



# SANREM CRSP Annual Report 2006



Sustainable Agriculture & Natural Resource Management  
Collaborative Research Support Program



# **SANREM CRSP**

## **FY 2006 Annual Report**

**October 1, 2005 –September 30, 2006**

**Sustainable Agriculture and Natural Resource Management  
Collaborative Research Support Program**

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## **Executive Summary**

During the past year, the SANREM CRSP (Phase III) established the Long-Term Research Program that will generate the core of new sustainable agriculture (SA) and natural resource management (NRM) knowledge and development impacts. The overall SANREM CRSP vision is to develop knowledge pertaining to SA and NRM interventions and strategies, organize that knowledge into an accessible on-line knowledge base, place it in its proper development context, and disseminate the knowledge to decision makers. During this past year, the SANREM CRSP:

- Completed high-impact, short-term, Bridging Award research activities that capitalized on earlier SANREM Phase II research activities;
- Initiated five new long-term research activities;
- Initiated and expanded capacity building activities
- Continued development of a book on adaptive management of sustainable agriculture and natural resource management systems; and
- Sponsored (in collaboration with the IPM CRSP) the Biodiversity Conservation in Agriculture Symposium, which promoted the integration of biodiversity conservation into agriculture development programs.

The SANREM CRSP promotes stakeholder empowerment and improved livelihoods through the discovery, organization, and dissemination of SA and NRM knowledge. Our approach is participatory, engaging stakeholders at all levels in research problem formulation within priority areas of inquiry, focusing on multiple countries and/or regions to facilitate scaling research findings up and out. Program efforts are competitively driven and organized through a nested landscape systems approach. Gender sensitivity is integral to the SANREM approach and reinforced by gender-sensitive participant training programs that include degree and non-degree 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.

### ***Program Impact Areas***

The SANREM CRSP FY 2006 Annual Report is organized into four program impact areas: SANREM Management Entity Activities, Bridging Activities, Long-Term Research Program, and Training and Institutional Capacity Development. SANREM FY 2006 outputs include:

- 38 long-term degree students (27 women and 11 men)
- 2,832 short-term training participants (including over 1,000 women)
- 11 referred journal articles
- 3 books
- 5 book chapters
- 3 theses
- 6 extension publications
- 2 working papers
- 2 websites
- 48 papers and presentations
- 1 fact sheet
- 4 research briefs
- 6 newsletters and magazine articles
- 13 reports
- 1 abstract

### ***SANREM Management Entity Activities***

**SANREM Knowledge Base (SKB):** The SKB is a web-based knowledge storage and retrieval database that organizes and provides access to all knowledge generated by the SANREM CRSP. The SKB is designed to provide sustainable agriculture and natural resource management practitioners with pertinent information on best practices adaptable to site-specific conditions. The SKB is managed by the SANREM CRSP Management Entity (ME) and knowledge is contributed by the ME and SANREM CRSP Landscape System Coordinators, and Bridging Activity and Long-Term Research Activity Principle Investigators and their partners. The SKB is fully operational and allows researchers and practitioners to catalog and search SA and NRM “information resources” (books, reports, journal articles, videos, movies, presentations, etc.). As of 30 September 2006, 1274 “information resources” have been entered into the SKB, which is accessible at: [http://www.oired.vt.edu/sanremcrsp/menu\\_information/knowledgebase.php](http://www.oired.vt.edu/sanremcrsp/menu_information/knowledgebase.php).

**Landscape System Coordinators** are developing a book on adaptive management for SA and NRM systems. The goal of this book is to provide development practitioners with the knowledge, understanding, and tools to promote sustainable solutions to agricultural and NRM problems and to improve the innovative capacity of stakeholders. Initial system level chapters have been drafted and exchanged for review and cross-scale integration. Research for case study chapters demonstrating the application of the adaptive management approach to landscape systems is ongoing. The book will be completed during FY 2007.

In addition to work on the adaptive management book, the Landscape System Coordinators conducted eleven short-term training programs involving 186 women and 207 men and produced nine articles, one book chapter, eleven presentations, and ten other information products during FY 2006.

***Bridging Activities:*** Four Bridging Activities were initiated in January 2005. These activities involve high-impact, short-term, research activities that capitalize on earlier SANREM CRSP efforts (Phase II) and contribute to current SANREM inquiry areas. These activities resulted in the completion of four refereed journal articles, three books, three book chapters, six

presentations, and ten outreach publications, and other decision support tools in FY 2006. Three short-term training events were held involving over 270 participants.

*The Globalization, Agricultural Growth and the Environment: Consolidation and Continuity of SANREM Research in Southeast Asia Bridging Activity* (PIs: Ian Coxhead, Agricultural and Applied Economics, University of Wisconsin-Madison; and Gerald Shivley, Agricultural Economics, Purdue University; Partners: University of the Philippines Los Baños; Hue University, Vietnam; Nong Lam University, Vietnam) developed an applied general equilibrium model of trade, development policy, resource allocation, and environment and natural resource assets for Vietnam that can assist decision makers in evaluating alternative NRM policy options. The model is undergoing final testing at the University of Wisconsin and the National Economics University in Hanoi.

*The Sustainable Land Use and Biodiversity Conservation in the Andes: Scaling-up SANREM-Andes Research Bridging Activity* (PIs: Robert Rhoades and Virginia Nazarea, Dept. of Anthropology, University of Georgia) developed a suite of watershed visualization tools for land use change modeling and scenario planning in Ecuador; created policy guidelines and methods for biodiversity conservation, especially related to in situ/ex situ phenotypes and local needs for repatriation of Andean crops; and entered SANREM Phase II-Andes primary data and metadata into the SANREM Knowledge Base. It also investigated the rapid decline of Andean glaciers, which is severely reducing flows in downstream rivers, springs, and irrigation canals. This loss of water sources and lack of reform in water allocation is leading to conflicts between indigenous communities, urban areas, and irrigators.

In a third Bridging Activity, *Analysis Required for Payments for Watershed Environmental Services* (PIs: Douglas Southgate and Timothy Haab of the Dept. of Agricultural, Environmental, and Development Economics at The Ohio State University and Fabian Rodriguez of the Fundacion Antisana in Ecuador), upstream and downstream aspects of payments for environmental services were analyzed for the watershed providing water for urban residents around Quito, Ecuador. Rural households that are highly dependent on farming, with very limited non-agricultural earnings, were found to use conservation payments to diversify income-sources. By and large, the conservation payments they demand in exchange for reducing farmed area for the sake of watershed management are relatively low. The research also indicated that rural households with diversified earnings place a high value on resources that can be harnessed for subsistence production, especially during periods of below-normal, non-farm income. As a result, they demand high payments in exchange for reducing agricultural land use.

The fourth Bridging Activity, *Metadata Development for the SANREM Knowledge Base* (PIs: Conrad Heatwole, Gene Yagow, and Brian Benham, Biological Systems Engineering Department, and Margaret Merrill, University Libraries, Virginia Tech), cataloged all of the information resources produced during Phase II of the SANREM CRSP, created metadata on each information resource and then entered the metadata and uploaded non-copyrighted information resources to the SKB. Approximately 1000 information resources from SANREM Phase II were transferred to the SKB through this activity.



***Long-Term Research Program:*** The Long-Term Research Activities (LTRA) were awarded between January and March 2006 after External Review Panel (EEP) evaluation and ranking during the fall of 2005. Five LTRA awards were made based on the EEP recommendations. Seventy-four Planning Award submissions were received and evaluated. Applications from 18 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. Successful applicants included:

- Decentralization Reforms and Property Rights: Potentials and Puzzles for Forest Sustainability and Livelihoods, Lead PI: Elinor Ostrom, Indiana University (Kenya, Uganda, Mexico, Bolivia)
- Developing a Participatory Socio-Economic Model for Food Security, Improved Rural Livelihoods, Watershed Management, and Biodiversity Conservation in Southern Africa, Lead PI: Alex Travis, Cornell University (Zambia, Malawi)
- Watershed-based Natural Resource Management in Small-scale Agriculture: Sloped Areas of the Andean Region, Lead PI: Jeff Alwang, Virginia Tech (Ecuador, Bolivia)
- Adapting to Change in the Andean Highlands: Practices and Strategies to Address Climate and Market Risks in Vulnerable Agro-Ecosystems, Lead PI: Corinne Valdivia, University of Missouri (Bolivia, Peru)
- Agroforestry and Sustainable Vegetable Production in Southeast Asian Watersheds, Lead PI: Manuel Reyes, North Carolina Agricultural and Technical University (Philippines, Vietnam, Indonesia)

These activities have produced three refereed journal articles, two book chapters, 35 presentations, eleven outreach products, and various other decision support tools in their first six months.

***Training and Institutional Development:*** The SANREM ME, Bridging, and Long-Term Research Activities contributed to short and long-term training. Thirty-eight students from 15 countries are involved in long-term degree training. Twenty-five students are from developing countries and 13 are from the U.S. The students are working on twenty-two Ph.D.s, thirteen masters, and three undergraduate degrees. Twenty-seven students are female and eleven are male.

SANREM supported 65 short-term training activities involving over 2,832 persons (over a third of them women) in 12 countries. These activities were principally field days, workshops, and short courses.

## Introduction

The FY 2006 Annual Report for year two of SANREM CRSP Phase III describes activities from 1 October 2005 through 30 September 2006 under Leader-With-Associate Cooperative Agreement No. EEP-A-00-04-00013-00 between the United States Agency for International Development and the Office of International Research, Education, and Development at Virginia Polytechnic Institute and State University.

