SANREM CRSP Phase III has been transitional. In September 2005, the new SANREM CRSP management team was formed to revise and strengthen the SANREM CRSP and make it more competitive and responsive to USAID Mission goals. The new vision is to develop knowledge pertaining to sustainable agriculture and natural resource management interventions and strategies, organize that knowledge into an accessible knowledge base, place it in its proper development context, and disseminate the knowledge to decision makers. Under the VT Consortium, the SANREM CRSP has:

- Consolidated previous achievements and set the foundation for the SANREM Knowledge and Information System (KIS);
- Completed valuable research initiated under SANREM CRSP PHASE II through competitive bridging awards;
- Initiated new program priorities addressing implementation needs of biodiversity, sustainable agriculture and natural resource management projects; and
- Established a new policy and program framework to identify and promote vital research activities.

The SANREM CRSP's program strategy is based on promoting stakeholder empowerment and improved livelihoods through the discovery, organization, and dissemination of SA & NRM knowledge. Our approach is participatory, engaging stakeholders at all levels in research problem formulation within priority areas of inquiry, and comparative, focusing on multiple countries and/or regions to facilitate scaling up and out of research findings. 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 training plans. All activities link sustainable natural resources management with the economic concerns of local populations and the promotion of good governance.

Program Objectives

The objectives of the SANREM CRSP are to:

1. Increase scientific knowledge and technical innovations in SA and NRM;
2. Improve knowledge management, education and communication leading to behavioral changes in adaptation and adoption of new SA and NRM technologies and practices;
3. Reform and strengthen SA and NRM governance, policies, and local institutions; and
4. Promote the functioning of sustainable resource-based local enterprises in national, regional, and global markets.

The SANREM CRSP supports research activities that mobilize science and technology to foster innovation and improvements in the social, economic and environmental sustainability of agriculture and natural resources management, and that lead to improved livelihoods, expanded trade opportunities and capacities for stakeholders. Specifically, the SANREM CRSP seeks to strengthen sustainable agriculture and natural resource management training and education, outreach, and applied research.

The goals of SANREM CRSP Activities are to implement multi-disciplinary and multi-institutional research and knowledge dissemination activities. In order to accomplish these goals SANREM CRSP research and capacity building activities are designed to be competitively driven, accounting for 90 percent of non-ME expenses. The core of the five-year research program will be funded through $6.35 million in competitive Long-Term Research Awards (LTRAs), which will be linked with on-going development activities wherever possible. In FY 2005, Bridging Awards ($381,000) provided transitional funding for short-term, high impact research and knowledge dissemination activities initiated during the SANREM CRSP Phase II. In addition, Planning Awards ($702,000) have set the ground work for initiating the LTRA program in FY 2006.

Research activities that complement USAID Mission strategic objectives involving sustainable agriculture and natural resources management are high priorities. Partnerships are central to SANREM CRSP's participatory approach. These relationships are with IARCs, NGOs and other private sector organizations, national agricultural research services (NARS), host country universities and research institutions, U.S. minority-serving institutions, other CRSPs and US universities, and on-going projects across countries, regions, and landscapes to implement their research and knowledge dissemination activities. Development of these linkages is essential to the SANREM CRSP systems approach to sustainable development.

Program Areas

The SANREM CRSP FY 2005 Annual Report is organized into five program areas: SANREM Knowledge and Information System (KIS), Bridging Activities, Long-Term Research Program, Training and Institutional Capacity Development, and SANREM Policy and Operating Procedures Development.

SANREM Knowledge and Information System (KIS): The KIS is the core of SANREM CRSP activities and is built on the foundation of the SANREM Knowledge-Base (SKB). As shown in Figure 1, the KIS is structured to provide SA & NRM practioners with pertinent information on best practices adaptable to site-specific problems and conditions from the SKB's carefully cross-indexed "information resources". This knowledge and information documentation and retrieval system is managed by the Virginia Tech Program and currently fed by the Landscape System Coordinators (field, farm/enterprise, watershed, ecosystem, policy/governance, and technology transfer). A working prototype of a web application has been created to allow researchers to catalog and search SA & NRM "information resources" (books, reports, journal articles, videos, movies, presentations, etc.). Roughly 650 "information resources" have been entered into the SKB. Bridging Activities and, ultimately, the Long-Term Research Activities will also contribute to knowledge generation, assembly, cataloging, and dissemination as well. In

addition, two articles and eight books and/or book chapters were produced during FY2005 by System Coordinators and the Management Entity.

Bridging Activities: Four Bridging Activities were initiated in January 2005. These activities involve the completion of work commenced during SANREM CRSP Phase II. Two of these activities concern Phase II research sites in South East Asia (Philippines and Vietnam) and in Ecuador. These activities resulted in the completion of twelve refereed journal articles, six books, 19 book chapters, ten presentations, a variety of outreach outreach products (including a video on conservation in both English and Spanish), and other decision support tools in FY2005.

In a third Bridging Activity, the field survey work necessary to analyze how much of a payment would be necessary for upstream Ecuadorian peasants to provide environmental services has begun. One book chapter has already been published and completion of the survey will lead to at least one published article comparing methods for estimating payment values. The fourth Bridging Activity is linked to development of the SANREM Knowledge and Information System cataloging and making available more than 400 "information resources" generated during SANREM CRSP Phases I and II.

Long-Term Research Program: Planning activities launching the Long-Term Research Program were implemented this year. The program was initiated in January 2005 with a brief competition for Long-Term Research Activity (LTRA) Planning Awards. Seventy-four Planning Award submissions were received and evaluated. Eighteen were funded. From April through September 2005, the Planning Award recipients plus an additional 10 teams developed collaborative research applications with teams of researchers from 31 developing countries involving 17 US universities as lead institutions. These LTRA applications will be reviewed and evaluated by the SANREM CRSP External Evaluation Panel and the ME will award up to six Long-Term Research contracts by December 2005 providing global diversity and institutional breadth to our program.

Training and Institutional Development: The SANREM KIS and Bridging Activities have contributed to short and long-term training. Eight developing country and one US graduate students are working in six Ph.D.s and three Masters Degree programs. Four of these students are female; five are male.

SANREM CRSP Policies and Procedures Development: Policies and procedures to implement the new program were developed over the course of the year. The RFA for Bridging Awards was released within 15 days of project start up and set in motion the active management learning process, culminating in a Technical Committee Meeting in December 2004 when four projects were selected, initiating implementation of the new policies. Lessons learned from this competition informed the set-up and implementation of the LTRA Planning Awards (January-March 2005), which in turn shaped the LTRA competition itself. The learning process culminated in the formal approval of a revised Policy and Operating Procedures Manual by the Board of Directors in August 2005.

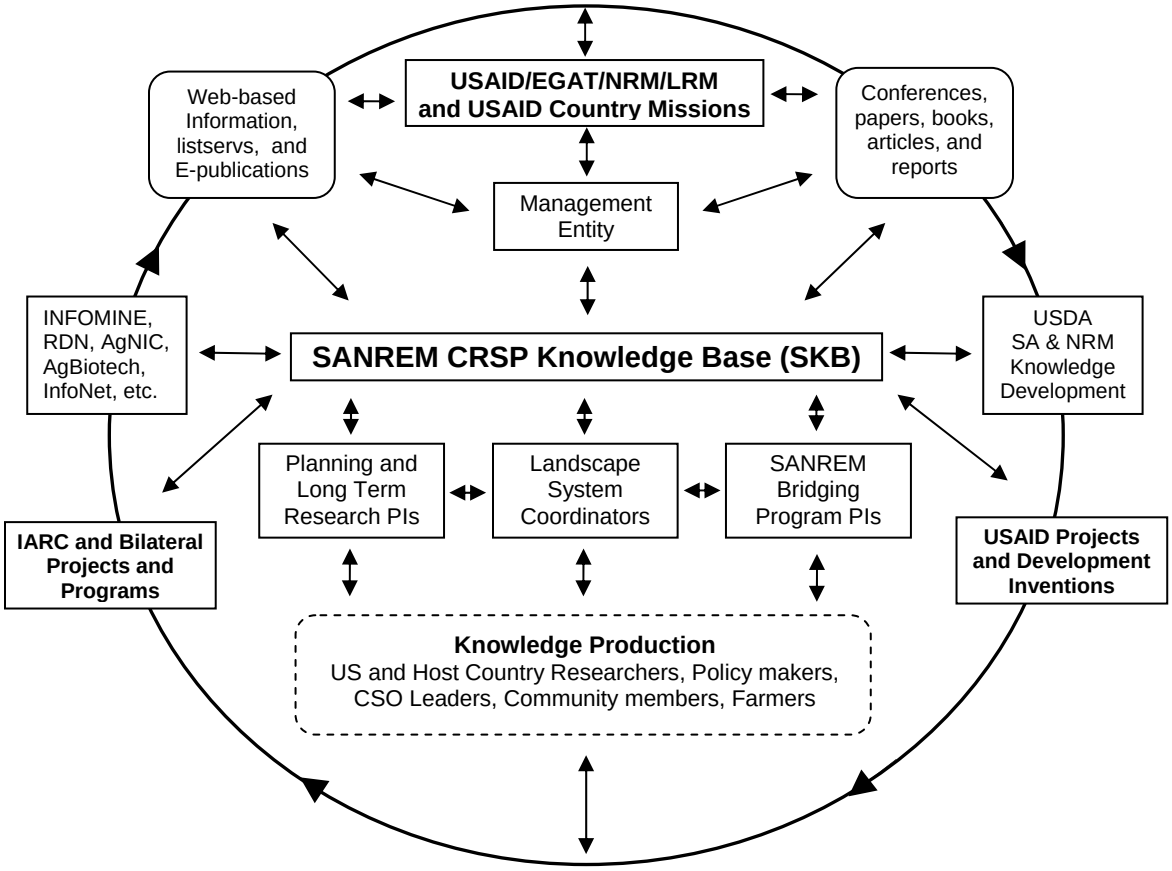

Figure 1: SANREM CRSP Knowledge and Information System (KIS)

SANREM CRSP Knowledge and Information System

Virginia Tech Activities

The Virginia Tech Management Entity (ME) provides overall guidance in the development of the SANREM CRSP Knowledge and Information System (KIS). This guidance involves providing intellectual leadership for the SANREM KIS, establishing the foundation of the SANREM Knowledge Base (SKB), managing Landscape System Coordinator activities, supervising KIS information technology development, networking with information users and other providers, and implementation of the KIS. The ME also keeps abreast of innovations and new approaches in the sustainable agriculture and natural resource management inquiry areas, and circulates SA & NRM knowledge and information among partners and the public through the SANREM CRSP website, a quarterly newsletter, and Research Briefs. Much of the past year was devoted to establishing a functional infrastructure for these activities.

SANREM Knowledge and Information System (KIS): The SANREM KIS is founded on a data base of "information resources" (books, reports, journal articles, videos, movies, presentations, etc.) produced or identified, classified, and summarized by SANREM CRSP researchers. These experts are providing easy access to metadata and/or information resources relevant to sustainable agriculture and natural resource management issues. This searchable database is organized by landscape system, as well as providing searchable fields such as: title, creator (traditionally specified as author), creation date, keyword, media type, time period and site documented, description (abstract), language, and SANREM Project Number (if appropriate). When fully operational, this Knowledge and Information System will be the prototype for future knowledge organization efforts.

Information Technology Development: Application developers from Agriculture, Human and Natural Resources Information Technology (AHNR-IT) of Virginia Tech were enlisted to develop a web application that provides the capacity for researchers to catalog and search for critical information resources on sustainable agriculture and natural resource management.

The first application component is currently operational. It provides the ability for SANREM CRSP researchers to classify and catalog resources. A researcher is granted the ability to login into the system by a SANREM administrator and is given one of three levels of permission. The first level of permission allows the researcher to simply enter resources or to view all resources in the system. To add a new resource, the researcher clicks on a button that takes them to a screen that allows them to classify the resource using a standard set of metadata. The Dublin Core Metadata Initiative (http://www.dublincore.net) has defined the metadata elements that are being used to perform this classification. The SANREM CRSP ME consolidated a list of restricted key words to guide and accelerate searches. The researcher also has the option of uploading non-copyrighted resources to a central server to allow access to the resource via the Internet. Resources can be any type of file such as PDF documents, Word Documents, images, or movies.

The second level of permission allows a researcher to become a reviewer. Reviewers have all the rights described above, as well as the right to edit the metadata other researchers have submitted on information resources for publication in the SANREM Knowledge and Information System. Once a resource is published it becomes available to the public through open access on the web. The final and highest level of permission is that of administrator. The administrator has all the rights of the reviewer, as well as the ability to add or remove users from the system.

The second application component is under construction. This web application will provide the general public with the ability to search the database for published resources without having to login. Resources may be searched by a number of different criteria including title, keyword, creation date, GPS location, and date of data collection, etc. Resources matching the given criteria are returned in a list from which they can be inspected and downloaded if appropriate.

Testing of the meta-data entry program will be completed and ready for implementation during the first quarter of FY 2006. VT Knowledge Management activities will also integrate outputs of the bridging activity on the SANREM CRSP PHASE II information resources, landscape system coordination, and the SANREM CRSP PHASE II West Africa Annotated Bibliography.

Communications Program

The SANREM CRSP has initiated a communications program to disseminate pertinent SA & NRM information. This program consists of: the ***SANREM CRSP Website*** channeling access to relevant information sources; the ***SANREM CRSP News***, an email newsletter updating partners and other stakeholders on SANREM CRSP activities and accomplishments; and ***Research Briefs***, highlighting technological and institutional innovations.

Website Development: From the very first days of project start up, the SANREM CRSP ME has maintained a dynamic website http://www.oired.vt.edu/sanremcrsp to inform partners, development practioners, policy makers, and other stakeholders. This website was purposefully designed to foster sustainable agriculture and natural resources management through support to the SANREM CRSP Knowledge and Information System. It has been organized to facilitate quick searches of the SKB for direct access to useful information, as well as providing links allowing the reader/surfer to explore other relevant sites. The website offers a diverse set of materials, including recent SA & NRM research findings, descriptions of SANREM CRSP activities, opportunities for collaboration, and information on SANREM CRSP policies and procedures. This website contributes to fulfilling one of the SANREM CRSP objectives: to improve knowledge management, education and communication leading to behavioral changes in adaptation and adoption of new SA and NRM technologies and practices affecting the livelihoods of men and women.

A special effort has been made to emphasize gender issues through the gender resources webpage. This page was created to encourage SANREM CRSP applicants and team members to address gender issues in a continuous and reflective manner. Two main documents provide the basis for reflecting on gender issues: the “Principles for Integrating Gender into Agriculture-based Projects”; and an USAID publication, “Gender and Community Conservation”. There is also a PowerPoint presentation which provides relevant information in a concise but purposeful

manner. Each of these documents helps participants to identify gender issues, alerts them to complex gender inequalities, and motivates participants to become more gender sensitive.

Newsletters and Research Briefs: The ME has also developed a SANREM CRSP newsletter and Research Briefs to promote and transfer relevant sustainable agriculture and natural resource management messages and information. Research Briefs provide concise summaries of SANREM CRSP research findings and how they can be applied in the field, scaling them up and out. ***Research Brief No. 1***, "Developing Social Infrastructure for Effective NRM" was published in May 2005. The ***SANREM CRSP News*** is an email newsletter that provides a quick update of SANREM CRSP activities, accomplishments and future events in multi-media format (available by email, on paper, and through the website). The first issue appeared in September 2005.

Landscape System Coordinator Activities, FY 2005

Landscape System Coordinators
The SANREM CRSP program vision is organized around five landscape systems which intersect and interact to impact SA & NRM: field, farm, watershed, ecosystem, and policy/governance. These systems are differentiated by the type of decision maker, scale of activities, and the predominant incentives faced. The extent to which decision makers and incentives are different has very important implications for many aspects of SA & NRM, including the appropriate types of technologies and practices and optimal technology transfer strategies.

Each of these systems is coordinated by a Landscape System Coordinator. The ME has also added a cross-cutting Coordinator for Technology Transfer. These System Coordinators are documenting the metadata and synthesizing SA & NRM research findings within and across these landscapes systems for inclusion in the SKB. They are also conducting workshops and seminars to disseminate findings in their areas of expertise. The overall purpose of the Landscape System Coordinators and their teams is to contribute to the KIS through achieving the following objectives.

Objective 1: Review literature reflecting the State of the Science in each System.
Objective 2: Identify State of the Art projects for case study analysis.
Objective 3: Develop case studies characterizing critical SA & NRM system issues.
Objective 4: Develop a State of the Art and Science review of each system.

Landscape System Coordinators have produced five refereed journal articles, two book chapters, two books, four conference proceedings and two paper presentations. However, their primary output will be a book-length manuscript, building on landscape system coordinator syntheses for each system. Case studies for inclusion in the book will be selected based on literature reviews and case study analyses conducted over the past year. The key accomplishments of each Landscape System Coordinator and associated partners are summarized below. Full reports may be viewed in Appendix A.

Landscape System: Field/Production Unit-based

Principle Investigator(s): Paul Mueller, North Carolina State University; Paul Hepperly, Rodale Institute.

North Carolina State University (NCSU): Activities for the SANREM Field-level system have included training for international agriculture professionals and students, collaboration with several international development organizations, and significant progress in the review of literature and identification of exemplary projects in the Field-level system. Fifty agriculture professionals and students participated in SANREM training activities at the Center for Environmental Farming Systems during FY2005. In addition, NCSU SANREM leaders collaborated with the Soil Management CRSP on research and training activities in Central America. Networking with several IARC's, NGO's, and host country institutions has contributed to SKB development and may lead to collaboration in future SANREM activities.

Approximately 330 resources have been reviewed for the SANREM knowledge base and for the development of a synthetic review on the state of the art in SANREM at the field level. Preliminary analysis of 22 projects identified in year one indicates that participatory processes, and applications of indigenous knowledge are two key components of current development programs that have a SANREM focus. This finding will be further investigated through in-depth case studies of selected projects during year two.

Rodale Institute: Rodale's focus has been soil quality protection and its improvement in developing countries in the tropics. Thus far, approximately 200 projects and/or critical information resources have been identified. Approximately 55 of these resources have been uploaded to the SANREM knowledge database. Ten existing case studies have been examined, and many projects for potential case study identified. A focus on Africa has highlighted the importance of Integrated Soil Fertility Management (ISFM), cover crops, agroforestry, ethnopedology, conservation tillage, and soil carbon sequestration. Several networking/training activities related to the SANREM project have taken place over the past year, including interactions with Opportunities Industrialization Centers International (OICI) and the Ghana Ministry of Food and Agriculture, USAID Food for Peace Program, Africare, Tuskegee Institute, and a group of Korean students together with a Korean professor of agriculture.