The SANREM CRSP promotes stakeholder empowerment and improved livelihoods through the discovery, organization, and dissemination of sustainable agriculture (SA) and natural resource management (NRM) knowledge. The SANREM approach is participatory, engaging stakeholders at all levels in research problem formulation within priority areas of inquiry, focusing on multiple countries and/or regions to facilitate scaling research findings up and out. Program efforts are competitively driven and organized through a nested systems approach that progresses from the field to farm/enterprise to watershed to policy/governance and ecosystem scales. 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***

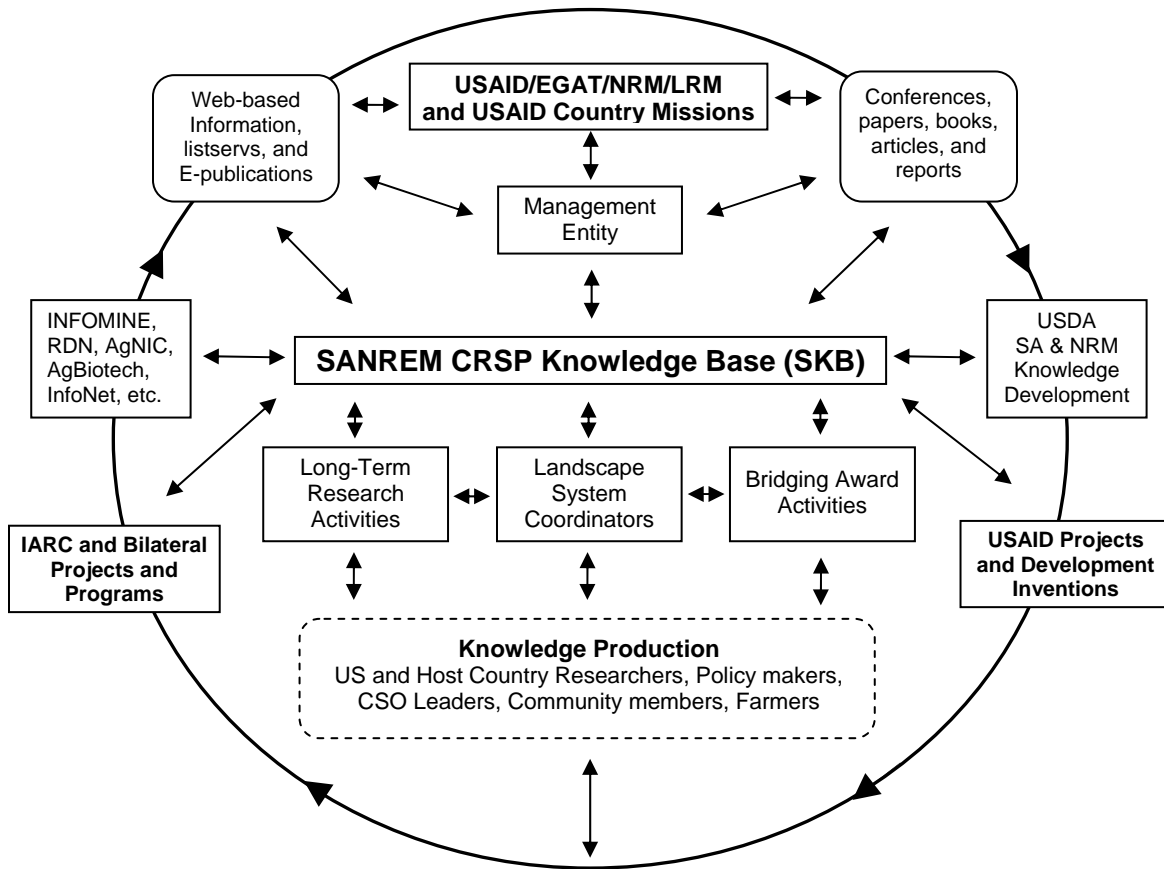
The objectives of the SANREM CRSP are to:

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 goals of SANREM CRSP Activities are results oriented. In order to accomplish these goals, SANREM CRSP research and capacity building activities are competitively driven, accounting for 90 percent of non-ME expenses. The core of the five-year research program is being funded through \$6 million in competitive Long-Term Research Awards (LTRAs) linked with on-going development activities in over ten countries. In FY 2006, Bridging Awards provided transitional funding for completion of short-term, high impact research and knowledge dissemination activities initiated during SANREM CRSP Phase II.

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 International Agricultural Research Centers (IARCs), nongovernmental organizations (NGOs), the private sector, national agricultural research services (NARS), host country universities and research institutions, U.S. minority-serving institutions, other CRSPs and US universities. SANREM also partners with 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. The overall SANREM CRSP program or Knowledge and Information System (KIS) is depicted in Figure 1. The figure shows the critical linkages between the various SANREM partners and stakeholders and how SANREM generated information and knowledge is developed, disseminated, and utilized.



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

## **SANREM CRSP Management Entity Activities**

The Virginia Tech Management Entity (ME) provides overall guidance in the management of the SANREM CRSP Knowledge and Information System (KIS). This guidance involves providing intellectual leadership for the SANREM KIS, managing the SANREM Knowledge Base (SKB) and Landscape System Coordinator activities, supervising KIS knowledge development, networking with information users and other providers, promoting the SANREM CRSP, supporting SANREM CRSP researchers, and disseminating SANREM CRSP generated knowledge to potential users. The ME also keeps abreast of innovations and new approaches in the SA and NRM inquiry areas, and circulates SA and 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 enhancing the functionality of the infrastructure for these activities.

### ***SANREM Knowledge Base***

The SANREM Knowledge Base (SKB) is 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 information resources relevant to SA and NRM. This searchable database is organized by landscape system, as well as providing searchable fields such as: title, creator/author, creation date, keywords, media type, time period, location, description (abstract), language, and SANREM Project Number (if appropriate). The SKB is located on the SANREM CRSP website at: [http://www.oired.vt.edu/sanremcrsp/menu\\_information/knowledgebase.php](http://www.oired.vt.edu/sanremcrsp/menu_information/knowledgebase.php).

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

The SANREM Knowledge Base was built using Apple's WebObjects development platform. WebObjects is a state-of-the-art Java based application server that is particularly well suited for designing complex, high traffic web applications. While WebObjects has been successfully employed by many different companies and institutions, its most visible use has been in the implementation of Apple's iTunes Music Store, which manages millions of downloads and purchases each year. In addition to WebObjects, the SANREM Knowledge Base also uses the Oracle Database Management System. Oracle is the industry leader in data storage systems and is used by the largest companies and institutions in the world to provide fast, secure, and reliable access to information. By using WebObjects in conjunction with Oracle, the SANREM Knowledge Base is able to provide fast, secure, and reliable data access to its clients.

The SKB was operational at the beginning of FY 2006 and it is continuously assessed and improved as needed. 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 SKB

administrator and is given one of three levels of permission. The first level of permission, that of cataloger, allows the researcher to enter resources or to view all resources in the system. To add a new resource, the researcher classifies the resource using a standard set of metadata. The Dublin Core Metadata Initiative (<http://www.dublincore.net>) has defined the metadata elements that are used in the SKB. The SANREM CRSP ME developed an expanded list of key words pertaining to SA and NRM to guide and accelerate metadata entry and 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 (PDF, Word, images, video, etc.). System Coordinators, Bridging and Long-Term Research Activity PIs, and ME personnel have entered over 1,250 SANREM CRSP-generated information resources, as well as other associated materials.

The second level of permission is that of reviewer. Reviewers have all the rights of catalogers, as well as the right to review and edit the metadata other researchers. All resources submitted to the SKB by catalogers must be reviewed and approved by reviewers for quality control purposes before the resources are published and available to the public. Reviewers have the right to publish approved resources. 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 catalogers and reviewers, as well as the ability to add or deactivate users or change user permission levels.

The general public has the ability to search the database for published resources. 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. Data entry and searches are facilitated by the SKB Metadata Guide, Version 2 (Heatwole et al., 2006) [http://www.oired.vt.edu/sanremcrsp/documents/SANREM\\_Metadata\\_guide\\_V2\\_\(Sep06\).pdf](http://www.oired.vt.edu/sanremcrsp/documents/SANREM_Metadata_guide_V2_(Sep06).pdf).

## **Communications Program**

The SANREM CRSP communications program disseminates pertinent SA and NRM information in multiple forms for various purposes. This program consists of: the *SANREM CRSP website* channeling access to relevant information sources; the *SANREM CRSP News*, an e-mail newsletter updating partners and other stakeholders on SANREM CRSP activities and accomplishments; and *Research Briefs*, which target development practitioners by highlighting technological and institutional innovations.

**Website Development:** SANREM partners, development practitioners, policy makers, and other stakeholders public are informed of SANREM CRSP activities and announcements through the ME maintained SANREM website <http://www.oired.vt.edu/sanremcrsp>. 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 and NRM research findings, descriptions of SANREM CRSP activities, opportunities for collaboration, and information on SANREM CRSP policies and procedures. All SANREM CRSP publications, except for copyrighted materials, are archived on the SANREM website. The website contributes to the SANREM CRSP objective 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 ([http://www.oired.vt.edu/sanremcrsp/menu\\_resources/gender.php](http://www.oired.vt.edu/sanremcrsp/menu_resources/gender.php)). 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.

For historical purposes, the SANREM CRSP Phase II website has been archived and is available through the current SANREM CRSP website at: [http://www.oired.vt.edu/sanremcrsp/UGA/MyWeb\\_Sites/SANREM\\_UGA/www.sanrem.uga.edu/indexNU.html](http://www.oired.vt.edu/sanremcrsp/UGA/MyWeb_Sites/SANREM_UGA/www.sanrem.uga.edu/indexNU.html). The old website is not maintained, but since it was taken off-line by the University of Georgia in September 2006, the mirror site created by SANREM CRSP Phase II contains the only complete historical record of the previous SANREM CRSP project.