Landscape System: Farm/Enterprise-based

Principle Investigator(s): Chris Pannkuk, Peter Wyeth, Oumarou Badini, Washington State University

Washington State University: To develop the knowledge base component, the work initially focused on researching relevant projects and publications organized by farm activity (e.g. agroforestry, crop-livestock integration, aquaculture, etc.) within the PIs' specific geographic areas of expertise: Afghanistan, Armenia, Romania, Malawi, Burkina Faso, Ghana, Mali, and Niger. Meta-data relating to specific activities (agroforestry, NRM, small scale irrigation, gender, etc) was collected for resources relating to these countries. Further information was gathered through contacts with other organizations (Winrock, FAO, ICARDA and CIMMYT). Identified resources were entered into the SANREM Knowledge Base. Progress was also made towards the identification of relevant projects for case studies. Three case studies of long-term projects on soil water conservation and agroforestry systems were identified in Mali, Burkina Faso and Malawi for comparative studies on successes and failures and inclusion in the SANREM book.

Landscape System: Watershed-based

Principle Investigator(s): Saied Mostaghimi, Virginia Tech

Virginia Tech: Forty-two information resources were reviewed and the process of identifying additional works with an emphasis on case studies is well underway. Fifteen projects have been identified for review. Five of ten case studies selected for further analysis have been completed. Several case studies have already been summarized. Preliminary results from our literature review indicate that adopting a land capability classification system for evaluating land use capacity is essential for project planning. The literature synthesis also clearly indicates that

respect for farmers' knowledge of their land and local conservation practices is extremely important to success of projects in developing countries. There is strong evidence that top-down programs promoting non-local practices with incentives that go away before real benefits are realized are doomed to fail. The Watershed Systems team is collaborating with and providing advice to researchers at Virginia Tech, North Carolina A&T, and the University of Southern Florida on watershed hydrology and management for SANREM-related research and with the University of Hawaii modeling the effects of agricultural systems on soil erosion and water quality for the Soil Management CRSP.

Landscape System: Ecosystem-based

Principle Investigator(s): Andrew Manu, Iowa State University

Iowa State University: Over 400 documents have been reviewed and 70 relevant citations entered into the SANREM CRSP meta-database. This process led to the identification of the following potential components of effective ecosystem management: (1) application of integrated modeling in ecosysytem analysis and management; (2) use of agroforestry as part of ecosystem management; and (3) incorporation of indigenous knowledge into sound ecosystem research, development and management. Three case studies were identified and investigated with respect to their objectives and expectations, outcomes, factors contributing to their success, and those that mitigate their success. The case studies reviewed are:

1. Community Based Natural Resource Management project in Mount Cameroon area in Cameroon;
2. Development Through Conservation Project (Bwindi Impenetrable Forest, Uganda); and
3. The Kibale and Semuliki Conservation and Development Project (KSCDP) (Uganda).

The gaps between theory and practice in these case studies were investigated leading to an assessment of gaps in the current state of the ecosystem knowledge. As part of SANREM CRSP's contribution to degree and non-degree training, a Ph.D student has been funded as a research assistant in this effort. Linkages have been established with various individuals, institutions, organizations and other stakeholders in the effective management of ecosystems.

Landscape System: Policy and Governance

Principle Investigator(s): Gerald Shively, Purdue University

Purdue University: This project aims to document, summarize and contribute to the current "state-of-the-science" regarding the ways economic policies and governance influence incentives for sustainable agriculture and natural resources management. During the year we initiated work and made progress on a number of fronts. Seventy-five information resources have been identified, and many annotated and the metadata entered into the knowledge base. Two case studies have been initiated: one in the Philippines focusing on the relationship between tariffs and forest clearing; the other in Egypt on water management. Two other case studies will be identified for Africa and Latin America.

Landscape System: Technology Transfer

Principle Investigator(s): Kadi Warner, Winrock International

Winrock International: This project focuses on developing a knowledge base regarding the efficacy of technology transfer methods for establishing sustainable agriculture and natural resource management practices in the field. Thus far 20 information resources have been reviewed and entered into the data base on farming systems, participatory approaches, and CBNRM. A community-based wetlands project in Bangladesh has been identified for in-depth study in early 2006. During the period covered by this report substantial progress was made in the assessment of SA & NRM projects and programs for the effectiveness of their technology transfer programs.

Bridging Program

The SANREM Competitive Grants Bridging Awards support high-impact, short-term research activities that capitalize on earlier SANREM program efforts and contribute to current SANREM inquiry areas and objectives. The SANREM CRSP ME drafted and revised a Request for Applications (RFA) for Bridging Awards and issued it on October 19, 2004. Twelve applications were received by the deadline of November 23, 2004. These were reviewed and scored by the Technical Committee and the four top ranking proposals were selected for funding. Bridging PIs are currently mid-way through the 18-month period of activity performance. Their accomplishments to date are summarized below. Full reports can be viewed in Appendix B.

Bridging Activity Synopses

Globalization, agricultural growth and the environment: consolidation and continuity of SANREM research in Southeast Asia

Principle Investigator(s): Ian Coxhead, Agricultural and Applied Economics, University of Wisconsin (UW)-Madison; and Gerald Shivley, Agricultural Economics, Purdue University.

Host Country Partner(s): University of the Philippines Los Banos;
Hue University, Vietnam;
Nong Lam University, Vietnam.

Synopsis: This work aims to bring to fruition several activities initiated in SANREM CRSP PHASE II, and provides continuity for ongoing initiatives in what has become a highly visible research program in the region. There are have three main activities: (1) continuation of empirical research focused on economic and environmental features of commercial tree crops, especially coffee, in Vietnam, and refinement of tools for SA & NRM policy analysis at landscape and national scales; (2) consolidation of research lessons from the Philippines into a new book; and (3) transfer to the ME of relevant metadata from SANREM SE Asia, particularly data from the Philippines.

(1) In Year 1, PI Gerald Shively (Purdue University) and Co-investigator Dang Thanh Ha (Nong Lam University) continued research on smallholder production of commercial tree crops in Vietnam. PI Coxhead (University of Wisconsin) and Co-investigator Bui Dung The (University of Hue) coordinated the collection of commune and district level data on land use and aquaculture activity in Central Vietnam, and began econometric analysis. Steps were made toward the construction of an applied general equilibrium model of trade, development policy, resource allocation and the use of environment and natural resource assets. 2) The draft book on research lessons from the Philippines is near completion and an authors' meeting is scheduled for November 2005 to take the next steps. (3) Metadata collection and transfer was undertaken by Shively and assistants at Purdue University.

Coxhead and University of Wisconsin Research Assistant Diep Phan each made two trips to Vietnam. They presented seminars, held training sessions (Thai Nguyen University and Hue University) and coordinated with researchers at National Economics University and the Ministry of Agriculture and Rural Development. Two Vietnamese scholars funded by Fulbright-Hayes for 2005-06 joined the Wisconsin team. At Purdue, Research Assistant Nam Anh Tranh (formerly at Hanoi Agricultural University) began a M.S. in Agricultural Economics. He is funded by a fellowship from the Ford Foundation and will be working with Shively on issues related to commercialization of non-timber forest products in Vietnam.

Sustainable land use and biodiversity conservation in the Andes: scaling-up SANREM-Andes research

Principle Investigator(s): Robert Rhoades and Virginia Nazarea, Dept. of Anthropology, University of Georgia (UGA).

Synopsis: SANREM bridging research in the Andes between January 1 and September 30, 2005 accomplished all planned activities. Land Use Change (LUC)/Scenario tools (future visioning, 3-D physical modeling, and human dimensions of climate change) have been disseminated through networking with collaborators in the Andes, several publications, a farmer workshop in Cayambe, Ecuador, and presentations at several international and national conferences. Biodiversity Conservation with an emphasis on repatriation of native crops has advanced through institutional agreements between UGA, International Potato Center (CIP), and Association Andes (Cuzco, Peru), development of a joint repatriation website; initiation of field research in Cusco; a seed fair and farmer-gene bank exchanges in Ecuador; and numerous publications and invited presentations at international and national conferences. The refinement of the SANREM-Andes database advances on target with 90% completion of the "toolbook" CD on Cotacachi and final publication and integration of the Cotacachi Atlas in the Cotacachi Canton environmental information system. Training and capacity building activities included an educational seed fair in Cotacachi (125 participants), a farmer-gene bank exchange trip to the INIAP gene bank near Quito, as well as a farmer-based workshop on climate change and water in Cayambe, Ecuador. One Ph.D. student (Juana Camacho) conducted initial fieldwork for her dissertation in Cuzco, Peru.

Analysis required for Payments for Watershed Environmental Services (PWES)

Principle Investigator(s): Douglas Southgate and Timothy Haab, Dept. of Agricultural, Environmental, and Development Economics, The Ohio State University and

Host Country Partner(s): Fabian Rodriguez, Fundacion Antisana, Ecuador.

Synopsis: The fundamental purpose of this bridging activity, in the vicinity of Quito, Ecuador, is to demonstrate the degree to which watershed conservation can be financed locally – specifically, through the use of payments collected from the beneficiaries of conservation, who by and large live and work in lower watersheds. One specific objective was to estimate the price increases that potable water customers in Cayambe (a municipality with approximately 15,000 inhabitants) would pay for the sake of conserving water sources. However, this approach to benefit estimation was abandoned after opposition from Cayambe officials, who recently instituted price increases after promising that water prices will remain stable for several years. Instead, this project has focused on the costs of using conservation payments in watershed management. Much of the preparatory work required to estimate the payments that people in Paquiestancia (a rural community upstream from Cayambe and an important source of the city's drinking water) would expect has been completed: federally-required human-subjects review has been completed, the questionnaire for the survey of rural households has been designed and tested, and survey enumerators recruited from the local community have been trained. In addition to preparation for the survey, a biophysical assessment of the watershed has been completed, as has a legal analysis of conservation payments. Thus, this project is shedding light on how watershed assessment, legal investigation, and economic analysis all contribute to effective implementation of PWES.

Metadata development for the SANREM knowledge base

Principle Investigator(s): Conrad Heatwole, Gene Yagow, and Brian Benham, Biological Systems Engineering Department, Virginia Tech and Margaret Merrill, University Libraries, Virginia Tech

Synopsis: The overall goal of this project is to support the SANREM mission of effective knowledge dissemination in the domain of sustainable agriculture and natural resource management. To accomplish this, the objectives are: a) define a metadata structure for SANREM resources that will facilitate the access and dissemination of materials; b) catalog existing SANREM resources generated in the previous project phases; and c) provide a manual that provides guidance for those defining and using these metadata in the future.

Project implementation has proceeded as anticipated, and is on schedule. The metadata structure has been refined and is stable, with over 400 records entered. A draft guidance manual has been developed which provides documentation for the metadata template and documents the particular format and procedures being followed for entries to the SANREM Knowledge Base (SKB). The resources referenced on the UGA SANREM website (www.sanrem.uga.edu) have been cataloged. Of nearly 900 resources evaluated, over 400 have been identified as having archival value and have been entered in the SANREM Knowledge Base.

Development of Long-Term Research Activities

The goals of the Long-Term Research Awards program are to implement multi-disciplinary and multi-institutional SANREM CRSP research and knowledge dissemination activities. Research activities that complement USAID Mission strategic objectives involving sustainable agriculture and natural resources management are high priorities. Applicants have been encouraged to link with on-going projects and programs already addressing SANREM areas of inquiry at different system scales. Long-Term Research Award recipients are expected to develop partnerships with other US universities, USAID Missions, IARCs, NGOs and other private sector organizations, national agricultural research services (NARS), host country universities and research institutions, U.S. minority-serving institutions, other CRSPs, and on-going projects across countries, regions, and landscapes to implement their research and knowledge dissemination activities. The goal of the Long-Term Research Award program is to fund one or more high quality research activity in each USAID region, with particular emphasis on Africa.

To facilitate knowledge organization and the integration of activities among and within sites, SANREM organizes SA & NRM knowledge within the context of nested landscape systems (field, farm, watershed, eco-system, and policy/governance). SA & NRM actions and their subsequent outcomes interact across these systems; what happens in one system component has consequences in other components. In order for applicants to effectively integrate their research and interventions within this dynamic setting and assure immediate development applications of the knowledge acquired, the research problem statement must be formulated within the context of one or more of the highest level sub-systems (e.g., eco-system, governance/policy, and watershed). In order to assure that the research is livelihood driven, linkage with the field and/or farm/enterprise sub-systems must be explicit. In addition to situating research applications within one or more higher-level sub-systems, applicants were required to address one or more of the *priority inquiry areas* summarized below.

> **Technology Integration:** Technologies needed by stakeholders and decision-makers to promote SA & NRM practices (i.e., biotechnology, GIS, decision support tools, etc.)
>
> **Governance:** Policies, regulations, and institutional arrangements enabling civil society to better manage natural resources
>
> **Economic Policy and Enterprise Development:** Supporting sustainable SA & NRM practices that develop niche markets, and are eco-friendly and competitive
>
> **Social and Institutional Capacity Building:** Training and policies promoting improved SA & NRM leadership, NGO technology transfer, and increased civil society and government synergy

Biodiversity Conservation and Environmental Services: Integrated management of agriculture and natural resources to promote synergistic relationships between production, biodiversity, and livelihoods

Systems Linkages: The integrated SANREM CRSP systems approach demonstrates how linkages between gender, biophysical, technology, governance, economic, social, environmental, and globalization factors achieve sustainable development

Globalization, Vulnerability, and Risk: SA & NRM best practices to manage globalization and address risk and vulnerability caused by HIV/AIDS, food insecurity, etc.

Implementation of the Competition

The SANREM CRSP ME designed a two-stage process to develop high quality long-term research activities. The purpose of the Long-Term Research Awards is to involve US universities in partnerships with host country institutions, NGOs, IARCs, and the private sector to conduct long-term (up to 3 years and 9 months), multi-disciplinary, multi-dimensional SA & NRM research on priority areas of inquiry. Research topics should address concrete issues/challenges faced by development practitioners in the field.

Stage One involved drafting and circulating a Request For Applications (RFA) to more than 400,000 individuals and listserv members around the world announcing the competition for Planning Awards to prepare Long-Term Research Applications. The RFA for both Planning and Long-Term Research Applications was released on January 7, 2005. The Long-Term Research Award RFA was revised for clarity and precision on June 1, 2005.

On February 23, 2005, the SANREM CRSP received 74 Planning Award Applications from 37 different U.S. universities to address critical sustainable agriculture and natural resource management issues. Eighteen Planning Awards from 11 different lead U.S. universities (including 3 of the 9 initial partners) were selected for funding by the SANREM CRSP Planning Award External Review Panel. The Planning Awards involved building research teams and activities in at least 22 different developing countries.

Stage Two involved preparation and submission of the Long-Term Research Applications. This competition was not restricted to only those who had won Planning Awards. As a consequence, another 18 letters of intent were received. However, only 28 applications were submitted for evaluation by the due date of September 30, 2005. The LTRA Applications were distributed regionally as follows: Global (4), Sub-Saharan Africa (11), Asia and the Near East (4), Latin America and the Caribbean (6), and Europe and Eurasia (3). They involved some 41 countries and 18 different lead US universities.

Planning Award Abstracts

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

Submitted by:	Indiana University
Principal Investigators:	Elinor Ostrom, Indiana University Krister Par Andersson, Indiana University Ruth Meinzen-Dick, CGIAR Systemwide Program on Collective Action & Property Rights (CAPRi) Esther Mwangi, CGIAR Systemwide Program on Collective Action & Property Rights (CAPRi) Bruce Campbell, Center for International Forestry Research (CIFOR)
Host Countries:	Uganda, Kenya, Mexico, Bolivia

Decentralization policies formulated at the governance/policy level often fail to account for the complexities involved in land use at the farm/field/forest level. As a result, they can fall short of their goals of sustainable natural resource management (NRM) and improving livelihoods. The proposed research will collect and analyze data from Uganda, Kenya, Mexico, and Bolivia in order to identify the institutional conditions and interactions that will deliver benefits equitably to local people while sustaining natural resources. Utilizing the existing research networks of the International Forestry Resources and Institutions (IFRI) program, the Program on Collective Action and Property Rights (CAPRi), and the Center for International Forestry Research (CIFOR), the project will seek to answer the following research questions:

1) How do decentralization policies made at the governance/policy level affect resource sustainability and the equity and efficiency of forest resource management at the local (farm and field) level?
2) How does decentralization alter forest property rights?
3) What are the implications of decentralization for different groups, including women and forest-dwelling communities? How can different interests be accommodated?
4) What lessons can be derived from a study of diverse multi-level governance arrangements that will help develop policies that result in improved livelihoods and sustainable forest governance outcomes?

Expanding Local Capacities to Deliver Agricultural Production, Biodiversity Conservation and Local Livelihood Benefits in Ecoagricultural Landscapes: A Hybrid Institutional Approach

Submitted by:	Cornell University
Principal Investigator:	Norman Uphoff, Cornell University
Co-Principal Investigators:	Jacqueline Ashby, International Center for Tropical Agriculture (CIAT)

Louise Buck, Senior, Cornell University
Thomas Gavin, Cornell University
Sara Scherr, Ecoagriculture Partners
Ann Stroud, International Center for Research in Agroforestry (ICRAF)

Host Countries: Ethiopia, Kenya, Uganda, Mali, Malawi, Tanzania, Bolivia, Colombia

One of the most promising innovations in recent institutional capacity development is the emergence of 'hybrid' forms of local organization. These new organizational forms combine natural resource governance capabilities with sustainable agricultural initiatives that are encouraged by market and enterprise development. As a result, farmers are given incentives to pursue: biodiversity conservation; increases in agriculture production; and, livelihood enhancement. This proposal will support a comparative study of hybrid institutions that are proving capable of delivering material benefits to their members while generating public environmental and social goods. In-depth inquiry will focus on three primary areas:

1) The system of Koloharena ("Protect Our Resources") farmer associations that have emerged in agricultural zones connected with protected areas of Madagascar under a USAID project there.
2) Farmer Research Committees that are developing new market opportunities for genetic resources in Latin America and sub-Saharan Africa.
3) Landcare groups in the east African highlands that are rehabilitating fragile agro-ecosystems.

These studies will seek to understand underlying conditions, catalytic processes, internal and external linkages, and their effects on innovation, adaptation and institutionalization of eco-agriculture at the farm and landscape level. Findings will be linked into a global network of case study documentation and information exchange, principles will be distilled, and guidelines disseminated.

Integrated Watershed Management to Support Community-Based Responses to Increasing Water Scarcity

Submitted by: Cornell University
Principal Investigators: David R. Lee (Lead PI), Cornell University
Susan Poats, Corporación Grupo Randi Randi, Ecuador
Brent Swallow, World Agroforestry Centre (ICRAF), Kenya
Host Countries: Kenya, Ecuador

Water scarcity is a critical constraint limiting agricultural production and improvement of human livelihood in the rural areas of many developing countries. More effective water management strategies and policies have high potential for addressing rural food security needs and environmental objectives. This project proposes to conduct comparative integrated watershed

analysis. This analysis will include spatially distributed watershed models, community-based natural resource management, and participatory social learning research on ever improving water management. This work is designed to support decision-making by resource users and local institutions that face critical water scarcity, quality and equity problems in watersheds located in Ecuador and Kenya. In addition to integrated work carried out in these locations, the comparative focus of the project will emphasize universal problems and issues. The work proposed focuses on integrative, interdisciplinary, gender-focused research, involving local collaborators at all stages and uniting the efforts of scientists, planners and local community members.