**Newsletters and Research Briefs:** The ME publishes a SANREM CRSP newsletter and Research Briefs to promote and disseminate relevant sustainable agriculture and natural resource management messages and information. Research Briefs provide concise summaries of peer-reviewed SANREM CRSP research findings and how SANREM research findings can be applied in the field. **Research Briefs 2-5** were published in FY 2006 and are available on-line:

2. [Modeling Tool Improves Watershed Analysis](#) (pdf)
3. [Lowland Irrigation Practices Benefit Upland Farms](#) (pdf)
4. [Understanding Alternatives to Forest Use in Malawi](#) (pdf)
5. [Subsistence Farmers Move Into the Market](#) (pdf)

In addition, SANREM CRSP Phase II Research Briefs are available on-line at: [http://www.oired.vt.edu/sanremcrsp/UGA/UGA\\_RB.htm](http://www.oired.vt.edu/sanremcrsp/UGA/UGA_RB.htm).

The **SANREM CRSP News** is an e-mail newsletter that provides a quick update of SANREM CRSP activities, accomplishments and future events in multi-media format (available by e-mail, on paper, and through the website). Two issues of the **SANREM CRSP News** appeared in March and September of this year and are available on the SANREM CRSP website at: [http://www.oired.vt.edu/sanremcrsp/menu\\_information/newsletters.php](http://www.oired.vt.edu/sanremcrsp/menu_information/newsletters.php). **SANREM CRSP News** will be published on a quarterly basis in FY 2007.

## ***Biodiversity Conservation in Agriculture Symposium***

More than 85 biodiversity conservation and agricultural researchers and development specialists from seven countries participated in the Biodiversity Conservation in Agriculture Symposium, from May 31 to June 2, 2006, in Punta Cana, the Dominican Republic to learn how wild biodiversity can be conserved in agricultural areas around the world. The goals of the

symposium were to:

- 1) Better understand the importance of biodiversity and why it is essential for the provision of ecosystem services;
- 2) Explore how biodiversity conservation can be integrated into agricultural development activities;
- 3) Demonstrate why biodiversity conservation is essential to sustainable development; and
- 4) Learn how agricultural development projects can be designed to meet US Agency for International Development (USAID) Biodiversity Conservation Earmark requirements.

The keynote speakers included Jeff McNeely, Jon Erickson, Paul Ferraro, Sara Scherr, and Mary Rowan. Jeff McNeely, Chief Scientist at the World Conservation Union (IUCN) in Gland, Switzerland, spoke on “[Magnitude of Global Biodiversity Loss](#),” recounting the history of biodiversity loss and its causes. Jon Erickson of the Rubenstein School of Environment and Natural Resources and the Gund Institute for Ecological Economics at the University of Vermont, spoke on “[Biodiversity—What is it and Why is it Important?](#)” His presentation used an ecological and economic framework to define biodiversity, appraise its importance, and assess the synergies and trade-offs between agricultural development and biodiversity conservation. Paul Ferraro of the Department of Economics in the Andrew Young School of Policy Studies at Georgia State University spoke on “[Biodiversity, Agriculture and Markets](#),” and described the positive and negative relationships between biodiversity and agriculture and the roles of payments for environmental services in biodiversity conservation. Sara Scherr, the President of Ecoagriculture Partners, spoke on “[Ecoagriculture: Integrating Agriculture and Biodiversity Conservation—a Landscape Perspective](#).” Mary Rowan, Wildlife and Biodiversity Advisor at USAID, provided an overview of USAID biodiversity conservation programs, which currently have an annual investment of \$165 million. She also described USAID’s definition of biodiversity conservation and discussed what projects must do to meet USAID biodiversity conservation earmark requirements.

Synergies between agriculture and biodiversity in existing ecoagriculture systems were discussed as well as approaches to landscape design that respect both agricultural livelihood and biodiversity conservation goals. In addition to these concepts, speakers addressed such concepts as “[Biodiversity Conservation in Cattle Production Systems](#),” “[Biodiversity Conservation and Coffee Production in Central America](#),” “[Aquaculture and Biodiversity Conservation](#),” “[Alternative Biodiversity Conservation Standards](#)” and “[Considering Biodiversity Threats to Production Agriculture](#).”

A central theme of the symposium was the understanding that biodiversity, sustainability, and development are not mutually exclusive. If agriculture and development are managed intelligently, the goal of sustaining biodiversity while improving people’s livelihoods can be achieved. During their presentations, many of the speakers acknowledged that combining biodiversity and development goals is a challenge, but if done with proper planning, balance can be achieved and result in substantial long-term benefits. Speakers acknowledged that producing short-term results poses a major challenge because of the difficulty in measuring livelihood and ecosystem service improvements associated with conservation activities. Conservation activities may not be seen as worthwhile since, historically, international development activity evaluations

have tended to focus on short-term rather than long-term gains.

The symposium was sponsored by the Integrated Pest Management (IPM) and SANREM CRSPs, with funding and support from [USAID](#) and the [PUNTACANA Ecological Foundation](#). More information on the symposium, including abstracts and presentations from all presenters, can be found at: [www.oired.vt.edu/sanremcrsp/other/biodsymposium.php](http://www.oired.vt.edu/sanremcrsp/other/biodsymposium.php).

## ***Landscape System Coordinator Activities***

### **Landscape System Coordinators**

The SANREM CRSP program vision is organized around five landscape systems, which intersect and interact to impact SA and NRM: field, farm/enterprise, watershed, ecosystem, and policy/governance systems. 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 SA and 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 and there is also a cross-cutting Coordinator for Technology Transfer. These Coordinators are synthesizing SA and NRM research findings within and across the SANREM landscapes systems for inclusion in the SKB. They are also developing metadata for information resources entered into the SKB to facilitate efficient retrieval of SA and NRM knowledge and conducting workshops and seminars to disseminate findings in their areas of expertise. Each System Coordinator is contributing to the landscape systems book on adaptive management. The overall purpose of the Landscape System Coordinators and their teams is to contribute to the KIS through achieving the following objectives.

1. Review literature reflecting the state of the science in each system.
2. Identify state of the art projects for case study analysis.
3. Develop case studies characterizing critical SA and NRM system issues.
4. Develop a state of the art review of each system.

Landscape System Coordinators have produced nine refereed journal articles, one book, eleven presentations, and ten other information products. 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 Landscape System Coordinator reports for FY 2006 are provided in Appendix A.

### ***Book on adaptive management of sustainable agriculture and natural resource management systems***

Small holders around the world are confronted by the linked problems of poverty and environmental degradation. In order to address these multiple and complex factors, SANREM



CRSP Landscape System and Technology Transfer Coordinators are developing a guidebook for development practitioners. This book introduces an evolving adaptive management approach to SA and NRM systems. The goal of the book is to provide development practitioners with the knowledge, understanding, and tools to improve the innovative capacity of stakeholders. A sub-goal is to encourage policy maker and donor support for local innovation and adaptive management.

Part I of the book provides an overview of the complex adaptive systems and the principles for adaptive management in the context of landscape systems. Part II of the book is composed of six landscape system chapters and a chapter on stakeholder empowerment/capacity building. Each of these chapters:

- describes critical system components, their cause-effect relations and interactions;
- highlights the timeframe(s) for component processes;
- identifies links between system processes across temporal and spatial scales; and
- demonstrates how to act strategically to promote innovation.

Concrete examples will be used to illustrate systemic properties and principles of sustainable management, decision making criteria, and links for scaling up, out, and down. Each chapter operates at two levels. At the first level, each systems chapter describes: the current state of agricultural and NRM science for each system; how system properties and processes are relevant to sustainable improvements in livelihoods and environmental services; and cross-scale linkages between systems that provide constraints and opportunities for development intervention impacts. At the second level, these chapters identify technologies and institutional practices that together form a toolkit of innovation principles and options for adaptive management. Identification of these practical innovation principles will assist practitioners in project implementation and in scaling up and out of successful technological and institutional innovations. They will also help donors and project developers design successful and sustainable agricultural and NRM projects and programs that empower stakeholder innovation.

Part III of the book presents a set of case studies, which demonstrate the application of landscape system adaptive management principles. Material for these chapters is currently being researched to provide holistic, multi-system and multi-scale presentations. They will show how the landscape systems/adaptive management approach can lead to successful sustainable management of agriculture and NRM systems. In particular, cross scale interactions are highlighted that are critical to reducing poverty and improving long-term sustainability.

### **Field Systems Coordinator Activities:**

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

**Synopsis:** North Carolina State University (NCSU) activities for the SANREM Field-level System have included training for local and international agriculture professionals and students, collaboration with several relevant entities, and significant progress in production of two book chapters. Thirty-eight international agriculture professionals and students participated in SANREM training activities at the Center for Environmental Farming Systems during FY 2006

In addition, NCSU SANREM partners provided support for a series of sustainable agriculture workshops for local North Carolina agriculture professionals. The NCSU SANREM program continued to build its relationship with the University of Chapingo, NGO's, and host country institutions in Mexico through a trip to the region and internship program for Chapingo students at the Center for Environmental Farming Systems. Approximately 80 resources were reviewed for the SANREM knowledge base and development of the book chapter on the state of the art of SA and NRM for field systems. A first draft of this chapter and significant revisions were completed during the project year. The NCSU SANREM team also identified Guaymango, El Salvador as a case study for inclusion in the forthcoming SANREM book and completed a preliminary draft of the case study chapter.

The Rodale Institute team focused on improving soil quality through research and outreach activities on innovative soil conservation techniques, particularly in tropical developing countries. Rodale partnered with Africare to provide technical support for an intensive organic agriculture and composting course in Ghana with Opportunities Industrialization Centers International (OICI) and The Ghana Ministry of Food and Agriculture. Rodale also developed agro-ecological education programs for Korea and gave a keynote speech at an agro-ecological conference at the University of Chapingo in Texcoco, Mexico. Rodale cooperated with North Carolina State University's Paul Mueller and Denise Finney to develop the Field Production Unit chapter for the landscape systems book. Rodale reviewed and contributed approximately 200 projects and critical information sources to SANREM's knowledge database and is developing a case study analysis involving projects in Ghana, Senegal, and Zimbabwe.