Large Scale Linkages between Agriculture and Wildlife Health in the Rungwa-Ruaha Ecosystem, Tanzania

Submitted by:	University of California–Davis
Principal Investigator:	Jonna Mazet, University of California—Davis Peter Coppolillo, Wildlife Conservation Society, Rungwa- Ruaha Program, Tanzania
Host Countries:	Tanzania

The collaborative research program proposed by the University of California Davis (UCD) and the Wildlife Conservation Society (WCS) will focus on 2 major linkages between agriculture and biodiversity: water and disease. Both have significant effects on rural livelihoods, human health, and biodiversity, and they are inextricably linked, as water limitation allows disease to play a population limiting role and forces wildlife and livestock to interact, increasing the likelihood of disease transmission. Research will address the Environment and Natural Resources (ENR) and Economic Growth, Agriculture, and Trade (EGAT) Strategic Objectives of USAID's Tanzania Mission. The following partners have already been engaged and will contribute to the development of the Long-Term SANREM CRSP Proposal:

- The Iringa District Veterinary Office and Veterinary Investigation Centre
- Tanzania National Parks Veterinary Unit
- Ruaha National Park Ecology Department
- Sokoine University of Agriculture
- The Malinzanga Pastoralists Association
- The Rufiji Basin Water Office
- The WCS Rungwa Ruaha Program
- The WCS Field Veterinary Program (based at the WCS Wildlife Health Center)
- UCD Wildlife Health Center

The research plan complements WCS's proposed work with the USAID Tanzania Mission in two ways. First, Mission funds will remain available for implementation and rural development activities that may be prioritized by research findings without having to directly support that research. Second, due to funding constraints and the need for scientific data, disease examination was only preliminarily included in the WCS proposal currently being considered by the USAID Tanzania Mission; SANREM support will facilitate the addition of intellectual partners to gather this needed data and will provide a greatly enhanced picture of disease interactions and their socioeconomic implications.

Restoration of Biodiversity and Economic Values to Degraded Rainforest and Agricultural Landscapes in Southeastern Madagascar

Submitted by:	Virginia Tech
Principal Investigator:	James D. Fraser, Virginia Polytechnic Institute and State University
Co-Principal Investigator:	Sarah M. Karpanty, Virginia Polytechnic Institute and State University
	Patricia C. Wright, Stony Brook University
Host Countries:	Madagascar

Deforestation is severe in the eastern rainforests of Madagascar, one of the biologically richest nations on earth, where less than 10% of the original forest cover remains. This project will design the highest priority research needed to successfully implement biodiversity and forest restoration (BAFRE) and to support sustained yield extraction in the forests of eastern Madagascar. Specific goals of this planning grant are to 1) determine the forest resource value needs of local women and men; 2) decide the role of biodiversity and forest restoration in achieving those goals; and, 3) find the knowledge gaps that must be filled to achieve those goals. Research will focus on degraded lands in the corridor between Ranomafana and Andringitra National Parks in southeastern Madagascar, one of two corridors targeted by the USAID Madagascar Mission. This comparative study of reforestation, restoration, and sustainable harvest methodologies in Madagascar will increase capabilities of all stakeholders to:

- Increase forest cover,
- Increase connectivity between existing forest cover, and
- Adapt alternatives to slash and burn agriculture.

Research conducted in this region can be expanded throughout the eastern rainforest system of Madagascar and potentially to other tropical rainforests around the world.

Agricultural Transitions in West Africa: Impacts on Agropastoral Livelihoods, Livestock Mobility and the Environment

Submitted by:	University of Wisconsin-Madison
Principal Investigator:	Matthew Turner, University of Wisconsin-Madison
Co-Investigators:	Augustine Ayantunde, International Livestock Research Institute, Niger
	Mark Powell, University of Wisconsin-Madison
	Joshua Ramisch, University of Wisconsin-Madison
Host Country:	Mali

This project seeks to develop a research program that allows an accommodation of livestock husbandry and farming in the southern Sahelian and Sudanian zones of Mali. Significant regional transformations in Mali have led to a reduction in livestock mobility and an increasing year-

round presence of livestock in the southern Sahelian and Sudanian zones. While this has arguably increased the potential for greater integration of crop-livestock systems, it also has led to several problems—a regional imbalance of grazing pressure; an increase in more localized year-round grazing pressure around settlements to the south; animal nutrition problems where feed supplements are not available; and an expansion in social conflict among farming and herding groups. These problems exacerbate rural poverty and pressures on natural resources within the region. One major part of any such accommodation is the development of new sets of institutions and technologies that would facilitate the seasonal use of Sahelian pastures—an ecoclimatic zone that cannot be easily exploited by crop agriculture and that offers higher quality forage to animals. Development of effective co-management strategies will include the active involvement of local government and various non-governmental organizations.

Promoting Sustainable Agriculture and Natural Resource Management for Livelihood Security

Submitted by:	Iowa State University
Principal Investigator:	Robert E. Mazur, Iowa State University
Co-Principal Investigators:	Richard C. Schultz, Iowa State University
	Andrew Manu, Iowa State University
	Lorna Michael Butler, Iowa State University
	Corinne B. Valdivia, University of Missouri – Columbia
	R. James Bingen, Michigan State University
	Mateete Bekunda, Makerere University, Uganda
	Amon Z. Mattee, Sokoine University of Agriculture, Tanzania
	Samuel G.K. Adiku, University of Ghana
Host Countries:	Uganda, Tanzania, Ghana

A multi-national team of researchers and practitioners will collaborate to assess the strengths and weaknesses of current ecosystem management in Uganda, Tanzania and Ghana. The team will diagnose underlying dynamics, problems, enabling factors, and priority needs; examine promising solutions; facilitate stakeholders' identification of appropriate solutions and strategies, expected outcomes and activities; and plan implementation, monitoring and evaluation of these activities. The team will promote synergy between diversification of ecosystem components and livelihood activities to achieve sustainability of both. Using a conflict-sensitive development approach, the skills and capabilities of stakeholders will be strengthened to consider and negotiate potential tradeoffs among interventions and strategies to achieve sustainability ecosystem-wide. The planning process will identify opportunities for partner country USAID Missions to support a proposal for an Associate Award to complement core SANREM CRSP funding. Beneficial linkages to other SANREM CRSPs will be explored.

Multi-disciplinary Research to Optimize a Market-driven Approach to Food Security, Improved Rural Livelihoods, and Biodiversity Conservation in the Luangwa Valley Watershed Region in Zambia

Submitted by:	Cornell University
Principal Investigators:	Alfonso Torres, Cornell University
	Dale Lewis, Wildlife Conservation Society, Zambia
Host Country:	Zambia

A market-driven experimental model has been tested in the Luangwa Valley, Zambia watershed to improve biodiversity conservation by improving food security and livelihoods. This improvement was accomplished through implementing sustainable agricultural practices at the level of individual farms and rural communities. The catalyst for adoption of these practices is COMACO, "Community Markets for Conservation." COMACO uses a combination of extension support, marketing, and pricing strategies organized around regional trading centers to increase small stakeholder/producer profits. Preliminary data suggest that these market incentives are sufficient to maintain sustainable agricultural practices and to increase wildlife populations by alleviating poaching pressure on them, making future game-based economies possible. This research will optimize the COMACO model in specific areas that will allow COMACO to better achieve its goals in Zambia, and will also allow this model system to be thoroughly understood and able to be used as a paradigm for application in other nations.

Promoting Sustainable Development in West Africa through Creation and Dissemination of Knowledge to Improve Cotton-Based Agricultural Systems

Submitted by:	Virginia Polytechnic Institute and State University
Principal Investigator:	Ozzie Abaye
Co-Principal Investigators:	Bradford F Mills, Virginia Polytechnic Institute and State University
	Greg Mullins, Virginia Polytechnic Institute and State University
	Ames Herbert, Tidewater AREC
	Laomaïbao Netoyo, Institut du Sahel (INSAH), Mali
	Amadou Yattara, IER Cotton Breeder, Mali
Host Countries:	West Africa

Cotton is cultivated on some 2.4 million hectares in Francophone West Africa and has become the region's major export crop. As such it represents a predominant source of smallholder livelihoods and an engine for regional economic growth. Long-run rising demand and potential changes in production and marketing (e.g., Bt cotton, organics) promise to keep cotton in the forefront of regional development strategies. However, the long-term natural resource costs of cotton production are severe and threaten the sustainability of any such strategy. New, improved cotton-based agricultural production systems must be developed. Recent dramatic changes in US foreign policy will permit for the first time government supported activities to address the development aspects and needs of the West African cotton industry. SANREM is uniquely

suitable to assist in providing leadership to these efforts. This planning grant application proposes to build the regional and international partnerships necessary to identify and address priority SA & NRM concerns so that cotton may realize its development potential and help promote sustainable development in the region.

Natural Resource Management for Small-scale Agriculture: Sloped Areas in Latin America and the Caribbean

Submitted by:	Virginia Polytechnic Institute and State University
Principal Investigator:	Jeffrey Alwang, Virginia Polytechnic Institute and State University
Co-Principal Investigators:	Darrell Bosch, Virginia Polytechnic Institute and State University
	George W. Norton, Virginia Polytechnic Institute and State University
	Sarah Hamilton, University of Denver
	Carola Haas, Virginia Polytechnic Institute and State University
	Mary Leigh Wolfe, Virginia Polytechnic Institute and State University
	Paul Backman, Pennsylvania State University
	Jonathan Lynch, Pennsylvania State University
	Albert Essel, Virginia State University
	Stan Wood, Research Fellow, International Food Policy Research Institute
Host Countries:	Bolivia, Ecuador, Peru

This SANREM project integrates research, teaching and outreach/community engagement to promote sustainable natural resource management (NRM) in the sloped areas and highlands of the Latin America and Caribbean (LAC) region. These areas often have limited access to communications and transportation infrastructure, and have weak and ineffective access to central governing institutions. This project will identify and introduce new technologies and innovative uses of natural resources in poor areas in ways consistent with sound management of the natural resource base. The participatory and community-based approach involves sites in three countries in a process of identifying natural resource and human asset bases, identifying technical alternatives for livelihoods given asset bases and the policy context, measuring and monitoring the social, economic and environmental impacts of livelihood alternatives, and using the economic and environmental focus to effect community change. The project will bring together teams of social scientists, agricultural and natural resource scientists, geo-spatial experts, and local development and outreach specialists. They will help to holistically identify and generate livelihood alternatives consistent with sound NRM. Partners include academics and technicians from host countries, IARCs, NGOs, and U.S. university faculty and students.

Rural Poverty, Watershed Conservation, and Public Policy in Latin America

Submitted by:	The Ohio State University
Principal Investigator:	Douglas Southgate
Co-Principal Investigators:	Claudio González-Vega, The Ohio State University
	Timothy Haab, The Ohio State University
	Alan Randall, The Ohio State University
	Randall Bluffstone, Portland State University
Host Countries:	Bolivia, El Salvador, Ecuador, Guatemala, Peru

Drawing on close, collaborative relations that the investigators have established with NGOs and public agencies in Bolivia, Ecuador, El Salvador, Guatemala, and Peru, this project will examine key linkages between low living standards in the upper reaches of drainage basins in the Andes and Central America and payments for watershed environmental services (PWES), which are being used in various settings to foster resource conservation. The fundamental purpose of this project will be to identify best practices for calibrating PWES to local realities, which will involve determining efficient payments *to* upstream resource users as well as efficient payments by downstream beneficiaries of watershed conservation. In addition, special attention will be paid to the income variability experienced by rural populations below and near the poverty line because of environmental and market "shocks," and the implications of this variability for this population's acceptance of conservation initiatives, generally, and PWES, specifically. Institutional changes and policy reforms needed to raise incomes and reduce the variability of earnings in the countryside will be identified.

Cover Crops in Natural Resources Improvement and Tree Crops Sustainability under Tropical Agro-forestry Systems in South America

Submitted by:	University of Florida
Principal Investigator:	Yuncong Li, University of Florida
	Virupax Baligar, Agricultural Research Service, USDA
Host Countries:	Brazil, Peru

This partnership is preparing a long term research proposal to develop legume-based cover crop technology for cacao-based plantation systems in the infertile, degraded tropical soils of Peru and Brazil. Fully developed cover crop technology will lead to reduced soil erosion, improved carbon sequestration, enhanced soil quality, increased productivity, reduced costly fertilizer inputs, improved cacao sustainability and reduced the intensity of diseases and insects. Cacao is a major high value crop in this region and improvement in its productivity will help the resource-poor farmers. Efforts to increase yields economically to viable levels, by adapting ecologically sound practices is necessary due to the fragile nature of the soils. The research will be implemented in different geographic regions to assess the beneficial effects of a range of leguminous cover crops. Over the next six months, researchers will be conducting a participatory process with collaborators (government, non-government, private sectors, universities, foundations, industries) in Brazil and Peru to develop long term research program. Emphasis will also be placed on capacity building of involved research institutes. A partners meeting will be held in

Tarapoto Peru in May and Ilheus, Brahia Brazil in June with the principle coordinators at University of Florida in July to lay the frame work of the long- term research proposal.

Caribbean Food Systems Vulnerability to Global Environmental Change

Submitted by:	University of Florida
Principal Investigator:	James W. Jones, University of Florida
Co-Principal Investigators:	Walter Baethgen, Columbia University
	Mike Brklacich, Carleton University
	John Ingram, NERC Centre for Ecology & Hydrology, UK
	Arvin R. Mosier, University of Florida
	Ranjit Singh, The University of the West Indies
	Segio Sepulveda, Inter-American Institute for Cooperation on Agriculture (IICA)
	Adrian Trotman, The Caribbean Institute for Meteorology and Hydrology, Barbados
Host Countries:	Caribbean Region

Changes in climate and other important environmental factors pose a major concern to food security throughout the Caribbean. The overall goal of this SANREM research is to enhance livelihood opportunities and reduce the vulnerability of Caribbean food systems to environmental change. This will be accomplished by improving policy formulation capacity at national and regional levels. To implement these objectives, the aid of country-based USAID Mission offices will be enlisted to locate partners in three case study countries—Guyana, Haiti, and Jamaica—and use existing relationships to further develop these contacts. Working with these partners, this project will accomplish the following: 1) develop a project to identify key food systems and their vulnerabilities; 2) develop different scenarios of the effects of global environmental change on the Caribbean single market approach and development; 3) adapt the University of Florida climate risk Decision Support System (DSS) to key food systems; and 4) integrate the food production DSS with socioeconomic factors so that it use can be used in making decisions on adaptation of food systems. This program will train systems scientists by engaging female Ph.D. level students from each country in DSS development, as well as training other students in the technique of scenario development and the integration of production DSS with socio-economic development.

Agroforestry and Sustainable Vegetable Production in Southeast Asian Watersheds

Submitted by:	North Carolina A&T State University (NCA&TSU)
Principal Investigator:	Manuel R. Reyes, NCA&TSU
Co-Principal Investigators:	Conrad Heatwole, Virginia Polytechnic Institute and State University
	Ronald Morse, Virginia Polytechnic Institute and State University
	Raghavan Srinivasan, Texas A&M University

Delia Catacutan, World Agroforestry Centre
Rodel Lasco, World Agroforestry Centre
Manuel Palada, World Vegetable Center-AVRDC
Robert Yoder, International Development Enterprises (IDE)
Sudarshan Suryawanshi, IDE
David Midmore, Central Queensland University, Australia
Anas Dinurrohman, Bogor Agricultural University, Indonesia
Manuel Biona, Don Bosco Technical College
Elena Chiong-Javier, De La Salle University
Victor B. Ella, University of the Philippines Los Banos
Victoria Espaldon, University of the Philippines Diliman
Jean A. Saludadez, University of the Philippines Open University
Chapika Sangkapitux, Chiang Mai University, Thailand
Dang Thanh Ha, Nong Lam University, Vietnam

Host Countries: Thailand, Vietnam, Indonesia, Philippines

North Carolina A&T University in partnership with Virginia Tech, Texas A&M, The World Agroforestry Center (ICRAF), the World Vegetable Center (AVRDC) International Development Enterprises (IDE) and a range of local research institutions are preparing a long term research proposal that focuses on environmentally and economically sustainable production for small scale hillside farmers in South East Asia (SEA). This project seeks to reduce poverty and malnutrition of upland small-scale farmers (SSFs) and environmental degradation in SEA. To accomplish this, researchers will combine agroforestry, no-tillage, low cost drip irrigation, watershed modeling, and GIS/GPS technologies in the production and marketing of high-quality vegetables. Market analysis research will be conducted to identify opportunities for small-scale farmers (SSFs) to penetrate the vegetable market; intentionally targeting mechanisms to justly compensate women. Moreover, local capacity building will be emphasized by packaging the technologies in such a way that SSFs and trainers will own them. Policy changes friendly to SSFs will be researched and recommended. This research is targeting Vietnam, Indonesia, the Philippines, and Thailand with partners meeting in the Philippines in May to lay the framework of the long-term research proposal.

Dynamics of Farm-Forest Linkages in the Context of Changing Land-use Policies in South and Southeast Asia

Submitted by: Michigan State University
Principal Investigator: Murari Suvedi, Michigan State University
Dietrich Schmidt-Vogt, Asian Institute of Technology
Host Countries: Bangladesh, Cambodia, Indonesia, Vietnam

Rural communities throughout Asia are being affected by new and emerging land use and forest policies that impact on NRM-based livelihood strategies. Land use policies restrict the ability of

communities to practice swidden agriculture, while movement toward decentralization and community-based forest management alters forest access rights and thus biodiversity conservation. This research program will investigate how the dynamics of the farm-forest interface is changing under new policies in the Chittagong Hills of Bangladesh, NE Cambodia, West Sumatra, Indonesia, and central Vietnam, and how those changes are manifested at the landscape level. This project will use an interdisciplinary research strategy that integrates agriculture, forestry, biodiversity, and remote sensing and geographic information systems. The approach will link policy-level information to changes at the micro-level, and then back up to the landscape level for evaluation and dissemination to regional stakeholders.