#### **Farm/Enterprise Systems Coordinator Activities:**

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

**Synopsis:** Washington State University (WSU) contributed to the SANREM Knowledge Base and worked on two chapters for the landscape systems book," one on the current state of knowledge of farm/enterprise systems and the other on two case studies. Other activities involved participating in SANREM planning meetings and networking with projects in Malawi and Burkina Faso for development of case studies. Over the past year, work has progressed in all three areas at a pace consistent with stated objectives and no specific obstacles were encountered except over-commitment of time by the authors.

#### **Watershed Systems Coordinator Activities:**

**Principle Investigator:** Saied Mostaghimi, Virginia Tech

**Synopsis:** During FY 2006, the Watershed Systems team reviewed the literature concerning the design and implementation of water resource projects in developing countries. Findings were summarized in a chapter for the landscape systems book detailing an adaptive management approach to watershed management. The draft chapter was submitted for review. Eight case studies were prepared and another case study on a comprehensive long-term watershed

management study in Zimbabwe<sup>1</sup> is in preparation. Key topics from the literature review included: erosion and hydrologic processes; the watershed planning process; examining land use capacity as a prerequisite to project planning; use of GIS, remote sensing, and computer modeling in the planning process; dealing with a lack of data and adapting computational methods for use in developing areas; the importance of a stakeholder-driven process vs. an agency-driven process; involvement of all stakeholders rather than one particular focus group (such as the poor, women, etc.); and stakeholder experimentation, evaluation, and adaptation.

### **Ecosystems Coordinator Activities:**

**Principle Investigator:** Andrew Manu, Iowa State University

**Synopsis:** Several outcomes were produced by the Iowa State University within the SANREM CRSP project over the past year. Over 200 citations were entered into the SANREM CRSP meta-database, 12 projects with elements of ecosystem management approach were evaluated, a field research phase for the analysis of three exemplary projects was prepared, and a book chapter on the ecosystem management was drafted for the SANREM landscape systems book. In addition, two presentations, three proceedings, and one research article were published, a Ph.D. student is pursuing his degree in sociology, and research relationships were established with three institutions in the U.S. and abroad. The Ecosystems Coordinator led a three-week ecosystem study tour to Ghana, West Africa with students from the College of Agriculture at Iowa State University.

### **Policy and Governance Systems Coordinator Activities:**

**Principle Investigator:** Gerald Shively, Purdue University

**Synopsis:** System coordinator activities focused on documenting and summarizing the current “state of the science” regarding the ways economic policies and governance influence incentives for sustainable agriculture and natural resources management for the landscape systems book chapter. Information resources have been identified and entered into the SANREM knowledge base. Case study summaries were initiated: one for the Philippines relating tariffs and forest clearing and the other for Egypt on water management. Work has progressed in a manner consistent with the timeline and no significant obstacles have been encountered.

### **Technology Transfer Systems Coordinator Activities:**

**Principle Investigator:** Devona Bell, Winrock International

**Synopsis:** The sub-award to Winrock International focuses on developing a knowledge base regarding innovation systems and technology transfer methods for establishing sustainable agriculture and natural resource management practices in the field. Activities, approaches, and the proposed content of the landscape systems book chapter were presented for discussion and

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<sup>1</sup> Kuda Murwira, Helen Wedgwood, Cathy Watson and Everjoice J. Win, with Clare Tawney, “Beating Hunger: The Chivi Experience”. London: IT Press, 2000.

inputs for improvement at the Annual SANREM meeting plenary session on April 18 and the authors' meeting on April 19 in Blacksburg, Virginia. Since that time, a solid framework has evolved for developing a complete chapter for the SANREM landscape systems book. There have been challenges in meeting the original timeline given turnover in the management of the sub-award. In order to deliver a high quality book chapter, Winrock has partnered with Ecoagriculture Partners (EP) to write the innovations systems chapter: *Innovation Systems for Agriculture, Natural Resources and Ecosystem Services*.

## ***Selected Landscape System Highlights***

Although it is relatively early in the SANREM CRSP Phase III project cycle, some research findings, insights, and lessons learned are beginning to accumulate. These highlights have been arranged according to the system to which they most likely apply. Full comprehension and ability to apply these findings and lessons learned should be based on a careful reading of the relevant research activity report.

### **Field Systems**

In the Andes communities of Ancoraimas and Umala, Bolivia, the most important pest problems involve the potato weevil and the potato tuber moth and they are perceived as becoming increasingly severe. (LTR-4: Valdivia)

No-till cover crops were determined to be inappropriate in a targeted Vietnamese village because surface residue must be minimized to facilitate harvesting of cashews (LTR-5: Reyes).

Crop growth and plant disease models can be combined with climate change models to predict the likely impacts of climate change on plant diseases for alternative cropping systems (higher levels of diversity, crop variety mixtures, manipulation of disease resistance genes in crops, etc.).

### **Farm/Enterprise Systems**

Economic research in the vicinity of Cayambe, Ecuador suggests that rural households that are highly dependent on farming, with very limited non-agricultural earnings, use conservation payments to diversify income-sources. By and large, the conservation payments they demand in exchange for reducing farmed area for the sake of watershed management are relatively low. In contrast, rural households with diversified earnings place a high value on resources that can be harnessed for subsistence production, especially during periods of below-normal, non-farm income. As a result, they demand high payments in exchange for reducing agricultural land use. (Bridging Activity: Southgate)

Improved poultry husbandry (particularly improved predator control and disease diagnostics) decreased poultry mortality by up to 50 percent in less than one year after implementation in Zambia. This represents a tremendous increase in available dietary protein and family income. (LTR-2: Travis)

Projects attain greatest impact when they discard innovations in which farmers show no interest and put their effort into facilitating farmer adaptation of innovations that farmers prefer. (Farm/Enterprise System: Pannkuk)

### **Watershed Systems**

Some advocates of PES suggest that actual compensation levels need not be very high – generally reflecting average levels of output from land being taken out of production. This standard for determining compensation overlooks the de facto insurance value of resource-access to rural households and therefore underestimates minimally acceptable levels of conservation payments for households that have a high value on those resources for subsistence production particularly during periods of below normal household incomes. (Bridging Activity: Southgate)

Livestock quality and production in the Andes has improved overall, however, farmers are increasingly concerned about access to rangeland and land for forage production. (LTR-3: Alwang)

The key to solving technically and socially complex water resource problems is to utilize the ingenuity of the stakeholders to identify strategies that work for them. Stakeholder driven strategies are more likely to be sustainable and locally-appropriate because they are developed and adapted to meet the needs of the stakeholders. (Watershed Systems: Mostaghimi)

### **Ecosystems**

The rapid decline of Andean glaciers, especially those at elevations below 3500 m (mean sea level), is drying up regional rivers, springs, and irrigation canals. This loss of water resources and lack of reform in water allocation is creating conflicts between indigenous communities, former haciendas, urban areas, and floriculturists. (Bridging Activity: Rhoades)

Incorporation of plant disease models into sophisticated climate models to simulate the adaptive potential of plant and pathogen populations may be an important predictor of the magnitude of climate change effects. (LTR-4: Valdivia)

In the sub-humid montane and arid ecosystems of the Andes, alternative high value crops (peas/onions, forages) are perceived as a way to increase food security, but the impacts of these crops on these fragile ecosystems is unknown. (LTR-4: Valdivia)

### **Policy/Governance Systems**

In Ecuador, payments for environmental services (PES) legislation largely reflects the desire of the national government to capture international payments for environmental services of global significance produced in Ecuador. This legislation poorly addresses the potential of PES for provision of environmental services to address environmental needs in Ecuador, such as watershed conservation. Nevertheless, local governments are proceeding with PES schemes; making use of the power they have under Ecuador's municipalities' law to safeguard local water-sources. (Bridging Activity: Southgate)

The most notable finding to date is that, even within the first study sites, we are seeing decentralization policies that have widely disparate forms and correspondingly disparate effects on livelihoods and natural resource management. In a policy environment where “decentralization” is thrown around liberally as an approach to governance, this is highly instructive, and points to a need for greater attention to detail in implementing such policies. (LTR-1: Ostrom)

Associating national advisory committees composed of national level policy actors with SANREM CRSP research activities helps improve communication of local-level findings and the interpretation of empirical research. In Kenya, this led the Senior Deputy Chief Conservator of Forests to recognize the significance of Loita Maasai indigenous knowledge for improved NRM. (LTR-1: Ostrom)

### **Cross-Scale Interactions and Technological Change**

The concept of complex adaptive systems (CAS) provides a new framework from which development practitioners can develop and implement SA and NRM projects. The review of field system components through the CAS lens indicates that successful strategies in adaptive management are those that simultaneously enhance multiple components at the field level and exploit positive synergies between the field and other systems. This finding highlights the need to expand the number and focus of indicators (e.g., soil quality and biodiversity measurements) to assess project impacts. (Field System: Mueller)

Translating research ideas and products into practical innovations and enhancing the roles of local people in those innovation processes are complementary elements of innovation systems. Stakeholder learning relies on linking the experience and capacities of multiple institutional actors. (Technology Transfer: Bell)

## **Bridging Award Program**

The SANREM Bridging Awards Program supported high-impact, short-term research activities that capitalized on earlier SANREM program efforts and contributed to current SANREM inquiry areas and objectives. Four Bridging Activities completed their 18-month period of performance at the end of June 2006. Minor extensions were granted to finalize issuing of reports and papers. Bridging Award accomplishments are summarized below. Full reports can be viewed in Appendix B.

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

**Principal Investigator(s):** Ian Coxhead, Agricultural and Applied Economics, University of Wisconsin - Madison (UWM); and Gerald Shively, Agricultural Economics, Purdue University.

**Host Country Partner(s):** Agnes Rola, University of the Philippines Los Banos; Bui Dung, Hue University, Vietnam; Dang Thanh Ha, Nong Lam University, Vietnam.