Assessing the Linkages between Community Conservation & Governance in Nepal's Forest User Groups

Submitted by:	Yale University
Principal Investigators:	Dr. William R. Burch, Yale University
	Dr. Michael A. Rechlin, Principia College
	Dr. A. L. Hammett, Virginia Polytechnic Institute and State University
	Dr. Bhishma Subedi, ANSAB
Host Countries:	Nepal, India

Strong linkages have been recognized between the community-based management of natural resources and the development of a country's civil society. In many societies, resource management user groups are a community members' first experience with democratic decision-making. This research will investigate the success or failure of resource management user groups to adapt to changes imposed by environmental, market and political forces. The research will explore the dynamics of user group decision making, and how those dynamics have evolved in relation to equity and benefit distribution. The research will begin in Nepal and India, two countries with a long history of community based natural resource management. Based on the extensive sociological and ecological theory embedded in the Human Ecosystems Model it will develop a conceptual framework for understanding group decision making processes. In the four year time frame, the research will branch out to Afghanistan, Bangladesh, Sri Lanka and Thailand as it tests, and revises, the conceptual model under varying social, cultural and economic conditions. The results of this research will assist development practitioners in assuring that natural resource management user groups achieve a high level of citizen participation and that the fruits of the resource management activity are equitably distributed among village groups; including women and marginalized social and economic minorities.

Healthy Landscapes: Developing a Framework and Indicators for Sustainability and Management

Submitted by:	Cornell University
Principal Investigators:	Harold M. Van Es, Cornell University
	Rebecca L. Schneider, Cornell University

George S. Abawi, Cornell University
Host Countries: Ukraine, Bulgaria, Slovakia

Landscape health is a critical concept for sustainability of rural communities in Eastern Europe (EE) and Western Asia. Landscapes in this region have been affected by production-oriented and centrally-planned economic strategies, resulting in severe degradation of soil, water, and air, increased occurrence of droughts and floods, and loss of habitat and biodiversity. This situation has remained largely unchanged despite the recent economic and landownership transitions. Revitalization is needed to bring these landscapes to where they provide sustainable economic development and a multifunctional and safe environment that supports life in its broadest sense.
The proposed program aims to help rural communities and businesses in the region address complex issues related to environmental management, and link them effectively with the scientific and professional (GO and NGO) organizations. This builds on extensive US experience with linking universities with stakeholders, and addresses the regional USAID objectives to strengthen democratic governance, promote civil society, and enhance natural resources. The proposed work includes the development of a framework of landscape health assessment around four focal areas: diffuse water pollution control, flood and drought prevention, improvement of landscape biodiversity, and soil health management.

The Livestock, Wildlife, and Human Health Interface in Mongolia

Submitted by: Michigan State University
Principal Investigator: Amanda E. Fine, Michigan State University
Co-Principle Investigators: Steve Osofsky, The Wildlife Conservation Society
Charles Krusekopf, Western Washington University
Host Country: Mongolia

Michigan State University (MSU) and its partners, the Wildlife Conservation Society (WCS) and the American Center for Mongolian Studies (ACMS), plan to address one of the most urgent challenges facing rural Mongolia—the intersection of livestock, wildlife and human health. This project is designed to address disease challenges to the development of Mongolia's livestock and wildlife/ecotourism sector. This planning grant will be used to initiative a research and extension program focusing on diseases of economic and public health priority, including foot and mouth disease, plague, and brucellosis. The project will explore how interactions between Mongolia's livestock and wildlife populations lead to increased transmission of disease between the two populations, and how various management actions can decrease disease transmission. Understanding infectious disease dynamics among livestock, wildlife and human populations will lead to testable management strategies to mitigate the impact of disease on the competitiveness of Mongolia's livestock product markets, food security, human health and wildlife conservation efforts. In addition, this project will demonstrate the value of using a collaborative effort and multidisciplinary approach to disease management, addressing the broader ecological and socio-economic dimensions of the problem.

Training and Institutional Capacity Development

Long-Term Degree Training

The SANREM CRSP uses degree training to strengthen the technical skills of researchers and teachers from US and host country universities, NARS, NGOs, and relevant ministries. While developing a global knowledge base in US universities, SANREM is addressing specific host country SA & NRM questions, opportunities, and constraints. Five U.S. universities and one host country institution provided long-term training for 9 graduate (6 Ph.D. and 3 MS) students associated with SANREM CRSP activities. Of these, five are men and four are women. All but one of these students are developing country nationals working in both the Bridging and Knowledge-base Development Activities (see the Table of *SANREM CRSP Degree Training Participants: FY 2005* in Appendix C.

South East Asia Bridging Award (Wisconsin-Purdue): Two graduate students are in doctoral studies in the Department of Agricultural Economics at Purdue University. Their work targets the analysis of coffee data from Vietnam. At the University of Wisconsin, the project supported two Ph.D. students in agricultural and applied economics, one of whom has been working on SANREM project activities since beginning her graduate studies.

***Ecuador Bridging Award (Georgia)*:** This bridging activity provided support for one female Ph.D. student from Colombia working on food and biodiversity in the Andes.

SANREM Watershed System Coordination (VT): This activity supported two graduate research assistants in Biological Systems Engineering studying water resources management.

Short-Term Training

Short-term training programs have been demand-driven, linked to long-term program goals, and targeting professionals and students at different levels.

Field-based Systems work has been promoted by the Center for Environmental Farming Systems (CEFS) at North Carolina State University and The Rodale Institute. A CEFS program on agroecology research methods targeted 35 students from the Agricultural University of Honduras. Twelve Turkish agricultural professionals and three undergraduates from the University of Chapingo (Mexico) received hands-on training in sustainable agriculture, agroecology, and diversified organic production. Another 15 Honduran and Nicaraguan collaborators participated in a workshop on experimental procedures for soil fertility trials and learned about applying the Nutrient Management Support System software in collaboration with the Soil Management CRSP.

The Rodale Institute held a seminar on composting and organic farming techniques for 29 Ghanaian small farmers. They have also been working with the USAID Food for Peace Program

(22 participants) and Africare (14 participants), providing workshops on regenerative agriculture and collaborative activities in Africa. Students and faculty from Tuskeegee Institute (12) and the Gyeongsang University in South Korea (8) participated in a Workshop and Seminar, respectively, in regenerative agriculture and associated techniques.

The **Sustainable Land Use and Biodiversity Conservation** activity in Ecuador disseminated information on in situ conservation of germplasm, local genebanks and seed exchanges through field days, fairs, and exchanges hosted by SANREM-supported indigenous organizations and animated by the University of Georgia research team. These activities involved 170 participants, many of whom are NGO leaders who will in turn disseminate what they have learned to their members. They will also provide training to other SANREM researchers on Toolbook data integration, training of stakeholders through gene bank-farmer exchanges, and future visioning training for NGOs and partners in the Andes.

SANREM Policy and Operating Procedures Development

The Management Entity has placed a high priority on developing standardized policy and operating procedures to assure the smooth, efficient and fair management of routine and periodic SANREM CRSP activities. This can be witnessed in the evolution of the Policy and Operating Procedures (POP) Manual, from when it was first presented to the Technical Committee in December 2004 until finalized at the Board of Directors Meeting in August 2005. SANREM CRSP policy and operating procedures take as their frame of reference the newly revised and BIFAD-approved Guidelines for Collaborative Research Support Programs (CRSPs) (February 2005 and as printed on 25 March 2005). The POP Manual has been further adapted to take into account management of the increasingly dynamic competitive processes for selection of CRSP activities. Formalizing procedures for the establishment and functioning of the External Evaluation Panel and an ad hoc External Review Panel has been particularly important in the management of the SANREM CRSP competitive awards programs. In addition, the POP Manual is supplemented by 12 standardized forms and procedures documents available to partners and collaborating institutions on the SANREM CRSP Website. These forms include standardized budget spreadsheets, procedures for setting up subawards, invoicing and accounting, forms for international travel approval, and instructions for using TraiNet and HAC Insurance.

Gender sensitivity

SANREM CRSP is a gender-sensitive project. The Management Entity (ME) at OIRED/VT encourages all participants to be conscious of gender issues relevant at all levels of activity implementation. To assist applicants in thinking and acting in a gender sensitive manner, the ME provides guidance with gender resources through a page on the SANREM CRSP Website http://www.oired.vt.edu/sanremcrsp/Gender.html. This webpage contains relevant information for all working in the field of Sustainable Agriculture and Natural Research Management.

All SANREM CRSP RFAs (Bridging, Planning, and Long-Term Research) require applicants to consider gender issues in the research methodology and to ensure women and other minorities full participation in the planning and implementation processes. Links to supplemental information on gender issues are provided in each of the RFAs. These links reinforce the importance of gender equity in all SANREM CRSP activities. The integration of gender is also reflected in the evaluation criteria, where 15 points are directly attributable to how well gender and minorities are considered by applicants.

SANREM CRSP activities are designed to result in both women and men's empowerment through the development, cataloging and transfer of technologies for increased income generation, enhanced resource management, strengthened local institutions, improved market access for small-holders and communities, and sustainable and environmentally sound development.

Appendix A:

Landscape System Reports, FY 2005

Landscape System: Field/Production Unit-based

Principle Investigator(s): Paul Mueller, North Carolina State University (NCSU)

I. Synopsis

Activities for the SANREM Field-level system have included training for international agriculture professionals and students, collaboration with several international development organizations, and significant progress in the review of literature and identification of exemplary projects in the Field-level system. Fifty agriculture professionals and students participated in SANREM training activities at the Center for Environmental Farming Systems during FY2005. In addition, NCSU SANREM leaders collaborated with the Soil Management CRSP on research and training activities in Central America. Networking with several IARC's, NGO's, and host country institutions has contributed to SKB development and may lead to collaboration in future SANREM activities. Approximately 330 resources have been reviewed for the SANREM knowledge base and for the development of a synthetic review on the state of the art in SANREM at the field level. Preliminary analysis of 22 projects identified in year one indicates that participatory processes, and applications of indigenous knowledge are two key components of current development programs that have a SANREM focus. This finding will be further investigated through in-depth case studies of selected projects during year two.

II. Research Accomplishments by Objective

Objective 1: Review literature reflecting the State of the Science for the Field-Level System

Two researchers are currently assigned to this project. Denise Finney was hired as the SANREM Coordinator at NC State (a ¾ time position) in June 2005. A ½ time intern, Kelly Grube, is responsible for reviewing literature and case studies for the Rodale Institute.

The review process began with the identification of key organizations that serve as central information sources for relevant research and development programs, such as the Food and Agriculture Organization of the United Nations (Rome, Italy), CGIAR institutions, and the International Development Resource Center (Ottawa, Canada). Through analysis of available information from these sources, the following areas have been identified as priority areas in sustainable agriculture and natural resource management at the field-level system: integrated soil fertility management (ISFM), conservation agriculture, ethnopedology, soil carbon sequestration, integrated pest management (IPM), conservation of plant genetic material, irrigation systems, and technology transfer. Current literature review efforts aim to identify and gather resources available on applicable best practices within these priority areas as well as field management systems that incorporate a number of best management practices to promote sustainable agricultural production, such as: organic agriculture, low external input sustainable agriculture, agroforestry, and crop-animal integration. The Rodale Institute has primary responsibility for reviewing resources relevant to soil quality, including the priority areas of ISFM, conservation agriculture, ethnopedology, and soil carbon sequestration, and agroforestry agricultural systems. NCSU is responsible for reviewing literature on all other priority areas and agricultural systems and coordinating case study analysis and development (with contributions from Rodale).

Approximately 330 resources have been reviewed to date. Fifty-six resources have been contributed to the knowledge base by Rodale. NCSU has entered twelve resources on the knowledge base and has entered approximately thirty resources into an Excel spreadsheet catalogue.

A number of best practices have been identified within each of the priority areas at the field-level system. Best practices relevant to soil quality include: integration of organic and inorganic fertilizers, improved manure and compost management, legume intercropping, improved fallows, soil biodiversity conservation, cover cropping, mulching, reduced- and no-tillage, terracing, contour planting, and buffer strips. Integrated pest management encompasses multi-pronged approaches to the management of disease, weeds, and insect pests. Best practices in IPM include soil and input solarization, natural product extracts, allelopathic and repellent crops, and resistant variety selection. State of the art practices for conservation of plant genetic material include farmer participatory breeding, home gardening, and identification and development of production systems for indigenous crops. In the area of irrigation, rooftop and field water harvesting and low-input drip irrigation systems are among the best practices identified. Leading technologies for transferring knowledge rely heavily on participatory processes such as community participatory assessment, farmer participatory research, and farmer to farmer dissemination.

Objective 2: Identify State of the Art projects for case study analysis

Twenty-two projects have been identified for possible case study analysis by NCSU. Selected project names, locations, and principle technologies appear in Appendix 1. Initial comparative analysis of fifteen of the identified projects reveals two trends that may represent the state of the art in project/program development: (1) participation by the designated beneficiary population; (2) incorporation of indigenous knowledge, practices, and biodiversity.

In the identified case studies, participation occurs in the form of participatory rural appraisal, participatory technology development (e.g. on-farm trials, designation of farmer-researchers), and participatory scaling up/technology dissemination (e.g. farmer to farmer extension, on-farm demonstrations). It must be noted that “participation” in most cases did not imply the inclusion of women stakeholders, though some cases did list the inclusion of women in their project objectives. Three case studies highlight specific structures to promote participation: comites de investigacion agricola (CIALs, Honduras), “landcare” groups (Philippines), and learning projects (Peru). The first two structures represent means of organizing farmer or community associations; the latter was a strategy to encourage participatory project design in local agricultural research institutions.

Six projects reported an explicit focus on indigenous knowledge, practices, and/or biodiversity, suggesting a growing recognition of the value of indigenous resources in promoting sustainable agriculture and natural resource management. Four projects based technology development aspects of their respective programs on identified indigenous practices of fallow management, soil conservation, and soil fertility management. The process of technology development involved research to both validate the effectiveness of identified practices and improve upon

them. In addition, three of the projects worked to identify, catalogue, and gather cultural and scientific information on indigenous plant material for food, fodder, and soil improvement applications. In all cases, participation of local stakeholders was critical to the acquisition of information.

In addition to the projects identified, fifty-three additional case study reports have been collected. Existing case studies will be included in the production of the synthesis report as described under Objective 3. Metadata has been created for existing case studies and project resources collected under this objective.

The Rodale Institute is in the process of reviewing project examples to determine which will be most valuable for case study analysis and potential follow-up case study development.

Objective 3: Develop case studies characterizing critical SA & NRM system issues

No original case studies have been developed in year 1. Ten to twenty case studies from those identified in Objective 2 by both NCSU and Rodale will be selected for in-depth analysis during year 2. Following case study analysis, a synthesis report based on new and existing case studies collected (see Objective 2) will be developed on the approaches and factors that tend to promote and hinder the achievement of desired outcomes in field level management/restoration projects with SA and NRM themes.

Objective 4: Draft synthetic review of the State of the Art and Science in your system

Reports, articles, and other materials collected through Objectives 1 – 3 will be utilized to draft a synthetic review of the state of the art and science at the field-level system.

III. Degree and Non-Degree Training Activities

See attached Non-Degree training table. Degree training was not associated with this program.

IV. Publications, Presentations, and Other SANREM CRSP Products

No publications were produced during the 2004-05 fiscal year.

V. Networking Activities

Partnerships have been forged with several organizations, including international NGO's (IUCN, The Rodale Institute, and HasNa, Inc.), IARC's (ICRAF, Peru; CIAT, Central America), and other relevant country institutions in Latin America (CIPAV, Colombia; IDIAF, Dominican Republic, CATIE, Central America). These partners will contribute to the development of case studies. Specific efforts were also made to develop a long term collaborative relationship for SANREM-CRSP with CIAT and CATIE in Central America. Though this has not yet resulted in a funded research activity, other collaborative possibilities with these organizations are under investigation.

NCSU SANREM Coordinator Denise Finney assisted the Soil Management-CRSP in a training conference for 15 research collaborators in Central America. Current collaborators responsible for carrying out CRSP research in Nicaragua and Honduras participated in a three-day workshop during which the previous year's field trial results were reviewed, protocol expectations discussed, and applications of collaborators' research findings were applied to the NuMaSS software program.

VI. Project Highlights:

- More than 300 resources and 20 projects have been reviewed for inclusion in the SANREM knowledge base. These resources will contribute to the development of a synthetic review of SA and NRM in the field-level system and comparative analysis of effective scaling up strategies.

Appendix 1. Sample projects selected for SANREM field-level review.

Project	Location	Field-level technologies	Participatory elements?	Indigenous resource focus?
African Highlands Initiative	East Africa	Soil fertility mgmt; IPM; Livestock mgmt; Diversification/intensification	Y	
RELMA	Uganda	Indigenous soil & water conservation strategies	Y	Y
Indigenous food plants	Uganda	Reintroduction of indigenous fruits and vegetables	Y	Y
Indigenous vegetables for food security	Zimbabwe	Indigenous vegetable production	Y	Y
Rock phosphate blends: delivering local alternatives	Zimbabwe	Low cost P and blended fertilizer alternatives		
Wetland production systems in Bhutan	Bhutan	Rice cropping systems (cash crops, improved fallow); Improved rice varieties; IPNS; Agroforestry applications		
CBNRM and the farmer centered research network	China	Crop-animal integration; Water conservation in rice; Cassava variety selection; Cultivation strategies; Improved fallows	Y	
Sustainable land use for shifting cultivators	India	Agroforestry for improved fallow; Indigenous fallow practices and tree species; Polyculture; Nitrogen fixing species	Y	Y
The Landcare Program	Philippines	Soil conservation practices: contour hedges	Y	
Rice-based production systems for salt affected areas	Philippines	Rice + fish + vegetable rotation; Raised seedbed, staggered planting	Y	Y
Community based upland natural resource management in Hong Ha commune	Vietnam	Improved rice seed; Fertility & pest mgmt in rice; Rice cultivation; Home gardens; Livestock breeding	Y	
Conservation tillage in Guaymango	El Salvador	Soil conservation practices: no burning, contour planting, living erosion barriers, zero tillage		
Honduran Hillsides	Honduras	Variety selection; Alternatives to slash and burn; Soil conservation strategies	Y	
Quesungual	Honduras	Soil conservation practices: no burning, contour planting, zero tillage, agroforestry, slash and mulch	Y	Y
Poverty and the Environment in the Amazon	Peru	Organic fertilizers; Reduced tillage; Living barriers; Crop variety improvement	Y	
Organic cotton	Krygyzstan	Promotion of organic cotton farming		

Landscape System: Field/Production Unit-based – Soil Quality

Principle Investigator(s): Paul Hepperly and Kelly Grube, Rodale Institute

I. Synopsis

Rodale's focus has been soil quality protection and its improvement in developing countries in the tropics. Thus far, approximately 200 projects and/or critical information resources have been identified. Approximately 55 of these resources have been uploaded to the SANREM knowledge database. Ten existing case studies have been examined, and many projects for potential case study identified. A focus on Africa has highlighted the importance of Integrated Soil Fertility Management (ISFM), cover crops, agroforestry, ethnopedology, conservation tillage, and soil carbon sequestration. Several networking/training activities related to the SANREM project have taken place over the past year, including interactions with Opportunities Industrialization Centers International (OICI) and the Ghana Ministry of Food and Agriculture, USAID Food for Peace Program, Africare, Tuskegee Institute, and a group of Korean students together with a Korean professor of agriculture.

II. Research Accomplishments by Objective

Objective 1: Review literature reflecting the State of the Science in your System.

Approximately 55 critical information resources have been reviewed and added to the online SANREM knowledge base. These information resources document soil constraints, improvement strategies, and on-the-ground field projects focusing on soil quality conservation and improvement.

Soil types vary greatly by geographic region, but the same soil type in different geographic areas shares similar behaviors and agricultural use potentials and challenges. Oxisols and Ultisols, infamous for their wide prevalence in the tropics and poor fertility, are a major focus of our review. Literature research is on-going on soil quality protection and improvement for developing countries.

The erosion of topsoil by wind and water, exacerbated by deforestation and drought, has caused major soil losses in many under-developed regions of the world. Erosion is stimulated by excessive tillage, tillage of sloped land, and overgrazing, all of which contribute to the ultimate limitation of the capacity of the land to support food crops and animals.

To address the problem of soil loss by erosion, scientific frontiers include i) greater use of cover crops that stabilize the soil, ii) agro-forestry practices such as alley-cropping annual crops with rows of leguminous trees, iii) improved methods of conservation tillage, which seek to minimize disturbance of the soil profile, iv) better grazing strategies, and v) integrated animal plant production systems. Standard best practices include the planting of perennial vegetative buffer strips to catch soil, terracing, contour planting, live fencing, and perhaps most popularly, conservation tillage practices. In addition, ethno-pedology, the study of the indigenous skills,

knowledge, and technology relating to soil management accumulated and refined over time by generations of local people, is a real opportunity not fully exploited in previous development strategies. Combining the best of indigenous knowledge with appropriate technology from outside can prove a synergistic knowledge foundation to promote soil improvement strategies.

Besides soil erosion, declining soil fertility of agricultural soils is associated with nutrient mining and loss of soil organic matter (SOM). Loss of SOM leads to a downward spiral of increased nutrient leaching and soil compaction, as well as reduced water-holding capacity, cation exchange capacity, soil structure, and biological activity.

Applied technologies that conserve and build both soil nutrients and SOM have the best potential for improving both natural resources and agricultural capacity at the heart of Sustainable Agriculture and Natural Resource Management SANREM mission goal. Because of the local shortfall of both capital and infrastructure in many developing countries, using local sources of organic matter as inputs including compost, manure, and new techniques in cover cropping are more likely to improve soils than exporting inappropriate technologies out of their developmental context from industrialized countries. Best management practices for reaching soil objectives include increasing plant residue return to soil, cover cropping with legumes and non-legumes, improving manure management, particularly compost use, improved fallowing, and employing conservation tillage practices that slow the rapid oxidation of SOM that typically occurs in the tropics.

Objective 2: Identify State-of-the-Art Projects in the area of Tropical Soil Quality Improvement

We have identified approximately 100 projects for potential case study analysis thus far and we will highlight one, below, which has most of the successful elements we were looking for.

Soil infertility is a complex problem, encompassing a complex of nutrient deficiencies and toxicities. These limiting variables interact with other constraints such as inappropriate germplasm and cropping system design, pests and diseases losses, cultural aspects of poverty and land degradation, and national and global policies that contribute to these. All of the above mentioned constraints ultimately lead to food insecurity for the rural poor. A program for soil improvement will only be effective if it simultaneously improves the quantity and quality of food, farm income, and the sustainability of soil productivity.

An innovative approach, known as Integrated Soil Fertility Management (ISFM) promoted by the Tropical Soil Biology and Fertility Institute of CIAT (International Center for Tropical Agriculture), seeks to look beyond the narrow focus on nutrient replenishment alone to remediate soil fertility decline at its root causes. This approach addresses broad biological, physical, chemical, social, economic, and political aspects of soil fertility decline.

Research on ISFM emphasizes understanding and managing the processes that contribute to change and farmer participatory approaches that increase the appreciation and use of local knowledge systems. This approach utilizes and recognizes the sociological root of farming behavior. If we change the soil we must start with people who manage it.

Specific ISFM technologies that have been widely adopted include i) integrated nutrient management, ii) micro-dose fertilization, iii) improved manure management, iv) high quality organic inputs, v) inter-cropping emphasizing use and integration of multi-purpose legumes, vi) improved fallows, and vii) techniques to conserve and increase soil biodiversity. In ISFM, all of these technologies are viewed in the context of landscape, economic and social constraints, and government policy.

ISFM fits well within the larger framework of natural resource management. In addition to agricultural impacts, the degradation of soil resources undermines ecosystem services and contributes to environmental degradation including i) the conversion of natural habitat, ii) decreased water quality and quantity (reduced groundwater recharge), iii) associated human health risks of reduced water quality, iv) increased risk from diseases and pests due to lower biological control, and v) increased greenhouse gas emission contributing to climate change, as well as increased risk of catastrophe such as landslide and flood. Society as a whole benefits from restoring soil fertility.

The most appropriate testing and outreach methods are based on farmer participation. This means i) involving farmers in developing and fine-tuning the best combinations of soil fertility management options, and ii) combining local knowledge with research-based technologies to make the best of locally available resources.

An example of this approach is called Participatory Learning and Action Research (PLAR). It seeks to stimulate joint learning and experimentation among farmers, researchers and extension workers. This program was started by the International Institute for Environment and Development and was successfully piloted in Western Kenya in 1997. Unique aspects of the PLAR program include i) a preliminary diagnosis of the community land use system, ii) the formation of a village advisory committee, iii) developing a resource flow map, iv) monitoring and experimentation being carried out by farmers themselves, and v) technical support from researchers and extension agents.

The Participatory Learning approach takes into account the diversity and complexity of farming systems in Africa and Western Kenya, and does not seek to come up with a single strategy for the "average" farmer. Instead, the approach seeks to provide a menu of options which farmers can choose from depending on their soil type, cropping system, resource availability, and economic constraints. The PLAR program has been both popular and successful with African farmers, who are empowered to try new techniques and share their experiences with their neighbors and peers.

Objective 3: Develop case studies characterizing critical SA and NRM system issues.

Not yet in progress.

Objective 4: Review of the State-of-the-Art and Science in Tropical Soil Systems.

Not yet in progress

III. Degree (not applicable) and Non-Degree Training Activities

In April 2005, the principal investigator, Dr. Paul Hepperly, traveled to the northern region of Ghana where he worked with polyvalent facilitators of Opportunities Industrialization Centers International (OICI) in Tamale and the Ghana Ministry of Food and Agriculture. He gave an intensive course on Soil Quality, Composting and Organic Agriculture. He worked in country in Ghana for 3 weeks.

In July 2005, we hosted a group of 8 student-visitors and lead Professor from Gyeongsang University to our research facility for a period of 20 days, exchanging information about cropping systems research, composting, soil fertility maintenance and improvement, and water quality research.

IV. Publications, Presentations, and Other SANREM CRSP Products

1. Pimentel, D., Hepperly, P., Hanson, J., Douds, D., and R. Seidel. 2005. Environment, energy, and economic comparisons of organic and conventional farming systems. Bioscience 55(7): 573-582.

2. PowerPoint presentation-Carbon Sequestration and Soil Organic Matter

Please see attached Bioscience article and PowerPoint presentation.

V. Networking

We have been routinely collaborating with Paul Mueller and Denise Finney at North Carolina State University on the literature review for this field-based landscape system.

From June to September, we worked with Dr. O. Abaye, Associate Professor of Crop Sciences from Virginia Tech on a regional SANREM proposal aimed at cotton agroecosystems for West Africa. We also hosted and worked with Dr. Richard Dick, Professor Crop Ecology, of Ohio State University on his proposal relating productivity to preservation of native shrubs in agricultural systems in West Africa.

In June through September, we linked with the USAID Food for Peace Program explaining our research and outreach capacity on soil regeneration for the tropics. We also met with groups from Africare and Tuskegee Institute, exploring the linkages for expanded collaboration. In September 2005, Dr. Kokoasse Kpomblekou-A, Associate Professor of Agronomy, from Tuskegee University visited our research facility. During the visit we exchanged scientific presentations and discussed potential collaborative efforts.

We explored collaborating with Food for Peace programs of USAID by meeting with P. E. Balakrishnan and staff both here and in Washington, D.C. Balakrishnan is the Director of Development and Program for Office of Food for Peace for USAID in Washington D.C. We

similarly explored collaborating with Africare by meeting with Julius Coles, President Africare and staff. In all cases the focus included areas of potential joint endeavor and possible synergy.

VI. Project Highlights:

- Bioscience Article appears in Economics, Energetics and Environmental Performance of Organic Agriculture (July 2005)

- Worked with Opportunities Industralization Centers International (OICI) in Ghana to train 30 extension agents from OICI and the Ministry of Food and Agriculture in the Northern Region of the country in the areas of composting and organic agriculture (April 2005)

- Sustainable Agriculture short course for eight Korean University students and their Professor (July 2005)

- USAID Food for Peace brainstorming with 14 of their Program Managers (June 2005)

- Africare brainstorming with 11 managers (August in Pennsylvania and September in Washington, D.C.)

- Powerpoint Presentation on Soil Organic Matter (June 2005).

Annex: Soil Quality State of the Science Review Preliminary Outline

1. Geographic areas severely affected by soil degradation

    a. Africa
    b. South America
    c. Central America
    d. Southeast Asia

2. Emphasis on soil degradation at the field level

    a. Erosion

        i. Excessive tillage
        ii. Lack of adequate soil cover
        iii. Cultivation of hillsides, sloped lands
        iv. Overgrazing
        v. Slash and burn agriculture

    b. Nutrient Depletion / Soil Infertility

        i. Lack of adequate inputs: fertilizers, lime, organic matter

            1. Unaffordable / no access
            2. Labor intensive
            3. Lack of knowledge

        ii. Loss of soil organic matter

            1. Tropical soils low in SOM to begin with
            2. Excessive tillage
            3. Over-harvesting of residues for fuel and fodder
            4. Lack of on-farm sources of organic matter (leaves, manure)

        iii. Toxicities

            1. Overly acidic soils
            2. Aluminum toxicities

3. Best practices to promote SANREM

    a. Integrated soil fertility management

        i. Integrated nutrient management
        ii. Micro-dose fertilizer use
        iii. Improved manure management

iv. Transfer of high quality organic inputs
v. Intercropping with legumes
vi. Improved fallows
vii. Techniques to improve and conserve soil biodiversity

b. Cover cropping

i. Legumes / non legumes

c. Agroforestry

d. Conservation agriculture

i. Conservation tillage
    1. Reduced tillage
    2. Zero till
ii. Terracing
iii. Contour planting
iv. Perennial vegetative buffer strips
v. Live fencing

e. Ethnopedology

f. Soil carbon sequestration

4. Technology transfer

a. Farmer to Farmer
b. Participatory process
c. Extension

Landscape System: Farm/Enterprise-based

Principle Investigator(s): Chris Pannkuk, Peter Wyeth, Oumarou Badini, Washington State University

I. Synopsis

To develop the knowledge base component, the work initially focused on researching relevant projects and publications organized by farm activity (e.g. agroforestry, crop-livestock integration, aquaculture, etc.) within the PIs' specific geographic areas of expertise: Afghanistan, Armenia, Romania, Malawi, Burkina Faso, Ghana, Mali, and Niger. Meta-data relating to specific activities (agroforestry, NRM, small scale irrigation, gender, etc) was collected for resources relating to these countries. Further information was gathered through contacts with other organizations (Winrock, FAO, ICARDA and CIMMYT). Identified resources were entered into the SANREM Knowledge Base. Progress was also made towards the identification of relevant projects for case studies. Three case studies of long-term projects on soil water conservation and agroforestry systems were identified in Mali, Burkina Faso and Malawi for comparative studies on successes and failures and inclusion in the SANREM book.

II. Research Accomplishment by Objective

Objective 1: Review literature reflecting the State of Science at the farm level

- The meta-data we have collected has been entered in the Excel format provided by Virginia Tech. For each of the African countries mentioned above, we have entered meta-data on approximately 75 projects. For the other countries we have gathered less information – we have entered meta-data on about 20 projects for each.
- Regarding best practices being promoted among smallholders, we have focused on agroforestry, small-scale irrigation, combining irrigation and aquaculture, and introducing community based NRM.
- The most promising practices being tested that we have found so far are refinements of the above, e.g. experimenting with different species of shrub in agroforestry techniques to improve soil fertility and testing alternative technologies for small-scale irrigation.
- A graduate student dedicated 20 hours a week to SANREM research

In this first year of the SANREM project obstacles we have dealt with include:

- Identifying an efficient method for organizing researched literature so that it adheres to the needs of SANREM's end users.
- Identifying those elements of our research that are unique and value adding in comparison to existing material.
- Defining a realistic scope of work that is feasible for our capabilities and the SANREM timeline.

The guidelines from Virginia Tech for organizing meta-data entries have been very helpful.

Objectives 2 and 3: Identify State of the Art projects at the farm level for case study analysis and Develop case studies characterizing critical SA & NRM system issues.

During this past year, more focus was put on the identification of projects for case study analysis. Each project was rated on a scale of 1 to 3 with 3s being the most relevant to farm/enterprise-based systems. Two projects pertaining to agroforestry systems, crop-livestock integration systems, soil fertility and water conservation and management and micro-enterprise development will be further investigated: the USAID-funded Malawi Agroforestry Extension Project together with its predecessor and successor projects, and the IFAD Special Programme for Soil and Water Conservation and Agroforestry in Burkina Faso and Mali in West Africa. (A third might be added later if funds and time permit.)

The purpose of the Malawi projects was first to research, and then extend agroforestry and other soil conservation measures that smallholders with limited cash and labor can use to restore soil fertility and timber supplies and reduce erosion. The projects have also researched and extended improved approaches to small scale irrigation that allow farmers to produce dry season crops for consumption and sale. The program is recognized as being highly successful and the work continues with funding from several donors, including USAID.

In Burkina Faso, the Special Program for Soil Water Conservation and Agroforestry commenced in 1988 and lasted for 15 years over two phases. The overall program objectives were (i) conservation of natural resources; (ii) effecting a lasting improvement in production, incomes and living standards for rural households farming on land of less than three hectares, or approximately 40,000 smallholdings (20% of them headed by women). A follow-up visit is scheduled later this year to these countries to assess with stakeholders the relevance of the actions and approaches taken in relation to project objectives and expectations, to determine the actual outcomes, impact and changes made, and draw lessons learned in relation to what factors have contributed to project successes and/or failures. Results from these case studies will be input in the upcoming SANREM book.

Guidelines from the TC regarding the form and length of case studies and suggested leading questions to harmonize synthesis in the book will be very useful.

Objective 4: Draft synthetic review of the State of the Art and Science in your system.

With the help of the metadata Excel format we have created a synthesized needs assessment based on geographic location, which is then subdivided into specific farm level activities. Ultimately our research has enabled us to better understand the potential of future projects, while also providing us access to documents corroborating such analysis.

III. Degree and Non-Degree Training

A graduate student employed in the cadre of the project benefited from knowledge on data collection and management as well as world farm/enterprise based systems review and synthesis.

IV. Publications, Presentations and Other SANREM CRSP Products

Badini, O., C.O. Stockle, J.W. Jones, R. Nelson, and M.Keita, 2005. Analysis of Productivity and Soil Carbon in Response to Time-Controlled Grazing in the West African Sahel Region. *Journal Agricultural Systems – Edition Special* (in print).

V. Networking Activities

Within this search for existing projects and studies we have also made contact with other organizations currently implementing projects in our focused regions, such as Winrock and the FAO, ICARDA and CIMMYT. Through the identification process of case studies, contacts were established with national research and NRM extension project coordinators in Mali, Burkina Faso, Senegal and Ghana. Organizations and key individuals contacted in these countries include:

- In Mali:
  (1) Institut d'Economie Rurale (IER) (Dr. Bino Témé, Director; Dr. Lassine Diarra, Scientific Coordinator SPGRN/ECOFIL and Scientific Editor; Dioni Lassana, Soil Scientist and Moussa Keita, Pasture Scientist; Dr. Samba Traoré, agronomist);
  (2) CILSS/Institut du Sahel (INSAH) (Dr. Sibiri Ouédraogo, Agroforester and Coordinator Réseau d'Observatoires de Surveillance Ecologique à Long Terme (ROSELT));
  (3) World Agroforestry Center (ICRAF) (Dr. Bocary Kaya);
  (4) International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Dr. Ramadjita Tabo, Assistant Director and Regional Coordinator (West and Central Africa) Desert Margins Program (DMP);
  (5) Ministry Of Agriculture and Animal Husbandry (Dr. Mamadou Coulibaly, Director of Service);
  (6) NGO Centre Technique pour l'Environnement, la Santé et l'Agriculture (CTESA) (Tiémoko Diakité, Président).

- In Senegal:
  (1) West and Central African Council for Agricultural Research and Development (CORAF/WECARD) (Dr. Paco SEREME, Executive Secretary and Dr. Marcel Nwalozie, Scientific Coordinator);
  (2) Regional Center of the Study of Inprovement of Plant Adaption to Drought (CERAAS) (Dr. François Lompo, Agronomist).

- In Burkina Faso:
  (1) Institut de l'Environnement et de Recherches Agricoles (INERA) (Dr. Boly Hamidou, Director; Dr. Jean Sibiri Zoundi, Chief Research-Development Liaison

Service; Dr. Bernadette Toé-Kiébré, Animal Scientist; Dr. Adama Neya, Phytopathologist);
(2) Ministry of Agriculture, Water and Halieutic Resources (Ibrahima Kaboré, Secretary General; Lompo Fimba, National Coordinator Soil Water Conservation and Agroforestry and Sustainable Development Programme; Jacob Ouédraogo, National Coordinator Community Investment Programme for Agricultural Fertility; Jean Paul Sawadogo, National Coordinator Sahel Integrated Lowland Ecosystem Management Programme;);
(3) Centre for Research and Development of Livestock in the Subhumid Zone (CIRDES) (Dr. Issa Sidibé, scientific Director); Remote Sensing and GIS Center (SIGET) (Sanou Patrice, Director); Center International Center for Soil Fertility and Agricultural Development (IFDC) (Dr. Abdoulaye Mando, Project Leader); Tropical Soil Biology and Fertility Institute of CIAT (TSBF-CIAT) (Dr. André Bationo).

- In Ghana:
  (1) Catholic University of Ghana – Fiapre (Rev. Dr. Michael J. Schulteis, President; Rev. Fr.Samual Batsa, Director Public Relations & Development);
  (2) Food and Agriculture Organization of the United Nations (FAO) (Dr. Lamourdia Thiombiano, Senior Soil Resources Officer);
  (3) USAID/WARP (Dr. Robert B. Kagbo, Senior Ag. Advisor/IEHA Coordinator USAID/WARP).

VI. Project Highlights

The main findings of the database research were:

- Agroforestry practices that have proven effective in East and Southern Africa merit further research in West Africa.
- GIS techniques have been underexploited as a means for eliciting discussions with rural people of current trends and possible improvements in natural resource management.