This work completed several activities initiated in SANREM II and provided continuity for ongoing initiatives in what has become a highly visible research program in the region. The project had 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 and 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. Coxhead (University of Wisconsin) and Co-investigator Bui Dung The (University of Hue) coordinated the collection of commune-level and district-level data on land use and aquaculture activity in Central Vietnam, and undertook econometric analysis of the aquaculture area response to prices, as the key indicators of increasing globalization of the industry. A manuscript on this work is now in preparation. An applied general equilibrium model of trade, development policy, resource allocation, and the use of environment and natural resource assets was constructed for Vietnam. It is now in the testing and validation stage at UWM and the National Economics University (Hanoi). A training session on the model and software was held in Hanoi, July 2006. The SANREM-funded work became the basis for a successful 3.5 year grant from the Ford Foundation. The draft of the book on research lessons from the Philippines is 95% complete and is scheduled for completion in December 2006.

## **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).

This bridging project had three objectives: (1) development of watershed visualization tools for land use change modeling and scenario planning, including climate change issues; (2) creating guidelines and methods for biodiversity conservation, especially related to in situ/ex situ propagation of phenotypes of Andean crops; and (3) delivery of SANREM-Andes data and meta-data to the SANREM knowledge base. The Land Use Change/Scenario tools (future visioning, 3-D physical modeling, multisource climate change method) have been disseminated through networking with collaborators in the Andes, publications in books and journals, farmer workshops in Ecuador, and presentations at several international and national conferences. The biodiversity conservation objective, with an emphasis on repatriation of native crops, was facilitated through an institutional agreement between UGA, CIP (International Potato Center), and Asociación Andes (Cuzco, Peru). The partners developed a joint repatriation website, initiated field research in Cuzco with communities of the Potato Park, held a seed fair and farmer-gene bank exchanges in Ecuador, produced numerous publications, and gave presentations at international and national conferences. The SANREM-Andes database in a “toolbook” CD form “People, Land, and Resources of Cotacachi, Ecuador” was completed and distributed. The Cotacachi Atlas (El Canton Cotacachi: Espacio and Sociedad) was published and integrated into the Cotacachi Canton environmental information system for policy and planning.

### **Analysis required for payments for watershed environmental services**

**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, Fundación Antisana, Ecuador.

Carried out in the vicinity of Quito, Ecuador, this bridging activity demonstrated the potential for local financing of watershed conservation, through the use of payments for environmental services and other innovative approaches. Household-level surveying required for this study was completed in Paquiestancia (a rural community upstream from the small city of Cayambe and an important source of drinking water in the region) in early 2006. From April to June, survey data were analyzed and a manuscript was submitted for peer-review to *Land Economics*, a leading journal in the field of environmental economics. In addition, research results were shared at a workshop held in Quito on June 26, 2006 as well as in meetings with USAID staff and local stakeholders. Proceedings from the workshop are being published and will be available in December 2006.



## **Metadata development for the SANREM Knowledge Base**

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

The overall goal of this project was to preserve and transfer information resources created during SANREM CRSP Phases I and II to the SANREM Knowledge Base. Specific objectives of this activity were to: a) define a metadata structure for SANREM CRSP information resources that facilitates access to and dissemination of materials; b) catalog and create metadata for SANREM CRSP information resources generated during Phases I and II; and c) develop a guidance manual for defining and entering metadata into the SANREM Knowledge Base.

The metadata structure was refined and over 378 information resources from SANREM Phases I and II were entered into the SANREM Knowledge Base. The guidance manual, ***SANREM Knowledge-Base Metadata Guide*** was revised to clarify data entry with the release of Version 2. The resources referenced on the original UGA SANREM website have been cataloged. Nearly 900 resources were evaluated and 378 identified as having archival value and were entered in the SANREM Knowledge Base (SKB).

## Long-Term Research Program

The Long-Term Research Awards program implements multi-disciplinary and multi-institutional SANREM CRSP research and knowledge dissemination activities. These activities complement USAID Mission strategic objectives involving sustainable agriculture and natural resources management are high priorities. Long-Term Research Award recipients have developed 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.

To facilitate knowledge organization and the integration of activities among and within sites, SANREM organizes SA and NRM knowledge within the context of nested landscape systems (field, farm, watershed, eco-system, and policy/governance). Sustainable agriculture and NRM actions and their subsequent outcomes interact across these systems and what happens in one system has consequences in other systems. In addition to situating research applications within one or more systems, applicants are addressing one or more of the *priority inquiry areas*: Technology Integration, Governance, Economic Policy and Enterprise Development, Social and Institutional Capacity Building, Biodiversity Conservation and Environmental Services, Systems Linkages, and Globalization, Vulnerability, and Risk

### ***Competitive Selection of Long-Term Research Activities (LTRA)***

Last year, the SANREM CRSP received 74 Planning Award Applications from 37 different U.S. universities addressing critical sustainable agriculture and natural resource management issues. Eighteen Planning Awards from 11 different lead U.S. universities were selected for funding by the SANREM CRSP Planning Award External Review Panel. The Planning Awards provided support to build research teams and for travel to host countries to engage local partners (USAID Missions, NGOs, IARCs, and host country universities and institutions) in identifying research priorities and in developing the long-term research activity proposal. Planning Award activities occurred in 22 different developing countries. This competition was open and not restricted to Planning Awards recipients. Twenty-eight applications for LTRAs were submitted for evaluation by the due date of September 30, 2005. Of the 28 applications, 18 had received Planning Awards.

The two-stage review process involved four External Evaluation Panel (EEP) members and five External Review Panel (ERP) members. During the first stage of the review process, each application was reviewed and scored by one EEP member and then two ERP members. The EEP then met via teleconference in early November and reduced the number of applications for the second stage review from 28 to 11. Each of the remaining applications was then reviewed by at least 3 members of the EEP. The EEP met in person in Blacksburg, Virginia on Dec. 1 and 2, 2005 and recommended five applications for long-term research awards. Successful and unsuccessful applicants were notified of the status of their application and the ME devoted the rest of December to working with the successful applicants to address comments and suggestions

from the EEP. Contracts for the LTRA awards were signed between January and March 2006 with a start date of January 1, 2006. The project abstracts for successful applicants are included below with a synopsis of their first year's activities:

## ***Long-Term Research Activities***

### **LTR-1: Decentralization Reforms and Property Rights: Potentials and Puzzles for Forest Sustainability and Livelihoods**

Principal Investigators: Elinor Ostrom, Indiana University  
Kristen Par Andersson, University of Colorado  
Ruth Meinzen-Dick and Esther Mwangi, CGIAR Systemwide  
Program on Collective Action and Property Rights (CAPRI)  
Bruce Campbell and Marty Luckert, Center for International  
Forestry Research (CIFOR)

Host Countries: Uganda, Kenya, Mexico, Bolivia

**Abstract:** Decentralization and property rights reform policies formulated at the national (governance/policy) level for large geographic domains often fail to account for the complexities involved in land use at the local (farm/field/forest) level, and can thus fall short of their goals of sustainable natural resource management (NRM) and improving local livelihoods. This research will collect and analyze data from Uganda, Kenya, Mexico, and Bolivia to identify the institutional conditions and interactions that will deliver benefits equitably to local people while sustaining natural resources. Utilizing the research networks of the International Forestry Resources and Institutions (IFRI, <http://www.indiana.edu/~ifri/>) program, the Program on Collective Action and Property Rights (CAPRI, <http://www.capri.cgiar.org/>), hosted at the International Food Policy Research Institute, IFPRI, <http://www.ifpri.org/>), and the Center for International Forestry Research (CIFOR, <http://www.cifor.cgiar.org/>), the project will answer the following: (1) What motivates the implementation of decentralization policies in the forestry sector? (2) What are the implications of forest decentralization policies for different groups, including women, the poor, and marginalized groups, at the local level? How can different interests be accommodated? (3) What are the implications of forest decentralization policies for resource conservation, biodiversity, and ecological sustainability at the local level? (4) How may public policies be modified to more effectively improve both the ecological sustainability of forests and the livelihoods of the communities that depend on them?

**Start-up Activities:** In its first seven months, the project achieved most of the objectives set out – particularly the crucial element of establishing a good organizational structure among eight units located in diverse settings. National Advisory Committees (NACs) were established and initial meetings held in all four countries (Bolivia, Kenya, Mexico, and Uganda) leading to plans for future research of most direct interest to policy makers in these four countries as well as the USAID missions in each country. Research in at least one site was completed in all four countries. The household survey that was developed went through several rounds of pre-testing

in Bolivia, Kenya, and Uganda and is being finalized for administration during the second year of the project.

At the first annual meeting of the participating partners of this project (held in June in Bali, Indonesia during the biennial meetings of the International Association for the Study of the Commons), a plan was presented by Krister Andersson of the University of Colorado, which called for a large-n nationwide survey of the forest communities to be conducted in each country. The Mexico Collaborating Research Center (CRC) agreed to take the lead in developing this survey and pre-testing the survey during the summer of 2006. The survey will be adopted as part of this project by the Mexican CRC and the Bolivian CRC. The Kenyan and Ugandan CRC will seek additional funding to add this survey to their research and policy agenda in the future.

In addition, our host country partners conducted extensive training. We trained a total of 89 community members and host country researchers in varying topics, from research methods to tree and soil management. Of these trainees, 39 (or roughly 43 percent) were women. The creation of the NACs in each country established a regular means of networking with key players in forest policy in each country. Host country partners also networked with various other actors at the local, regional, and state level.

**LTR-2: Developing A Participatory Socio-Economic Model For Food Security, Improved Rural Livelihoods, Watershed Management, and Biodiversity Conservation In Southern Africa**

Principal Investigators: Alex Travis, Alfonso Torres, Cornell University  
Dale Lewis, Wildlife Conservation Society-Zambia

Host Country: Zambia

**Abstract:** Unsustainable agricultural and natural resource management practices and unsound economic strategies contribute significantly to food insecurity, limitations in livelihood opportunities, and diminished biodiversity throughout southern Africa. In Zambia, a market-driven approach called "Community Markets for Conservation" (COMACO) is attempting to improve biodiversity conservation through improvements in food security and livelihoods. This community-owned enterprise implements sustainable agricultural practices at the level of individual farms using extension support, marketing, and pricing strategies organized around COMACO's regional trading centers to increase small stakeholder profits. Preliminary data show that these market incentives are sufficient both to foster sustainable agricultural practices and, via explicit linkages to behaviors aimed at conserving biodiversity, to increase wildlife populations, making future game-based economic opportunities possible. Through broad stakeholder consultations, the multi-disciplinary research team has identified key research issues regarding soil, crop, food, veterinary, and social sciences that are needed to optimize the COMACO model, to determine if it is sustainable without external subsidies, and to quantify the livelihood and environmental/biodiversity benefits of the model. Targeted research and training of host country nationals will inject new technologies and generate critical knowledge needed to scale-up the

COMACO approach within Zambia and across southern Africa to improve food security, rural livelihoods, and biodiversity conservation.

**Start-up Activities:** Substantial progress was made towards all objectives during the first six months of the project. Business economic data were gathered from the regional trading centers to evaluate the potential for economic self-sufficiency. Notable research progress has translated into impact regarding the integration of new technologies into COMACO's activities. For example, the production of value-added food products at the Lundazi Regional Trading Center has been evaluated. Significant details regarding hygiene/safety have been identified and corrected. Large-scale experiments to quantify maximum crop yields for different agroecozones and to evaluate the efficacy of different soil amendments were initiated. Because of the scope of these efforts, and through partnerships with the Tropical Soil Biology and Fertility (TSBF) and a host-nation organization, the Conservation Farming Unit, these findings should be applicable throughout much of southern Africa. Extensive data collection on poultry production practices was coupled with significant training of over 500 villagers in methods to improve poultry production. Anecdotal evidence suggests an increase in poultry production of over 50 percent in the research and training areas as a result of this research and the implementation of improved poultry husbandry measures, particularly measures related to predator management. COMACO extension officers received training as veterinary para-professionals and a small field laboratory, was established to improve diagnostic capabilities. Local veterinary para-professionals now have a satellite uplink that they can use to send images and consult with veterinary scientists at Cornell University. Project social scientists have evaluated and improved COMACO's existing survey methodologies and instruments. Quantification of COMACO's effects on biodiversity conservation has been greatly improved through the collection of data from control areas (both before/after COMACO participation, and within/without COMACO participation). Data analysis is underway and will continue. Additional research needs in watershed evaluation/monitoring were identified and Conrad Heatwole of Virginia Tech is conducting a feasibility study using and satellite imagery and watershed modeling to assess long-term program impacts on water resources and soil quality. Numerous miscellaneous items needed to support the research were purchased and installed. In particular, the V-sat broad-band satellite internet linkage has improved communications immensely between the two main COMACO sites in Zambia and with researchers in the U.S. Introduction of this link represents a "technology leap" for the area and is providing an enormous improvement in COMACO's business operations as well.

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

Principal Investigators: Jeffrey Alwang, Brian Benham, Darrell Bosch, Carola Haas, George Norton, and Mary Leigh Wolfe, Virginia Tech  
Paul Backman and Jonathan Lynch, Pennsylvania State University  
Duane Chapman, Cornell University  
Willis Flowers, Florida A and M University  
Sally Hamilton, University of Denver  
Stan Wood, International Food Policy Research Institute  
Victor Hugo Barrera, INIAP, Ecuador

Mario Antonio Gandarillas, PROINPA, Bolivia

Host Countries: Bolivia, Ecuador

**Abstract:** This SANREM project integrates research, teaching, and outreach/community engagement to promote sustainable NRM in sloped areas in the Andes in South America. Such areas often have limited communications and transportation infrastructure and are characterized by poor integration with central governing institutions. This project is identifying and introducing new productive technologies and innovative uses of natural resources within and beyond agriculture in ways that are consistent with sound management of the natural resource base. The project is also identifying and analyzing new income-generating livelihood alternatives, investigating constraints to adoption of such alternatives, and fostering community and producer organizations to facilitate broad-based participation. Impacts of changes in livelihood activities on social, economic and environmental outcomes are monitored in a participatory fashion. The participatory and community-based approach incorporates watersheds in two countries (Ecuador and Bolivia) in a process of identifying natural resource and human asset bases; identifying technical alternatives for livelihoods given asset bases and the natural and policy context; measuring and monitoring social, economic, and environmental impacts of livelihood alternatives; and using the economic and environmental focus to effect community change.

The multi-disciplinary project team includes social scientists, agricultural and natural resource scientists, geo-spatial experts from the U.S. and host countries and South American government agencies, non-governmental organizations and outreach specialists. The project team teams is identifying and developing livelihood alternatives consistent with sound NRM. Training and capacity building form a central part of the project. Cross-community study tours are promoting cross fertilization of ideas between the two project sites and undergraduate internships are facilitating learning about watershed management

**Start-up Activities:** During the first nine months of the project, a number of important activities were undertaken and milestones were passed. Administrative arrangements were completed, regional offices were equipped and opened, personnel were identified and hired, and field research activities commenced. In both sites sites (Chimbo, Ecuador and Tiraque, Bolivia), comprehensive participatory assessments and planning activities were completed. These activities helped prioritize research, sensitize residents about project objectives and methods, and build political support. A multi-disciplinary team of U.S. investigators visited the Chimbo watershed in June, where they collaborated with Ecuadorian and Bolivian counterparts. Problems related to soil erosion and productivity, options for higher-valued agriculture, water availability and drinking water quality, market access, and the presence of few alternative income-generating activities were identified. The research agenda was subsequently refined and designed to address these issues. Obstacles to effective local governance and institutional issues were also identified. A comprehensive baseline assessment was designed and started in both sites. The data from this assessment, when available in November-December 2006, will provide the basis for subsequent monitoring of project impacts, but are also essential inputs into household and watershed modeling. Data for GIS modeling were assembled and collected in Ecuador and GIS data gathering was started in Bolivia. A comprehensive training program was created and initiated at

U.S., Latin American, and European universities. Several non-degree training events were also held to build a common base of knowledge among collaborators, sensitize local stakeholders, and build institutional support.

**LTR-4: Adapting to Change in the Andes: Practices and Strategies to Address Climate and Market Risks in Vulnerable Agro-Ecosystems**

Principal Investigators: Corinne Valdivia, Leonie Marks, Peter Motavilli, and Jere Gilles, University of Missouri  
Cornelia Flora and Jan Flora, Iowa State University  
Karen Garret, Kansas State University  
Anji Seth, University of Connecticut  
Greg Forbes and Roberto Quiroz, International Potato Center  
Javier Aguilera, PROINPA, Bolivia  
Jorge Cusicanqui, Universidad Mayor de San Andrés, Bolivia  
Elizabeth Jiménez and Ramiro Molina, Universidad de La Cordillera, Bolivia  
Carlos Laruta, Centro de Investigación y Promoción del Campesinado, Peru  
Celia Turín and Silvia Vargas, Nacional Agrarian University-La Molina, Peru

Host Countries: Bolivia, Peru

**Abstract:** Climate, as well as economic and social change, is threatening Andean smallholder production systems. This research explores ways to increase the resiliency of these social-ecosystems by working with farmers to increase their capacity to adapt to change and build resilient livelihood systems. Team researchers and farmers in peasant communities are developing a common understanding of the factors leading to increased vulnerability and less diversity in these systems. The project is a research and development collaboration between rural communities in the Altiplano and high valleys of Bolivia and Peru, universities and non-governmental organizations in the region and the U.S., and institutions that formulate policy. It will strengthen the capacity of these communities and institutions to conduct research and to develop strategies to adapt to change, to reduce vulnerability and enhance biodiversity of their agro-ecosystems. A common understanding of how livelihood strategies develop in response to risks will create new knowledge aimed at increasing the ability of people and their environment to recover from shocks and stresses. Specific interventions envisioned include in situ conservation of cultivars and native plants, new markets for traditional crops, introduction of technologies and varieties to mitigate weather related risks, and the development of strategies to enhance soil organic matter.

**Start-up Activities:** The research team from Bolivia, Peru and the U.S. met in April to initiate the project, and in September to design the field and participatory research. Two research sites were identified in May, and collaboration from eight communities in Bolivia and Peru confirmed in June and July. Protocols, which included community participatory assessments and household

surveys, were developed, tested, and applied in seven communities located in two municipalities in the Central and Northern Altiplano ecosystems. They recorded baseline information on livelihoods, resources, ecosystem characteristics, and perceived changes. Collaborating communities in Peru were identified through participatory assessments. Instruments that integrate vulnerability, natural resource management, and knowledge, aspirations, skills, attitudes and practices (KASAP) were developed and are being tested. Field experiments were designed to assess practices in soils and pest management in the Bolivian Altiplano, and to measure biodiversity of potatoes. CIPCA was identified as the collaborator to carry out PRAs in Apolobamba. The sites were identified and the protocol for assessment developed. Assessments will be carried out in year 2. The climate research included securing data and analysis to describe the climatology of the North and Central Bolivian Altiplano. The major focuses this year were based on three objectives. Objective 1: develop a shared understanding on the drivers of change. The baseline assessment conducted also provided information for Objective 2 on perceptions, Objective 3 on practices, and Objective 4 on market strategies. Non-degree training focused on Community Participatory Assessment techniques, training of enumerators, and on participatory research methods. Four students were identified for long-term training in the U.S. and started in the fall of 2006. In Bolivia, recruitment of undergraduate students to conduct field research for their *licenciatura* thesis began. Networking with USAID Title II institutions in Bolivia, the Climate Change Program in this country, UNDP and WFP started with their participation in a stakeholder meeting in April. Collaboration with CIP is currently taking place in climate research, integrated pest management, and impact assessment of rural development projects in the Altiplano of Peru and Bolivia.