ANNEX: Sustainable Agriculture and NRM Priorities Found so Far by Country

Afghanistan

- Water/Irrigation: Diffusion of community management organization and training. In addition a need for the development of governmental institutions and policies to monitor and supervise these smaller organizations.

Armenia/Romania

- Integrating crop and livestock management: One of the aims of livestock development emphasizes the benefits of using animal manure as fertilizer.

Malawi

- Reforestation: tree planting, community forest management and nurseries, as well as the introduction of viable energy alternatives to fuelwood
- NRM: promoting specific practices that emphasize to smallholders the benefits of agroforestry and crop diversification for soil fertility, improved food security, pest control, and drought management.
- Small scale irrigation: Treadle pumps and other appropriate small scale irrigation methods coupled with training in land preparation and the cultivation of high value crops to increase the returns to water and labor.
- Irrigation/aquaculture: integrating these two activities and training for low input farmers in small scale fish farming

West Africa

- Forestry: decentralized forest management (community plantations, nurseries, community management) and fuelwood/income alternatives.
- Irrigation: continue diffusion of irrigation schemes in rural areas to capitalize on agricultures full potential
- Aquaculture: further integration of irrigation and aquaculture, through both community management plans and individual fish farm development
- NRM: emphasis on diversification and resulting benefits (soil fertility, food security, pest management)

Landscape System: Watershed-based

Principle Investigator(s): Saied Mostaghimi, Virginia Tech

I. Synopsis

Forty-two information resources were reviewed and the process of identifying additional works with an emphasis on case studies is well underway. Fifteen projects have been identified for review. Five of ten case studies selected for further analysis have been completed. Several case studies have already been summarized. Preliminary results from our literature review indicate that adopting a land capability classification system for evaluating land use capacity is essential for project planning. The literature synthesis also clearly indicates that respect for farmers' knowledge of their land and local conservation practices is extremely important to success of projects in developing countries. There is strong evidence that top-down programs promoting non-local practices with incentives that go away before real benefits are realized are doomed to fail. The Watershed Systems team is collaborating with and providing advice to researchers at Virginia Tech, North Carolina A&T, and the University of Southern Florida on watershed hydrology and management for SANREM-related research and with the University of Hawaii modeling the effects of agricultural systems on soil erosion and water quality for the Soil Management CRSP.

II. Research Accomplishments by Objective

Objective 1: Review literature reflecting the State of the Science in your System.

In an effort to expedite the completion of literature synthesis, a research associate with experience in watershed resource planning was hired in August of 2005. Previously summarized literature has been reviewed and the process of identifying additional works with an emphasis on case studies has begun. We have identified major watershed protection and restoration projects in developing countries in order to determine best management practices for recommendations for future projects. Among the numerous articles searched and reviewed, we have selected approximately 15 relevant projects for further review. We will be expanding on this list during the next few months. These research papers have been carefully read, analyzed, and subsequently summarized in an annotated bibliography. We have also commenced the entry of metadata.

Objective 2: Identify State of the Art projects for case study analysis.

We had anticipated writing a section on watershed protection and restoration measures by focusing on approximately 10 case studies. A total of five case studies have been summarized and they are currently being reviewed. These case studies include both successful and failed projects and represent a variety of social settings and geographic conditions. We are in the process of identifying the factors that would cause a certain project to succeed or fail. Lessons learned from these case studies will be very valuable to future success of SANREM CRSP projects. The preliminary results indicate that projects which have direct stakeholders involvement and in-country training have a much higher probability of success. Poverty is not

necessarily the main cause of environmental degradation and working only with the poor will not lead to effective resource management. Stakeholders must be involved in framing both the problem and the solution. Finally, our analysis indicate that what outside experts see as a crisis is not always viewed in the same light by local stakeholders and this perception could have a significant impact on the outcome of watershed management projects.

We will highlight these and other factors in our assessment of successful projects. We are currently in the process of collecting more information about these case studies and expanding on the number of the case studies.

Objective 3: Develop case studies characterizing critical SA & NRM system issues.

As indicated above, we have selected about 10 case-studies that focus on watershed management and restoration in developing countries. Five of these have been carefully reviewed and we are in the process of finalizing these reviews. These selected case studies cover diverse geographic areas with diverse watershed management needs.

We are in the process of summarizing objectives, outcomes, and factors contributing to success/failure of these projects and identifying common key factors contributing to their success/failure.

Objective 4: Draft synthetic review of the State of the Art and Science in your system.

Based on the results of the case studies and other literature review, we have outlined the table of contents for the draft of the chapter on watershed management. The following components have been identified for inclusion in the literature synthesis review chapter on watershed management. We are in the process of writing individual sections.

1. Introduction
2. Selection guidelines
    - Project
    - Site
    - Practice
3. Conservation practices and strategies
4. Management tools
    - Land capability classification systems
    - GIS and computer models
    - Data collection and feedback
5. Stakeholder involvement
6. Socio-economic factors
7. Project success and failure
8. Needs and Opportunities
9. Recommendations
10. Summary
11. References

APPENDIX – Case Studies

III. Degree and Non-Degree Training Activities

Two graduate students have been working on the literature review and case study development. Unfortunately one of them has taken a leave of absence to complete an internship and will join the project again in January 2006. The second graduate student started in August and he has been involved in conducting the literature review. No non-degree activities were conducted in 2005.

IV. Publications, Presentations, and Other SANREM CRSP Products

No publications were resulted during the first year of the study.

V. Networking Activities

In addition to interactions with SANREM TC and work plan members, I have collaborated with researchers from North Carolina A&T, assisting them with identifying tools and assessment methods and from Virginia Tech and the University of Southern Florida providing guidance on the hydrology and watershed protection for another proposed SANREM activity. I have also been collaborating with the University of Hawaii modeling the effects of agricultural systems on soil erosion and water quality for the Soil Management CRSP.

VI. Project Highlights:

Some of our most important research findings from the literature review:

General

- Poverty is not necessarily the main cause of environmental degradation and working only with the poor will not lead to effective resource management.

Conservation practices and strategies

- "Prevention" of degradation is better than "cure."
- Practices must show obvious short-term and long-term benefits to be adopted.
- There is some debate over the effectiveness of "bunds" (erosion control barriers) as a best management practice.

Management tools

- Adopting a land capability classification system for evaluating land use capacity is essential for project planning.
- Remote sensing and GIS are valuable tools for collecting and analyzing data for areas that are hard to access due to terrain or war.
- Hard-number, data-intensive modeling is usually not feasible for watersheds in developing countries: alternative modeling approaches are discussed in the literature.

Stakeholder involvement

- Respect of farmers for their knowledge of the land and local conservation practices is key to the success of management of natural resources.
- Stakeholders must be involved in framing both the problem and the solution. What outside experts see as a crisis is not always viewed in the same light by local stakeholders.

Socio-economic factors

- Land ownership linked to land stewardship is not necessarily a good strategy since management is often most effective at the community scale in developing countries.
- Political instability/institutional shortcomings are often a major challenge.

Successes

- Farmer-led landcare groups (at least in the Philippines) appear to work well.

Failures

- Top-down programs promoting non-local practices with incentives that go away before real benefits are realized.

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Landscape System: Ecosystem-based

Principle Investigator(s): Andrew Manu, Iowa State University

I. Synopsis

Over 400 documents have been reviewed and 70 relevant citations entered into the SANREM CRSP meta-database. This process led to the identification of the following potential components of effective ecosystem management: (1) application of integrated modeling in ecosysytem analysis and management; (2) use of agroforestry as part of ecosystem management; and (3) incorporation of indigenous knowledge into sound ecosystem research, development and management. Three case studies were identified and investigated with respect to their objectives and expectations, outcomes, factors contributing to their success, and those that mitigate their success. The case studies reviewed are:

4. Community Based Natural Resource Management project in Mount Cameroon area in Cameroon;
5. Development Through Conservation Project (Bwindi Impenetrable Forest, Uganda); and
6. The Kibale and Semuliki Conservation and Development Project (KSCDP) (Uganda).

The gaps between theory and practice in these case studies were investigated leading to an assessment of gaps in the current state of the ecosystem knowledge. As part of SANREM CRSP's contribution to degree and non-degree training, a Ph.D student has been funded as a research assistant in this effort. Linkages have been established with various individuals, institutions, organizations and other stakeholders in the effective management of ecosystems.

II. Research Accomplishments by Objective

Objective 1: Review literature reflecting the State of the Science in your System

Over 400 publications related to natural resource management practices at the ecosystem level specifically on the African continent have been reviewed. To date seventy entries have been made into the SANREM CRSP metadata base. The main discussion in the reviewed literature is built around two themes: ecosystems management and sustainable natural resource (NR) use and ecosystems restoration. The recent trend in NR management programs is the recognition of incorporation of livelihoods strategies and participatory processes into ecosystems management schemes.

Review of the literature has also identified several scientific frontiers in the management of ecosystems and sustainable NR use. Innovations identified as part of scientific frontiers for ecosystem management include: ecological-economic modeling approach in the management of dynamic ecosystems; ecosystems approach in NRM; collaborative and community-based resource management; landscape approach in ecosystems and NR management; use of indigenous knowledge in ecosystems management and restoration schemes; community-based

NR mapping and use of indigenous knowledge in GIS; and use of integrated modeling approach for NRM.

Best practices:
Reviewed literature was evaluated as potential source of the best practices in ecosystems research and management. Two areas – the methodology and practices discussed in the literature – were chosen as criteria for selection of appropriate examples of best practices. The following three areas appear to be the most interesting for further examination: (1) application of integrated modeling in ecosystems analysis and management, (2) agroforestry, and (3) incorporation of indigenous knowledge into ecosystems research and management. The empirical studies evaluated suggest that recent research in the area of ecosystems analysis and management is related to integrated and participatory methods and provides examples of best practices in the areas of integrated modeling, agro forestry and utilization of indigenous knowledge.

Objective 2: Identify State of the Art projects for case study analysis.

The main objective of the period covered in this progress report was to identify the criteria for the selection of potential projects for case studies analysis and to developing a case studies methodology. The evaluation of contemporary research in the area of sustainable use of natural resources suggested that management and sustainable use of forest ecosystems by surrounding communities is among the most acute contemporary conservation challenges. Literature review suggests that biologically significant forest ecosystems areas are often integrated into complex systems of natural resource use. Surrounded by communities, whose livelihoods are traditionally dependent on exploitation of forest resources, these ecosystems often face similar challenges regardless of geographic location. These most common challenges include encroachment of protected areas, pressure from population growth, loss of forest and forest biodiversity to agriculture and over-harvesting, and overall degradation of livelihoods. The significance of the above problems defined the criteria for case studies identification. The focus of the case studies analysis is to identify projects that address the problem of sustainable use of forest resources and fringe areas by neighboring communities. Three potential projects for case studies analysis were identified and discussed in this report.

State of the art in the project development: The projects identified further case studies analysis utilizing a combination of collaborative resource management rationale, indigenous techniques for ecosystems restoration and prevention of ecosystems degradation, domestication of species for local livelihood, replacement of crops to meet the local conditions, improved livelihood and market elements.

Where innovative ideas were promoted: The innovative ideas are promoted in forest resources use, in management and restoration of areas adjacent to forests (forest fringes), in harvesting of forest bioresources, in farming, marketing and decision-making regarding the management of forest resources.

What conditions have been most appropriate for testing improved techniques/approaches:
Several conditions appear to be consistent throughout all of the identified projects: (a) degrading forest ecosystems due to the unsustainable use of forest resources by local communities; (b)

population growth in communities adjacent to protected forests, (c) agricultural encroachment into forest ecosystems and (d) conflict between conservation agencies and local communities over the forest resources use.

Objective 3: Develop case studies characterizing critical SA & NRM system issues.

During the period covered by this report three projects have been evaluated as case studies: the Community Based Natural Resource Management project in Mount Cameroon area in Cameroon; the Development Through Conservation Project (Bwindi Impenetrable Forest, Uganda); and The Kibale and Semuliki Conservation and Development Project (KSCDP) in Uganda.

The case studies have shown participatory, community-based methods of ecosystems management are associated with: (a) community capacity building; (b) increased community awareness about sustainable use of natural resources; (c) improvement in communities livelihoods; (d) restoration of biodiversity; and (e) improved institutional linkages between government, NGOs and community based organizations**.**

On the other hand success of co-management schemes is not always assured but could depend on various factors including (a) adequate policy framework, (b) adequate financial resources; (c) adequate enforcement of co-management rules and regulations; (d) ability to overcome the problem of 'common pool resources' use; (e) conflict resolution among various stakeholders and (f) ability to fully employ participatory mechanisms.

Analysis of the case studies suggests that command and control approaches in ecosystems management are ineffective and could further lead to ecosystems and natural resource degradation. Co-management schemes, however, appear to be critical for the sustainability of ecosystems and natural resources. Also community-based natural resource management (CBNRM) brings benefits to major stakeholders. At the same time, in all three case studies of CBNRM, similar objective (e.g. financial, legal) and subjective (e.g. conflicts over resource use) challenges emerge. A good understanding of the socio-political context of natural resource use, the understanding of perceptions, stereotypes and needs of local communities, as well as the ability to utilize local resources for monitoring and enforcing rules regulating NR use appear to help to overcome the challenges that mitigate against the success of CBNRM.

Objective 4: Draft synthetic review of the State of the Art and Science in your system.

Status of review: The first phase of the review of the State of the Art and Science in ecosystems and natural resource management was focused on the role of the participatory processes in sustainable use of natural resources, as well as in management and restoration of ecosystems. Up-to-date review of existing practices in this area suggests several common trends in research and programs design.

First, participatory process in research, interventions design and implementation; incorporation of local interests into NR management schemes; incorporation of livelihood concerns into NR

management programs and incorporation of indigenous knowledge, appear to be critical factors for success of the ecosystems and natural resource management and restoration process.

Second, the above factors appear to make a difference when sustainability of natural resources use does not conflict with livelihood strategies of local communities, when defacto policy frameworks allow for co-management of NR, and where there is an adequate enforcement framework in place. The case studies and literature review suggest that hypothesized models of co-management of natural resource management are often oversimplified. These models often over rely on the assumption that simply delegating property rights to local communities automatically guarantees sustainable natural resource use. These models often fail to recognize problems associated with 'common pool resource' use and they do not often distinguish between co-management resource use schemes that are participatory in form but not in spirit.

III. Degree and Non-Degree Training Activities

A Ph.D. student is currently being funded through the SANREM CRSP. His dissertation research will focus on sustainable natural resource management in East Africa.

IV. Publications, Presentation, and Other SANREM CRSP Products

Andrew Manu made a presentation at a workshop in Ghana (July 13, 2005) on the SANREM CRSP. Similar presentations were made by Robert Mazur at workshops in Uganda and Tanzania. Andrew Manu made a presentation on my role as a system coordinator at the Teaching Panel Meeting of the Department of Agronomy, Iowa State University on September 29, 2005.

V. Networking Activities

The following individuals and organizations/institutions were consulted during this reporting period:

Dr. Jim Bingen - Michigan State University
Dr. Corinne Valdivia - University of Missouri
John Bates, Daniel Brinkmeier - Field Museum - Chicago
Mateete Bekunda, Mnason Tweheyo - Makerere University (Uganda)
Linda Maparana – World Vision Uganda
Amon Z. Matee, Zebedayo Mvena - Sokoine University of Agriculture
Dr. Edward Ackah-Nyamike - University of Ghana
Representatives of Community Resource Management Area (CREMA)-Ghana

VI. Project Highlights:

- Three case studies were identified and analyzed with respect to their objectives and expectations, outcomes, factors contributing to their success and factors mitigating against their success. The case studies discussed are:
    - Community Based Natural Resource Management project in Mount Cameroon area in Cameroon;
    - Development Through Conservation Project (Bwindi Impenetrable Forest, Uganda); and
    - The Kibale and Semuliki Conservation and Development Project (KSCDP) (Uganda).
- Discussed the gaps between theory and practice as far as these case studies are concerned and also assessed the gaps within the current state of ecosystem knowledge.

Landscape System: Policy and Governance

Principle Investigator(s): Gerald Shively, Purdue University

I. Synopsis

This project aims to document, summarize and contribute to the current "state of the science" regarding the ways economic policies and governance influence incentives for sustainable agriculture and natural resources management. During FY2005, we initiated work and made progress on a number of fronts. Seventy-five information resources have been identified, and many annotated and entered. Two case studies have been initiated: one in the Philippines on the relationship between tariffs and forest clearing; and the other in Egypt on water management. Two others will be identified for Africa and Latin America. Work is progressing in a manner consistent with our timeline and no significant obstacles have been encountered.

II. Research Accomplishments

Objective 1: Review literature reflecting the State of the Science in your System.
Two graduate students were hired at the start of the project. They have created an annotated bibliography of research on policy/governance linkages to sustainable agriculture and natural resource management. Approximately 75 published works have been reviewed. Some entry of metadata has taken place. This bibliography serves as source and background material for the book chapter highlighted below in Objective 4.

Objective 2: Identify State of the Art projects for case study analysis.
We have identified a number of case studies that will be combined with the background material highlighted in Objective 1. We have begun drafting a chapter that focuses on four case studies. These studies highlight ways in which broad economic policies (such as trade policies, macroeconomic policies, or sector-specific policies) have either had unintended negative consequences that undermine attempts at natural resource management or have helped to support or promote SA/NRM. During FY 2005, we have produced a book entitled "Land Use Change in Tropical Watersheds: Evidence, Causes, and Remedies" that contributes in an important way to this on-going activity. Some material from the book (which focuses on SANREM Phase II research in the Philippines) will be used in the case study analysis. In our selection of case studies we plan to provide both broad thematic coverage and geographic coverage (Asia, North Africa, Sub-Saharan Africa, and Latin America).

Objective 3: Develop case studies characterizing critical SA & NRM system issues.
We have identified two potential case studies (one on agricultural tariffs and forest clearing for vegetable production in the Philippines, the other on water management in Egypt). To these we will be adding case studies from Africa and Latin America.

Objective 4: Draft review of State of Science.
We have undertaken a review of the existing literature in our area. This will be incorporated into

the book chapter.

In addition to work on the objectives outlined above, empirical research has been undertaken in the Philippines, Vietnam, and Malawi.

III. Degree and Non-Degree Training Activities

See attached table. 2 Ph.D. students in Agricultural Economics are currently working on the project. One M.S. student working on related topics completed a thesis this year. No non-degree training took place during the year.

IV. Publications, Presentations, and Other SANREM CRSP Products

See the attached table. A total of 10 journal articles, one book, and 6 book chapters have been completed. A number of research articles are in progress.

V. Networking

A number of networking activities have been undertaken. These include:

1. On-going collaboration with the Purdue Climate Change Research Center and Purdue's Global Trade Analysis Project focusing on modeling trade-induced land-use change worldwide and potential impacts on agriculture, forestry, industry and carbon emissions.