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

Principal Investigators: Manuel Reyes, Charles Raczkowski, and Gudigopuram Reddy, North Carolina Agricultural and Technical State University  
 Robin Marsh, University of California-Berkeley  
 Ronald Morse and Conrad Heatwole, Virginia Tech  
 David Midmore, Central Queensland University  
 Howard-Yana Shapiro, Mars, Inc. and University of California-Davis  
 Raghavan Srinivasan, Texas A and M University  
 Delia Catacutan, Rodel Lasco, and Agustin Mercado, ICRAF, Philippines  
 Joshi Laxman and Meine van Noordwijk, ICRAF, Indonesia  
 James Roshetko, ICRAF and Winrock Intl, Indonesia  
 Flordeliza Faustino, Liwayway Engle, Greg Luther, Ali Mubarik, and Manuel Palada, AVRDC, Taiwan  
 Ma. Elena Chiong-Javier, De La Salle University, Philippines  
 Victor Ella and Ma. Victoria Espaldon, UPLB, Philippines  
 Dang Ha, Nong Lam University, Vietnam  
 Jean Saludadez, University of the Philippines Open University  
 Anas Susila, Bogor Agricultural University, Indonesia



Host Countries: Indonesia, Philippines, Vietnam

**Abstract:** In Asia about 1.7 billion persons live on less than US\$ 1/day. This project seeks to alleviate poverty, food scarcity, and reduce environmental degradation in Southeast Asia by combining economically-viable and resource-conserving agroforestry technologies, and gender friendly socio-economic policies to benefit and reward stakeholders, especially small-scale farmers both women and men. The hypothesis to be tested is “integrating vegetable production into agroforestry systems on small farms will help alleviate poverty and enhance environmental protection, sustainability, and ecosystem biodiversity in SEA watersheds.” Specific objectives of the project include: (1) develop economically viable and ecologically-sound vegetable-agroforestry systems; (2) develop a market value chain at the local, regional, and national levels that builds upon existing marketing strategies; (3) identify policy options and institutional frameworks that promote sustainability of vegetable-agroforestry production and reward environmental services; (4) assess the short and long-term environmental and socio-economic impacts for farm families adopting integrated vegetable-agroforestry systems; (5) provide mechanisms to ensure women’s involvement in decision-making and sustainable production and marketing practices to improve their socioeconomic wellbeing within the vegetable-agroforestry system; and (6) build host country capacity to manage and disseminate integrated vegetable-agroforestry system. The multidisciplinary project team includes 28 scientists from U.S. and host country universities, the World Agroforestry Center (ICRAF), the World Vegetable Center (AVRDC), and MARS Incorporated

**Start-up Activities:** The SANREM CRSP project in Southeast Asia, Technology, Markets, Policy, Environment, Gender, and Scaling (TMPEGS) completed major start-up activities during its first six months including: selecting country and theme coordinators; finalizing workplans, budgets, and contracts; organizing and conducting kick-off meetings in each host country; and selection of specific research sites; and initiation of site specific research activities. Research sites include: Ngia Trung commune, Bu Dang District, Binh Phuoc Province in Vietnam; three villages in the Parkan Muncang, Sukaluyu, and Hambang, Nanggung sub-districts in Bogor, Indonesia; and a village in Sungco, Lantapan, Bukidnon, Philippines. The Vietnamese site is predominantly perennial (tree) crops; the Indonesian site is a mix of perennial tree and annual (rice and vegetable) crops; and the Philippines site is predominantly annual (vegetable) crops.

Observations from the projects initial participatory appraisal involving both men and women small-scale farmers include the following: vegetable agroforestry may improve the quality of life for small-scale farmers; improved vegetable production methods have good prospects of increasing small-scale farmer incomes in Indonesia and the Philippines, whereas in Vietnam, increases in vegetable production are viewed as more important in improving the nutrition and health of small-scale farmers than as an income source. Introduction of improved and indigenous vegetables, drip irrigation, and integrated pest management are technologies that may improve vegetable and tree production. No-tillage may be useful in Indonesia and the Philippines, but may not be applicable in Vietnam for the agroforestry systems being considered. A ‘no tillage human powered’ plow was designed and a prototype has been fabricated and tested. Initial prototype tests look promising. For the Marketing objective, rapid market assessments were conducted in all countries. Indonesian and Philippine collaborators identified several common

vegetable species grown by small-scale farmers that have good potential for income generation while Vietnamese collaborators found that vegetables are rarely grown by villagers. For the Policy objective, initial Vietnamese results revealed that there are important benefit-sharing and credit policies that may impact vegetable agroforestry farming systems. Philippine collaborators were successful in convincing local legislators in the municipality to enact policies that are pro-small-scale farming and vegetable agroforestry. For the environmental and socio-economic impact objective, a socio-economic household baseline survey and a research report were completed in Indonesia. The Vietnamese team finished the socio-economic baseline and nutrient survey, while the Philippine collaborators completed the design of the baseline survey questionnaire. The Indonesian team reported on demographic and farm characteristics, household income and expenditures, and labor availability for their three villages. For the gender objective, the Indonesian and Philippine teams have interesting but opposite results. In Indonesia, the role of women in agriculture is limited to production activities, whereas in the Philippines, women and men have equal responsibilities and roles in agricultural production and marketing. Lastly, for the scaling-up objective, Indonesian partners completed a comprehensive vegetable production manual in Bahasa, while Philippine collaborators completed a training needs analysis instrument.

## 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 U.S. and host country universities, NARS, NGOs, and relevant ministries. While developing a global knowledge base in U.S. universities, SANREM addresses specific host country SA and NRM questions, opportunities, and constraints. Ten U.S. universities and eight host country institutions provided long-term training for 35 graduate students (22 Ph.D. and 13 M.S.) and three undergraduate students associated with SANREM CRSP activities. Of these, eleven are men and twenty-seven are women. Twenty-four of these students are developing country nationals working in the Bridging, Long-Term Research, and Knowledge Base Development Activities (see the Table of *SANREM CRSP Degree Training Participants: FY 2006* in Appendix D).

**Table 1: Long-Term Degree Training Participants by Country, FY 2006**

Country	Doctorate		Masters'		Bachelors'		Total
	Men	Women	Men	Women	Men	Women	
Albania	1						1
Australia	1						1
Bolivia	2	1		2			5
Canada		2					2
Ecuador	1		1	2		2	6
India	2	1					3
Kenya		1					1
Mali			1				1
Netherlands	1						1
Philippines		1		1	1		3
Thailand				1			1
Uganda		1					1
USA		6		4			10
Vietnam		1					1
Zimbabwe		1					1
Total	8	15	2	10	1	2	38

### **Short-Term Training**

Over the course of the year, SANREM CRSP partners held some 65 short-term training events serving over 2,832 persons (over 1,012 women among them). Training events were held in twelve different countries and often supported the initiation of Long-Term Research Activities. These numbers are underestimated because counts and distributions of men and women were not reported for all events.

Five field days were held introducing new and alternative conservation technologies to over 1,066 persons (more than 421 women among them). Six seminars were held addressing 276 people (91 women). Over half of the 726 participating in the 17 short courses were women (367). Thirty-four workshops were also held. These workshops served over 759 people; at least 180 of them were women. Three women had internships and two Fulbright Scholars were among the SANREM CRSP participants. A full accounting of these training events is provided in the Table, *SANREM CRSP Non-Degree Training Participants: FY 2006*, in Appendix D.

**Table 2: Short-Term Training Participants by Country, FY 2006**

<b>Country</b>	<b>Women</b>	<b>Men</b>	<b>Total*</b>
Bolivia	105	100	295
Ecuador	60	115	574
Honduras	15	20	35
Indonesia	49	71	124
Kenya	6	6	12
Mexico	11	3	14
Peru	42	46	88
Philippines	50	14	74
Uganda	15	33	48
USA	74	112	186
Vietnam	24	33	59
Zambia	561	752	1,323
<b>Total</b>	<b>1,012</b>	<b>1,305</b>	<b>2,832</b>

\* Total exceeds the number of men and women because sex disaggregated counts were not made for all training events.



## **Appendix A: Landscape System Reports, FY 2006**



## ***Field/Production-Unit System***

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

### **I. Executive Summary**

Activities for the SANREM Field-level System have included training for local and international agriculture professionals and students, collaboration with several relevant entities, and significant progress in production of two book chapters. Thirty-eight international agriculture professionals and students participated in SANREM training activities at the Center for Environmental Farming Systems during the 2005-06 project year. In addition, NCSU SANREM staff provided support for a series of sustainable agriculture workshops for local North Carolina agriculture professionals. The NCSU SANREM program continued to build its relationship with the University of Chapingo, NGO's, and host country institutions in Mexico through a trip to the region and internship program for Chapingo students at the Center for Environmental Farming Systems. Approximately 80 additional resources were reviewed for the SANREM knowledge base and development of a book chapter on the state of the art and science in SANREM at the field level. A first draft of this chapter and significant revision were completed during the project year. The NCSU SANREM team also identified Guaymango, El Salvador as a case study for inclusion in the forthcoming SANREM book and completed a preliminary draft of this chapter.

### **II. Research Outputs, Results, and Impacts by Objective**

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

The review of literature relevant to the field-level system continued under the coordination of Denise Finney. Approximately 80 additional publications were reviewed and meta-data entered into the NCSU internal data system during year 2. The internal data system is compatible with the SKB and will be utilized to facilitate meta-data entry to the SKB. No progress has been made in the entry of meta-data to the online SKB due to time constraints. Data entry is a priority for year 3. If the project coordinator is unable to carry out data entry, an NCSU student will be hired to assist with this process.

A number of best practices have been identified to promote sustainable agriculture and natural resource management in the field system. These practices include:

- Mulching
- Cover cropping
- Improved fallows
- Compost application
- Biodiversity conservation
- Crop rotation
- Intercropping
- Integrated pest management
- Conservation agriculture



- Micro-irrigation

A review of literature on complex adaptive systems and adaptive management was also undertaken to establish the context and perspective from which to address the state of the science and art at the field-system level. This review contributed to the production of the book chapter (objective 4).