2. Participation in a USAID/WRI meeting focusing on a review and revision of *Nature, Wealth, and Power*.

3. Participation in the annual meeting of the American Agricultural Economics Association was highly relevant to the PI's SANREM research. Two research papers were presented as selected papers at that meeting. These were "Farm size and nonparametric efficiency measurements for coffee farms in Vietnam" (co-authored with graduate student Ana Rios) and "Are Government Interventions in Food Markets Successful? Insights from the Philippine Rice Market" (co-authored with graduate student Richard Yao and Purdue Professor Will Masters). Both papers acknowledge SANREM support and build on SANREM-supported research in Vietnam and the Philippines. In addition to participating in a number of sessions, as discussant and paper presenter, a number of research contacts were made that have resulted in exchanges of papers on sustainable agriculture and agricultural technology adoption. These will be used as inputs into the book chapter being prepared under this work plan.

4. Participation in an ALO meeting in Nagoya, Japan entitled "Exploring Higher Education Collaboration between The United States and Japan for International Development Cooperation in Agriculture."

5. A number of research collaborations and contacts were established with colleagues at various universities and institutions. For example, the PI entered into a cooperative

partnership with researchers at the World Bank and CATIE in Costa Rica and is currently working with World Bank collected data from smallholder coffee farms in Nicaragua, Guatemala, and Honduras. In addition, private sector contacts were strengthened through participation in the World Cocoa Foundation annual meeting in Washington, D.C. We are currently exploring the possibility to work with Mars Corporation to study the Prima cocoa project in Indonesia to better understand constraints to smallholder cocoa adoption in Sulawesi and the potential regional economic impacts of cocoa adoption. We believe a careful analysis of adoption (and lack of adoption) in Indonesia might inform efforts to promote cocoa in Vietnam and the Philippines. Creating some kind of research collaboration between Purdue and Mars to undertake this kind of adoption study would be mutually beneficial.

VI. Project Highlights

- Publication of Coxhead, I. and G. Shively (Eds.). 2005. *Land Use Change in Tropical Watersheds: Evidence, Causes, and Remedies*. Wallingford (UK): CAB International. This book reports on SANREM research in the Philippines and highlights linkages among economic policies, governance, and sustainable agriculture outcomes.

Landscape System: Technology Transfer

Principle Investigator(s): Kadi Warner, Winrock International

I. Synopsis:

This project focuses on developing a knowledge base regarding the efficacy of technology transfer methods for establishing sustainable agriculture and natural resource management practices in the field. Thus far, 20 information resources have been reviewed and entered into the data base on farming systems, participatory approaches, and CBNRM. A community-based wetlands project in Bangladesh has been identified for in-depth study in early 2006. During the period covered by this report substantial progress was made in the assessment of SA & NRM projects and programs for the effectiveness of their technology transfer programs.

II. Research Accomplishments by Objective

Objective 1: Review literature reflecting the State of the Science in transfer technology methods.
As an important component in the preparation of the synthesis review [see Objective 4 below] a literature review was conducted of transfer technology methods. Metadata on some 20 information resources on these methods have been entered into the SANREM CRSP Knowledge Base. The literature review is a component of the synthesis paper.

Objective 2: Identify State of the Art projects for case study analysis.
A wide range of projects were reviewed in the preparation of the synthesis paper [see Objective 4 below]. One of the results of the synthesis paper was the identification of key factors for project success such as participatory processes, policy environment, clear rights and responsibilities to natural resources, and incentive based management practices. The review of past projects was also useful for identifying the changes in project design and objectives in response to an evolving development paradigm and shifts in donor interest. Although there has been a theoretical shift from a top-down economic growth model to a participatory more bottom-up model, project design and implementation continues to reflect externally derived objectives rather than household level concerns.

The recent trend for poverty alleviation to be the primary focus of development programs has revitalized interest and commitment for projects focusing on the poor and other marginalized groups. As a result most current projects are participatory in approach and explicitly concerned with raising incomes. More problematic has been the relative lack of recognition that poverty and successful poverty alleviation interventions cannot be measured by a single factor such as income, and that key factors [access to resources, perverse incentives, gender, etc.] cannot be ignored.

Objective 3: Develop case studies characterizing critical SA & NRM system issues.
A successful on-going project has been identified for an in-depth case study analysis in 2006 in order to better document critical SA & NRM issues and how they can be successfully addressed

in projects. This case study will focus on a USAID-funded project, Management of Aquatic Ecosystems through Community Husbandry [MACH], in Bangladesh that utilizes participatory incentive-based approaches to reach its dual objectives of improved sustainable resource management and improved livelihoods. The MACH holistic approach considers all factors affecting the communities and their wetlands. MACH advocates an integrated multi-disciplinary, multi-sectoral and participatory process of planning, implementation and monitoring for sustainable wetland resource management. Recognizing that the reduction of fishing is likely to be a critical part of reviving wetland fisheries, MACH includes supplemental income-generating activities for poor fisherfolk and others directly dependent on fishing.

To achieve this result MACH has mobilized and established diverse groups of people to advise, manage and implement program activities. They range from resource dependent groups of poor fishers to policy level decision makers. By involving people in the management and decision-making process, the project has facilitated ownership of the process by Bangladesh – from its concerned communities to its local and national governments.

The case study will focus on the actual outcomes of the project, the factors that have contributed to its success, as well as the potential for the project activities to be adopted and 'scaled-up' within Bangladesh.

Objective 4: Draft synthetic review of the State of the Art and Science in technology transfers methods.
Substantial progress was made on a synthesis review of technology transfers approaches and methods. The review describes:

- the evolving trends in technology transfer approaches from the traditional technology transfer science-based approach of the 1950s to the community-based natural resource management project of today;
- the context of the methodology [treatment of landscape, gender, social class economic setting, policy], its characteristics [degree of change required, capacity for change, resources required, tenure/access], goals and measures of success, and impact.

A preliminary analysis suggests that the changes in technology transfer approaches in part mirrored the changes in the definition of what was the critical problem or constraint for improving agricultural production and natural resource management. As the definition of the problem evolved in complexity so did the methodological response - from traditional technology transfer, to farming systems, to the current participatory community-based approach, that reflects social learning and local empowerment. The review also highlights the changes in intervention objectives from the initial focus on yields to that of benefits and decision-making. It is anticipated that the synthesis review will be completed in November 2005.

III. Degree and Non-Degree Training Activities

This project does not include degree or training activities.

IV. Publications, Presentations, and other SANREM CRSP Products

As it is early in the project, there have not been any publications or presentations.

V. Networking Activities

There has been participation in a number of networking activities. These include:

- Stakeholders Meeting of the Agricultural and Natural Resources Research Priorities Review in Washington, D.C., June 8, 2005
- On-going meetings and discussions of the Natural, Wealth and Power Steering Committee, organized by the USAID/EGAT/LRMT.
- On-going discussions with USAID natural resource advisors concerning how to frame the MACH case study to fit strategic and informational goals.
- On-going discussions with Winrock water specialist on expanding opportunities for integrated water management initiatives.

VI. Project Highlights

- Successful review of technology transfer approaches which address sustainable agriculture and natural resource management and which highlight the increasing efficacy of project interventions involving the adoption and implementation of integrated systems based multi-stakeholder approaches.

Appendix B:

Bridging Activity Reports, FY 2005

Globalization, agricultural growth and the environment: consolidation and continuity of SANREM research in Southeast Asia

Principle Investigator(s): Ian Coxhead, Agricultural and Applied Economics, University of Wisconsin (UW)-Madison; and Gerald Shivley, Agricultural Economics, Purdue University.

Host Country Partner(s): University of the Philippines Los Banos;
Hue University, Vietnam;
Nong Lam University, Vietnam.

I. Synopsis

This work aims to bring to fruition several activities initiated in SANREM CRSP PHASE II, and provides continuity for ongoing initiatives in what has become a highly visible research program in the region. There are have three main activities: (1) continuation of empirical research focused on economic and environmental features of commercial tree crops, especially coffee, in Vietnam, and refinement of tools for SA & NRM policy analysis at landscape and national scales; (2) consolidation of research lessons from the Philippines into a new book; and (3) transfer to the ME of relevant metadata from SANREM SE Asia, particularly data from the Philippines.

(1) In Year 1, PI Gerald Shively (Purdue University) and Co-investigator Dang Thanh Ha (Nong Lam University) continued research on smallholder production of commercial tree crops in Vietnam. PI Coxhead (University of Wisconsin) and Co-investigator Bui Dung The (University of Hue) coordinated the collection of commune and district level data on land use and aquaculture activity in Central Vietnam, and began econometric analysis. Steps were made toward the construction of an applied general equilibrium model of trade, development policy, resource allocation and the use of environment and natural resource assets. 2) The draft book on research lessons from the Philippines is near completion and an authors' meeting is scheduled for November 2005 to take the next steps. (3) Metadata collection and transfer was undertaken by Shively and assistants at Purdue University.

Coxhead and University of Wisconsin Research Assistant Diep Phan each made two trips to Vietnam. They presented seminars, held training sessions (Thai Nguyen University and Hue University) and coordinated with researchers at National Economics University and the Ministry of Agriculture and Rural Development. Two Vietnamese scholars funded by Fulbright-Hayes for 2005-06 joined the Wisconsin team. At Purdue, Research Assistant Nam Anh Tranh (formerly at Hanoi Agricultural University) began a M.S. in Agricultural Economics. He is funded by a fellowship from the Ford Foundation and will be working with Shively on issues related to commercialization of non-timber forest products in Vietnam.

II. Research Accomplishments by Objective

Objective 1: Policy-oriented research in Vietnam directed at contributing to knowledge regarding globalization, vulnerability, and risk.

One focus of our effort is to build a framework for understanding economy-environment linkages at the level of the national economy. In working toward this we recognize that field-level, sectoral, spatial and regional issues are very important in the context of globalization. Accordingly, we are continuing with highly focused empirical research on economic and environmental features of commercial tree crops, especially coffee (an important crop in Vietnam's ecologically fragile highland areas) while at the same time refining tools to build capacity for policy analysis at a landscape and national scale. In this area there are three major issues: on-site economic viability and environmental sustainability of commercial agricultural activities undertaken by poor farmers in ecologically fragile areas; off-site environmental and economic impacts of their decisions, especially with respect to land use, and the evolution of the broader market and policy setting which guides their decisions.

In previous SANREM work, Ha and Shively (2004) investigated smallholder response to declining coffee prices in Vietnam. In Year 1 of the bridging activity, they continued this work, and undertook parametric and non-parametric analysis of the efficiency of smallholder coffee production. In FY 2006, this analysis will be extended to allow cross-country comparisons using data from smallholder coffee farmers in Latin America. They also began work to assess the potential impacts of cocoa production in Vietnam. In the second strand of this activity, building on the site-specific work, we engaged in secondary data collection in Thua Thien Hue province. These data cover agricultural land use in lowlands and uplands, and the use of aquaculture in the ecologically important coastal lagoon, the drainage area for several key rivers covered by the data set. The third strand of this work relates land use decisions to the globalization and growth of the Vietnamese economy. The coffee boom was a product of Vietnam's opening to the world economy in the late 1980s, and many more changes in policy and in global markets will bear strong influence on future land use decisions. Understanding how globalization affects land use and farm incomes, and their broader environmental and economic consequences requires a national-scale economy-environment predictive model. We have begun to make concrete progress toward the construction of such a model.

Objective 2: Consolidation and dissemination of lessons from SANREM II research in the Philippines.

A decade of SANREM research in the Philippines produced a rich set of findings on the causes and consequences of land use change, especially arising from decisions made by poor commercial farmers. Much more remains to be learned by continued analysis of the Philippine data, and the lessons learned can be very profitably disseminated through the professional, academic and policy communities of which we are a part. During 2004 we completed a technical volume reviewing a decade of research in the SANREM CRSP Phase II Philippine site, the Manupali River watershed (Coxhead and Shively, 2005). During the bridging period we are consolidating new and additional research lessons from Manupali into a new book, to be authored by Coxhead and Rola. Seven chapters of this book are now in complete draft form,

with two more remaining to be completed. The authors will meet for a writing workshop in November 2005.

Objective 3: Provide SANREM SE Asia metadata to the ME.

A natural and deliberate by-product of our work is the accumulation of metadata for the SANREM CRSP Phase III Knowledge Base. We are consolidating relevant metadata from SANREM II SE Asia. We are also investing in creation and dissemination of equivalent metadata for Vietnam, where this type of integrated work has not previously been undertaken. We believe the data and metadata generation effort in Vietnam will contribute toward building capacity for informed SA & NRM decision-making by local, regional and national agencies.

III. Degree and Non-Degree Training Activities

Two Ph.D. students (from Vietnam and Thailand) are being funded through the SANREM CRSP. In addition, a short course was conducted for 20 participants at Thai Nguyen University on poverty and income distribution in the context of NRM.

Additional human resources development involves two additional Vietnamese scholars are in residence at UW during 2005-06 under the auspices of the Fulbright-Hayes program—one from the National Institute for Science and Technology Policy and Strategy Studies, the other from the Hanoi National Economics University (NEU), one of the partners in this project. A post-doctoral fellow with expertise in agricultural growth and land tenure in Vietnam will join UW in November 2005. One Ford Foundation fellow from Hanoi Agricultural University began work on an M.S. thesis at Purdue University.

IV. Publications, Presentations, and Other SANREM CRSP Products

Three articles, one book, seven book chapters, two extension publications, and two conference papers have been produced over the course of this project. The SANREM CRSP SouthEast Asia website at the University of Wisconsin is also being maintained and updated.

VI. Project Highlights:

Coxhead and Shively volume, *Land Use Changes in Tropical Watersheds: Causes, Consequences and Policy Options* edited and submitted to CAB International—will appear late 2005. Several other publications from SANREM Phase II also appeared in print this quarter.

Two Fulbright-Hayes scholars and a Ford Foundation Fellow from Vietnam are collaborating with SANREM CRSP team members at the University of Wisconsin.

Additional financial resources: counterpart project funding won from UW Business School (Center for Int'l Business Education and Research), UW Center for SE Asian Studies, and UW Center for World Affairs and the Global Economy, totaling about $25,000. Additional research proposals have been submitted to Ford Foundation and NSF.

Sustainable land use and biodiversity conservation in the Andes: scaling-up SANREM-Andes research

Principle Investigator(s): Robert Rhoades and Virginia Nazarea, Dept. of Anthropology, University of Georgia (UGA).

I. Synopsis

SANREM bridging research in the Andes between January 1 and September 30, 2005 accomplished all planned activities. Land Use Change (LUC)/Scenario tools (future visioning, 3-D physical modeling, and human dimensions of climate change) have been disseminated through networking with collaborators in the Andes, several publications, a farmer workshop in Cayambe, Ecuador, and presentations at several international and national conferences. Biodiversity Conservation with an emphasis on repatriation of native crops has advanced through institutional agreements between UGA, International Potato Center (CIP), and Association Andes (Cuzco, Peru), development of a joint repatriation website; initiation of field research in Cusco; a seed fair and farmer-gene bank exchanges in Ecuador; and numerous publications and invited presentations at international and national conferences. The refinement of the SANREM-Andes database advances on target with 90% completion of the "toolbook" CD on Cotacachi and final publication and integration of the Cotacachi Atlas in the Cotacachi Canton environmental information system. Training and capacity building activities included an educational seed fair in Cotacachi (125 participants), a farmer-gene bank exchange trip to the INIAP gene bank near Quito, as well as a farmer-based workshop on climate change and water in Cayambe, Ecuador. One Ph.D. student (Juana Camacho) conducted initial fieldwork for her dissertation in Cuzco, Peru.

II. Research Accomplishments by Objective

Objective 1: LUC/Scenario Tools

A collaborator network to apply SANREM tools related to study of climate change/societal impacts in the Andes has been established, especially between The Mountain Institute (TMI) and UGA. Robert Rhoades has been invited to join the Executive Board of The Mountain Institute in conjunction with this agreement. Agreement has also been reached to exchange ideas, methods, and findings as a first step to formulate a joint TMI-UGA project on local responses to high altitude climate change. Discussions have been held with the program leader of the CGIAR (future harvest) Global Mountain Program (now housed at CIP) although no formal agreement on research exchange has been reached. A participatory workshop was held on August 2, 2005, with local communities in Cayambe, Ecuador, duplicating the experience of Cotacachi. Twenty-five farmers and local leaders attended the conference in which similarities and differences between Cayambe and Cotacachi were drawn. Both regions are starting to suffer considerable water deficiencies due to the loss of the mountain glacier.

The Andes book based on SANREM II is being published by CAB International and contains a chapter entitled “Future Visioning for the Andes: Scientific and Local Perspectives on Land Use Change” as well as a chapter on four decades of LUC in the Cotacachi region. A chapter by R. Rhoades and V. Nazarea entitled “Forgotten Futures: Scientific Models versus Local Visions of Land Use Change” will be published in a volume *Local versus Global Science* by Bergman Books. It is based on the Cotacachi future visioning case study. A first draft of the future visioning/3-D physical model training video/PowerPoint presentation was developed and presented at the Society for Applied Anthropology annual meeting in Sante Fe, New Mexico (April, 2005). Robert E. Rhoades presented a paper on Cotacachi at an International Conference on Mountain Governance held in Banff, Canada during June, 2005 (travel funded by University of Georgia).

Field research on the human dimensions of glacier retreat and climate change in the Andean region was conducted over the past six months. This research documents the rapid decline of Andean glaciers, especially those areas below 3500 meters above sea level and on the western cordillera. While the landscapes were initially flush with water during the early glacier melting process, the rivers, springs, and irrigation canals are now drying up. Data from this research was presented at an international conference on global mountain change in Perth, Scotland (international travel funded by NASA and University of Georgia).

Objective 2: Biodiversity Conservation
Excellent progress has been made in establishing institutional linkage between UGA, International Potato Center (CIP), and Association Andes (Peruvian NGO) in research on repatriation of Native Andean crops. During a trip to Cuzco in late April and early May (only Juana Camacho’s travel funded by USAID), a meeting with collaborators (genebank managers, local communities, Association Andes, and UGA scientists) resulted in agreement on activities for the next year. A repatriation website was developed and evaluated by the partners. The video "conservation with a small 'c'" was completed in both English and Spanish. The book "Recetas Para la Vida" Platos, Dichos, y Costumbres de Los Andes" has been completed, delivered to Abya Yala Press in Quito and is now in press. The Protocol "Seed Preparation and Rapid Multiplication for Communal Gene Banking" by Dr. Zozimo Huaman is complete and also in press with Abya Yala Press (Spanish). In Cuzco, Peru, research was conducted with a Women’s group on traditional culinary preparation linked to repatriation of traditional crops from genebanks. The results of the Cotacachi work on how to link biodiversity concerns with culture was shared with Peruvian counterparts. The process of documenting traditional customary law in relation to benefit sharing of plant genetic resources has begun in Cusco. A book edited by Virginia Nazarea and Robert Rhoades and programmed to be published by an academic press is nearing completion with most of the chapters finalized. Dr. Nazarea’s book entitled *Heirloom Seeds and their Keepers* was published by University of Arizona Press.

Graduate students have been particularly active in this component. Juana Camacho prepared and received approval for a dissertation prospectus linked with the SANREM bridging project. She conducted initial fieldwork in Cuzco, Peru and presented a poster at the Society for Economic Anthropology annual meeting in Atlanta during spring, 2005, and prepared a chapter for the forthcoming CAB International book on Phase I of SANREM- Andes. Jenna Andrews, also a Ph.D. student at UGA, received training in biodiversity conservation and methods used in the

SANREM-Andes program in Cotacachi. Maricel Piniero, former UGA graduate student, presented a paper on women's gardens and biodiversity in the Andes at the Society for Applied Anthropology meetings in Sante Fe (spring, 2005).

Objective 3: Knowledge Base
The activity "Sustainable Mountain Futures: The SANREM Knowledge Base for Cotacachi in Toolbook CD Rom" is now 90% complete. During a visit to Ecuador during August, Dr. Robert Rhoades and Xavier Zapata (field coordinator) worked intensively on the product so that only minor editing and resolution of some software glitches is required. The toolbook CD presents in an integrated way (based on the SANREM-Andes research framework) all of the basic data, analysis, reports, publications, photographs, and much more in a multi-level and accessible database. The product is user friendly for both policy makers and scientists. If one wants basic data on a project, it can be found, but likewise summaries for the lay public and decision makers are also available. The toolbook approach is excellent for helping teams integrate their data.

The Natural Resource Atlas of Cotacachi (CD Rom and hard copy Atlas) entitled *El Canton Cotacachi" Espacio y Sociedad* has been publsihed by Ediguias C.Limited, Quito and copies distributed within Ecuador. The Atlas is now with the authorities of Cotacachi for their use in natural resource planning. Monsarrath Mejia (a graduate student at Catholic University) was the coordinator in charge of the Atlas project and completed her Master's degree in geography at Catholic University this year. Although she received no funding from bridging SANREM, her thesis was based in part on the atlas research.

III. Degree and Non-Degree Training Activities

One Colombian Ph.D. student (Juana Camacho) is completing her studies. Nearly 150 community members and Genebank managers learned about in situ conservation during field days and a Seed Fair and Exchange held in collaboration with local organizations. A workshop on the impact of climate change on mountain glaciers highlighted issues of water for agriculture for 25 community members and policy makers.

IV. Publications, Presentations, and Other SANREM CRSP Products

Four books, eight book chapters, seven presentations, one poster, one book review, a website and a video have been produced during the past nine months.

V. Networking

Dr. Nazarea was an invited guest speaker at a US Conference (travel covered by ARS-USDA) on cultural dimensions of plant and animal genetic resources held in conjunction with the Society for the Advance of Science among Native Americans and Chicanos. The conference, organized by Dr. Henry Shands, Director of the U.S. National Germplasm System, also had an educational and informational component as a way to bring minority groups into research on genetic resources.

IV. Project Highlights

- Land Use Change Scenario tools disseminated.
- Institutional agreements on repatriation of native crops signed between the International Potato Center, Associacion Andes (NGO), and the University of Georgia Ethnoecology/Biodiversity Lab.
- Workshop on climate change and Andean Glaciers retreat held.

Analysis required for Payments for Watershed Environmental Services (PWES)

Principle Investigator(s): Douglas Southgate and Timothy Haab, Dept. of Agricultural, Environmental, and Development Economics, The Ohio State University

Host Country Partner(s): Fabian Rodriguez, Fundacion Antisana, Ecuador.

I. Synopsis

The fundamental purpose of this bridging activity, in the vicinity of Quito, Ecuador, is to demonstrate the degree to which watershed conservation can be financed locally – specifically, through the use of payments collected from the beneficiaries of conservation, who by and large live and work in lower watersheds. One specific objective was to estimate the price increases that potable water customers in Cayambe (a municipality with approximately 15,000 inhabitants) would pay for the sake of conserving water sources. However, this approach to benefit estimation was abandoned after opposition from Cayambe officials, who recently instituted price increases after promising that water prices will remain stable for several years. Instead, this project has focused on the costs of using conservation payments in watershed management. Much of the preparatory work required to estimate the payments that people in Paquiestancia (a rural community upstream from Cayambe and an important source of the city's drinking water) would expect has been completed: federally-required human-subjects review has been completed, the questionnaire for the survey of rural households has been designed and tested, and survey enumerators recruited from the local community have been trained. In addition to preparation for the survey, a biophysical assessment of the watershed has been completed, as has a legal analysis of conservation payments. Thus, this project is shedding light on how watershed assessment, legal investigation, and economic analysis all contribute to effective implementation of PWES.

II. Research Accomplishments by Objectives

Objective 1: Estimating the Benefits of Watershed Management

It will not be possible to ask Cayambe residents about the additional payments they would make for the sake of watershed conservation, because of opposition from local officials and the biases potentially resulting from recent price increases.

Objective 2: Estimating the Costs of Watershed Management

This project focuses largely on a key part of the costs of watershed management – to be specific, the payments that households in the upper reaches of drainage basins would demand in exchange for adhering to watershed conservation guidelines. Estimating these payments involves, first, conducting a survey of a representative sample of rural households and then analyzing the data

collected in the survey. Preparation for the field survey of rural households was completed by September 30th.

- Approval of the survey was applied for and received from the Institutional Review Board of Ohio State University (OSU), as is required by federal laws and regulations governing research involving human subjects (April and May).
- A questionnaire was developed and pre-tested in Ecuador, and later reviewed with colleagues doing similar research in Guatemala and Peru (June through August).
- Enumerators from Paquiestancia were recruited and trained (August and September).

Related Deliverables – Legal Analysis and Watershed Assessment

During FY 2005, Fundación Antisana (FUNAN) contracted with Alegría de Better, who holds a doctorate in law and specializes in environmental law, to identify the various ways that the Ecuadorian legal system would allow payments for watershed environmental services to be structured. A complete draft of the report was submitted and reviewed in September. In response to comments received from PI Southgate and co-PI Rodríguez, de Better is currently working on the final version, which will be completed by early November 2005.

FUNAN also contracted Gustavo Mosquera, a biologist with considerable experience in the study area, to prepare a specific set of guidelines for watershed conservation. As was the case with the legal analysis, his draft report was submitted and reviewed in September. Mosquera also expects to complete the final version by early November.

III. Degree and Non-Degree Training Activities

This project does not include any degree training. Also, non-degree training did not occur in Year 1.

IV. Publications, Presentations, and Other SANREM CRSP Products

Book Chapter

Rodríguez, Fabián and Douglas Southgate. 2005. "Local Resolution of Watershed Management Trade-Offs: The Case of Cotacachi, Ecuador," in R. Rhoades (ed.), *Development with Identity: Community, Culture, and Sustainability in the Andes*. Cheltenham: CAB International.

Conference Paper

Southgate, Douglas, Timothy Haab, and Fabián Rodríguez. 2005. "Payments to the Rural Poor for the Sake of Conserving Tropical Watersheds: A Contingent Valuation Analysis in Ecuador," Annual Meeting of the Association of Environmental and Resource Economists, Providence, July.

V. Networking Activities

Thanks to previous contacts made by FUNAN, a meeting with the mayor of Cayambe, Diego Bonifaz, took place in July 2005. At this meeting, Bonifaz, a former planning secretary for the national government and widely recognized for being a forward-looking official, discussed innovative strategies for dealing with water issues in and around his municipality. The meeting concluded with a commitment from both sides to continue the dialogue.

In this project (and in related SANREM CRSP Phase II activities), FUNAN has facilitated dialogue between project investigators and representatives of local organizations and agencies with an interest in PWES. Among these agencies are Quito's municipal water company, environmental NGOs, as well as the local USAID mission.

VI. Project Highlights

Since research findings for this project will not be available until FY 2006, there are no bullets or project highlights to report at this time.

Metadata development for the SANREM knowledge base

Principle Investigator(s): Conrad Heatwole, Gene Yagow, and Brian Benham, Biological Systems Engineering Department, Virginia Tech and Margaret Merrill, University Libraries, Virginia Tech

I. Synopsis

The overall goal of this project is to support the SANREM mission of effective knowledge dissemination in the domain of sustainable agriculture and natural resource management. To accomplish this, the objectives are: a) define a metadata structure for SANREM resources that will facilitate the access and dissemination of materials; b) catalog existing SANREM resources generated in the previous project phases; and c) provide a manual that provides guidance for those defining and using these metadata in the future.

Project implementation has proceeded as anticipated, and is on schedule. The metadata structure has been refined and is stable, with over 400 records entered. A draft guidance manual has been developed which provides documentation for the metadata template and documents the particular format and procedures being followed for entries to the SANREM Knowledge Base (SKB). The resources referenced on the UGA SANREM website (www.sanrem.uga.edu) have been cataloged. Of nearly 900 resources evaluated, over 400 have been identified as having archival value and have been entered in the SKB.

II. Research Accomplishments by Objective

Objective 1: Develop, with the assistance of the SANREM Management Entity (ME), a metadata template for cataloging the resources produced by and related to the previous and ongoing SANREM project phases.

The metadata template, conforming to the Dublin Core elements, has been developed and implemented in the SKB. The template has been continuously revised over the past 6 months as the process of entering various types of data records has brought new issues to light. The template at this time represents a stable product (with well over 500 entries) and is being used by different groups and individuals adding data to the knowledge-base.

Objective 2: Catalog the digital and print resources of previous SANREM CRSP projects as referenced on the http://www.sanrem.uga.edu website and provide the metadata in a defined digital format.

The resources listed on the UGA website have been cataloged, with nearly 900 entries recorded. These resources were screened to identify those of referenceable and archival value, and for which an entry was created in the knowledge base, and keywords and a summary of the resource

created. For most resources, a digital copy is stored in the SANREM Knowledge Base providing a permanent archive. For resources that cannot be stored in the SKB due to copyright, format or availability issues, appropriate permanent reference to access the resource is included. To date, over 400 resources have been identified and cataloged from the UGA website. A general distribution of the types of materials is provided in the following list:

Journal Articles (68 records)
SANREM Conference Presentations (54 records)
Book Chapters (62 records)
Books (32 records)
Research Briefs (36 records)
Proceedings (4 records)
Working Papers (29 records)
Annual Reports (5 records)
Conference Papers (45 records)
Conference Presentations (96 records)
Theses and Dissertations (6 records)
Research Reports (14 records)

Of the entered resources, over 80% have been reviewed, classified by keyword and summary using the template developed in this project. This percentage of completion was the target for this stage of the project.

Objective 3: Develop a guidance document for metadata development for the SANREM Knowledge Base that will serve as a reference for future contributors of SANREM project materials.

A SANREM metadata documentation manual has been drafted and used for the past 4 months during data entry. Continual refinement through this period has resulted in a document that has been tested under a wide range of types of materials and with different users.

III. Degree and Non-Degree Training Activities

Four undergraduate students have gained on-the-job training working on the cataloguing tasks.

IV. Publications, Presentations, and Other SANREM CRSP Products

The SANREM CRSP Metadata Documentation Manual (draft).

V. Project Highlights

- A metadata structure has been defined that is effective for cataloging currently available SANREM data, and that provides a flexible framework for the future.

- The SANREM Knowledge Base template conforms to Dublin Core structure to provide a stable resource that will have long-term value and utility.
- Materials from the earlier SANREM projects have been cataloged. Nearly 900 resources have been screened, with over 400 selected for entry in the SKB. Of these, more than 80% have been reviewed to date.
- A draft of the guidance manual for entering data to the SKB has been developed and is being tested in ongoing cataloging activities.

Appendix C:

Training and Publications Tables, FY 2005

SANREM CRSP Degree Training Participants: FY 2005

Student Name	Sex (M/F)	Nationality	Discipline	Country(s) Supported	Sandwich Program (Y/N)	Program			Funding		SANREM CRSP Advisor/PI	University(s) (degree granting institution first)
						Start Date	End Date	Degree	SANREM CRSP	Non-SANREM CRSP		
Diep Phan	F	Vietnam	Economics	Vietnam	N	2002	2007	Phd	Y	Y	Coxhead	U of Wisconsin
Aksarapak Wongcharoen	F	Thai	Economics	Vietnam/SE Asia	N	2004	2008	PhD	Y	Y	Coxhead	U of Wisconsin
Bhagowalia, Priya	F	India	Ag Economics	Philippines, Vietnam	N	Sep-04	Jun-06	PhD	Y	Y	Shively	Purdue
Birur, Dileep	M	India	Ag Economics	Philippines, Vietnam	N	Jan-05	Jun-06	PhD	Y	Y	Shively	Purdue
Juana Camacho	F	Colombia	Anthropology	Ecuador/Peru	N	Jan-05	Jun-06	PhD	Y	N	Nazarea	U of Georgia
Colin Deschamp	M	US	CEE	global	N	Jan-05	Dec-06	MS	Y	Y	Mostaghimi	Virginia Tech
Anurag Mishra	M	India	BSE	global	N	Jan-04	Jun-07	PhD	Y	N	Benham/Mostaghimi	Virginia Tech
Oleg Stakhanov V.	M	Russian	Poli Sci/Sociology	Uganda	N	Aug-05	Aug-06	MS	Y	N	Andrew Manu	Iowa State University
Moussa Keïta	M	Mali	Local Development	Mali	N	Jan-04	Jun-06	Maitrise	Y	Y	Moore/Cissé	Delta-C

SANREM CRSP Non-degree Training

Program type (workshop, seminar, field day, short course, etc.)	**Date**	**Audience**	**Number of Participants**	**Training Provider** (US university, host country institution, etc.)	**Training Objective**
Field day/ Exchange	8/4/05	Community members and Genebank managers	20	UGA, INIAP (Ecuador) UNORCAC (indigo. Organ)	Expose farmers to germplasm in nacional genebank, explain in siute conservation, seek collaboration for the future
Workshop on climate change and water	8/2/05	Community members and provincial policy makers in Cayambe, Ecuador	25	UGA, UNOPAC (Indig. Organization), Cayambe Municipality	Identify issues of climate change, melting of glacier, and water issues for agriculture, agro-industries
Seed Fair and Exchange	8/3/05	Indigenous communities and local NGOs	125	UGA, UNOPAC, various NGOs	Seed exchange among local people, discuss issues of in situ conservation and need to link with genebanks
Seminar	4/2005	Ghanese small-holder farmers	29	OICI, Ministry of Food and Agriculture	Teach composting and organic farming technologies to small farmers in Ghana.
Workshop	6/2005-9/2005	USAID Food for Peace Program	22	The Rodale Institute	The role that regenerative agriculture has in confronting soil degradation problems in the tropics.
Workshop	8/2005	Africare	14	The Rodale Institute	Background on the mission of The Rodale Institute and complementary potential of our interaction with NGO structures in Africa.
Workshop	9/2005	Dr. Kokoasse Kpomblekoua from Tuskegee Institute	12	The Rodale Institute	Role of The Rodale Institute in helping disadvantaged farmers and potential of developing programs for minority farmers in the deep South plus potential for outreach to

Program type (workshop, seminar, field day, short course, etc.)	Date	Audience	Number of Participants	Training Provider (US university, host country institution, etc.)	Training Objective
					Africa.
Seminar	7/2005	Dr. Jin Yong Choe and students from Gyeongsang University (South Korea)	8	The Rodale Institute	Intensive training of under-graduate and graduate students with interest in regenerative agriculture techniques. Topics included certification, organic no till, biologically based weed management, long term trials, cover crops, rotations, nutrition and others
Field day	10/27/04	Students from the Agricultural University of Honduras	35	Center for Environmental Farming Systems (NCSU)	Introduce student to research methods and priorities in agroecology
Short course	11/1/04-11/12/04	Turkish agricultural professionals	12	Center for Environmental Farming Systems (NCSU)	Provide hands-on, problem-solving based training in sustainable agriculture and agroecology and Extension and Outreach methods.
Workshop	6/1/05-6/3/05	Honduran & Nicaraguan collaborators from CIAT-MIS	15	North Carolina State University, Soil Management CRSP	Review experimental procedures for soil fertility trials; apply data collected to Nutrient Management Support System software (a collaborative project with SM-CRSP)
Internship	6/5/05-7/28/05	Undergraduate students from the Univ. of Chapingo (Mexico)	3	Center for Environmental Farming Systems (NCSU)	Provide hands-on training in diversified organic production, experience in sustainable agriculture research, and classroom instruction on principles of agroecology
Short course	Aug 05	Faculty staff and students	20	UW	Lectures on poverty and income distribution in context of NR management

SANREM CRSP Publications, Presentations and Other Products

Category	*Bibliographic Citation**
Articles Published in Refereed Publications	Badini, O., C.O. Stockle, J.W. Jones, R. Nelson, and M.Keita, 2005. Analysis of Productivity and Soil Carbon in Response to Time-Controlled Grazing in the West African Sahel Region. *Journal Agricultural Systems – Edition Special* (in print). Coxhead, Ian, and Bayou Demeke (2004). "Panel data evidence on upland agricultural land use in the Philippines: can economic policy reforms reduce environmental damage?" *American Journal of Agricultural Economics* 86(5), December: 1354-1360. Coxhead, Ian, and Sisira Jayasuriya (2004). "Development strategy, poverty, and deforestation in the Philippines". *Environment and Development Economics* 9(5), October, pp. 613-644. Fisher, Monica M., Gerald E. Shively, and Stephan Buccola. 2005. "Activity choice, labor allocation, and forest use in Malawi." Land Economics. In Press. Fisher, Monica M., and Gerald E. Shively. 2005. "Can income programs reduce tropical forest pressure? Income shocks and forest use in Malawi." World Development 37(7):1115-1128. Ha, Dang Thanh and Gerald E. Shively. 2006. "Coffee vs. dacao: A case study from the Vietnamese Central Highlands." Journal of Natural Resources and Life Sciences Education. In Press. Mahmoud, Chowdhury and Gerald E. Shively. 2004. "Agricultural diversification and integrated pest management in Bangladesh." Agricultural Economics 30(3):187-194. Manu, A., Y.A. Twumasi, K.S. Lu, and T.L. Coleman. 2005. Predicting Urban Growth of a Developing Country City Using a Statistical Modeling Approach. *Computers, Environment and Urban Systems.* (under peer review). Pimentel, D., Hepperly, P., Hanson, J., Douds, D., and R. Seidel. 2005. Environment, energy, and economic comparisons of organic and conventional farming systems. Bioscience 55(7): 573-582. Shively, Gerald E. 2006. "Externalities and labour market linkages in a dynamic two-sector model of tropical agriculture." Environment and Development Economics. Forthcoming. Shively, Gerald E. 2004. "Introduction to the special issue on poverty and forest degradation." Environment and Development Economics. 9(2):131-134.

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