**Objectives 2 and 3:** *Identify state of the art projects for case study analysis and develop case studies characterizing critical SA and NRM system issues*

The NCSU SANREM team reviewed twenty-two projects identified in the first year of the project as potential case studies and selected Guaymango, El Salvador to be the focus of an in-depth case study for the forthcoming SANREM book.

The experience of the Guaymango community (Department of Ahuachpan, El Salvador) with conservation agriculture is a well-documented case study that has been developed over a period of more than 30 years. The project was officially launched by The National Center for Agricultural Technology (CENTA) with a diagnostic study conducted between 1970 and 1973. The case was summarized and published in 1991 and 1996, but the collection of information continues to be present. This case is of particular relevance because soil conservation practices such as no burning, contour planting, use of living erosion barriers, and zero tillage were linked to productivity-improving practices (improved cultivars, efficient fertilizer use, and increased plant populations) through economic incentives (agrarian land reform, credit availability linked to conservation practices) and were successfully adopted by farmers. A key factor in the success of the project was the manner in which crop residues were allocated for conservation purposes and livestock feed. This case demonstrates well the importance of cross-system approaches to adaptive management.

**Objective 4:** *Draft synthetic review of the state of the art and science in your system*

Paul Hepperly (Rodale Institute), Paul Mueller (NCSU), and Denise Finney (NCSU) completed the first draft of a synthetic review of the state of the art and science in the field system in April 2006. This review will serve as the basis of a chapter on complex adaptive systems and adaptive management in the field system. The review highlights four key components of the field system: soil, water, living organisms, and energy, and describes key characteristics of each, as well as the linkages between components. Based on component analysis, the chapter argues that adaptive management of the field system should consider the following two principles:

1. Adaptive management introduces technologies, innovations, and institutions that positively impact multiple components of the field system
2. Adaptive management strategies work in concert with external systems and exploit positive synergies between the field and external systems

Using scientific research and examples from development projects, the chapter describes sustainable agriculture practices that adhere to the above principles. These practices reflect those identified as “best practices” under objective 1.

### **III. Degree and Non-Degree Training Activities**

See attached Non-Degree training table. No degree training is associated with this program.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

No SANREM publications were produced during the 2005-06 project year.

### **V. Networking Activities**

The project team participated in number of networking activities during year 2, with a focus on Mexico. Project coordinator Denise Finney traveled to Mexico in November 2005 for a research trip. Contacts were made with the following entities during this trip:

- Faculty at the Autonomous University of Chapingo (Texcoco, Mexico)
- Faculty at the Graduate University (Texcoco, Mexico)
- The Agroecology Center at Las Canadas
- Beneficio Mixto de Prof. Manuel Sedas Rincon
- TOSEPAN Titaniske Cooperative

In addition, Dr. Mueller traveled to Oaxaca, Mexico, with 28 Extension faculty from North Carolina State University as a part of the North Carolina Cooperative Extension Service “Latino Initiative.” Contacts were made with faculty from the Autonomous University of Chapingo and the Graduate University and with various NGOs in Oaxaca. These contacts resulted in two significant training events supported by SANREM CRSP: (1) summer internship program in agroecology for Chapingo undergraduate students (held at the Center for Environmental Farming Systems; (2) NCSU and Rodale participation in the 4<sup>th</sup> International Agroecology Symposium to be held at Chapingo in October 2006.

Field system team members also participated in SANREM CRSP activities including the annual meeting in Blacksburg and the Biodiversity Symposium held in the Dominican Republic. ME representatives Keith Moore and John Lipovsky visited North Carolina State University to discuss research and education programs of the Center for Environmental Farming Systems (CEFS). They identified the professional training capacity of CEFS as a key opportunity for an associate award with missions that include agricultural training as an SO.

NCSU SANREM team members contributed to a significant sustainable agriculture/natural resource management training program for farmers, students, and other agricultural professionals in North Carolina. The 2006 Sustainable Agriculture Workshop series took place at the Center for Environmental Farming Systems and included ten production-focused workshops. These training events drew more than 400 participants. In addition to leading workshops, SANREM staff provided logistical support for this program.

## **VI. Project Impact Highlights (Bullets):**

The concept of complex adaptive systems (CAS) provides a new framework from which development practitioners can develop and evaluate SA and NRM projects. The review of field system components through the CAS lens indicates that successful strategies in adaptive management are those that simultaneously enhance multiple components of the field and exploit positive synergies between the field and other systems. This finding highlights the need to expand the number and focus of indicators (e.g., soil quality and biodiversity measurements) to assess project impacts.

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

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

### **I. Synopsis**

We have focused our research on improving soil quality by applying field production practices, particularly in tropical developing countries. We entered a collaborative agreement with Africare and provided technical support for an intensive organic agriculture and composting course in Ghana with Opportunities Industrialization Centers International (OICI) and The Ghana Ministry of Food and Agriculture. We also developed agro-ecological education programs for Korea and participated by giving a keynote speech in an agro-ecological conference at the University of Chapingo in Texcoco, Mexico. Our PowerPoint presentation focused on the relationship between soil quality and food quality. We also worked with North Carolina State University's Paul Mueller and Denise Finney to develop a Field Production Unit for the SANREM review book. We have reviewed and contributed approximately 200 projects and critical information sources to SANREM's knowledge database and planned a case study analysis of Ghana, Senegal, and Zimbabwe.

### **II. Research Accomplishments by Objective**

**Objective 1:** *Review literature reflecting the state of the science in your system.*

Best management practices for addressing soil quality constraints are focused on increasing soil organic matter through local strategies using locally available and sustainable inputs. Sustainability and natural resources improvement is addressed effectively by this approach.

Soil types vary greatly by geographic regions, and Oxisols and Ultisols are infamous for low fertility. The Amazon Indian Black soils are high fertility soils that have been developed from poor fertility Oxisols and Ultisols by the human inputs of soil carbon in the form of charcoal. These modified soils show that long term productivity and environmental improvements are possible with better understanding of traditional agricultural methods.

Erosion is a major problem for soil quality in all parts of the world. Novel no-tillage agricultural technologies that eliminate chemical inputs have been shown to reduce erosion and improve soil quality. The Rodale Institute has pioneered these systems and demonstrated their practical use under temperate conditions and is ready to develop systems that are appropriate for tropical climates.

Soil erosion and declining soil fertility are also associated with loss of soil organic matter and nutrient mining. Organic matter is crucial to increase the water holding capacity of the soil, a quality that is particularly essential in semi-arid areas with periodic droughts such as the Sahel region of Africa.

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

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

We employ a “training the trainers” model for our informational outreach. This is more effective way of promoting change as each trainer can disperse information to his clientele which often represents hundreds of people. We demonstrated an African pit composting system, utilizing field tree sites. The compost begun during the 2005 demonstration was applied in 2006 and generated continued interest and requests for application at the Sullivan Center outside Tamale. Besides teaching compost technique and calculation of application rates, we also taught effective selection of village representatives and how engage villagers by actively listening to their inputs.

We have identified approximately 100 projects for potential case study analysis thus far. One innovative approach to remedy soil infertility that we highlighted in our last annual report was Integrated Soil Fertility Management (ISFM), which has been promoted by the Center of International Tropical Agriculture (CIAT). This concept broadens the discipline of soil science to address the social economic, political and agronomic aspects of declining soil fertility.

We did receive positive responses from non-governmental agencies working with farmers. In Ghana, we trained about 40 extension educators in organic agriculture and composting, in conjunction with OICI and the Ghana Ministry of Food and Agriculture, and this program has continued to impact soil management practices in Tamale Northern Region of Ghana.

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

We have developed case studies critical to sustainable agriculture and natural resource management with our collaborative partners in Ghana, Zimbabwe, and Senegal.

In these countries, monoculture agriculture is a key obstacle to improving nutrition of diets and food security under periodic droughts. A more diversified agriculture system with more emphasis on drought tolerant and resistant plants is needed to remedy the current situation. We are developing a plan to expand and diversify the food crops grown in the region in order to confront drought and nutritional deficiency.

In Senegal, we are also studying non-chemical approaches to systematically manage Striga (witch weed) to prevent its broader development and dispersion.

Soil quality constraints are common to all the areas in Ghana, Senegal, and Zimbabwe that we have surveyed, and more effective use of land management and composting can be effective in all these areas without increasing outside inputs.

**Objective 4:** *Review of the state of the art and science in Tropical Soil Systems.*

### **III. Non-Degree Training Activities**

In 2006, a follow-up training at the Opportunities Industrialization Centers International and Ministry of Food and Agriculture agents in Tamale for Ghana's Northern region training for polyvalent facilitators was reinforced for their continued teaching and implementation of compost practices.

### **IV. Publications, Presentation, and other SANREM CRSP Products**

See Publications, Presentations, and Other Products table.

### **V. Networking**

We have been actively collaborating with Dr. Paul Mueller, Denise Finney, and the North Carolina State University team on a literature review and field-based landscape system analysis. We hosted their visit to the Rodale Institute when we worked to develop the outline of Field Scale Practice for Sustainable Agriculture and Natural Resource Management for Review Book in the project.

We continue to collaborate with Africare and OICI on programs to train agricultural extensionists and look forward to moving ahead with our collaborative agreements with both organizations.

We have entered a collaborative agreement with Gyeonsang University in Korea. We are also developing collaborative agreements with University of Chapingo in Mexico and North Carolina State University. We have recently signed an agreement of collaboration with Moscow State University in Russia. Finally, we are also exploring accredited teaching collaborations with Alfred State University in New York and Kutztown University in Pennsylvania.

### **VI. “Bulleted” or Project Highlights**

- The International Society of Organic Agriculture Research featured our long-term Farming Systems Trial (FST) in their Scientific Series.
- Collaborative work with OICI and The Ministry of Food and Agriculture in Ghana developed composting and organic agriculture in Northern Ghana.

- Sustainable agriculture training for Korean students at the Rodale Institute continues and is leading to a collaborative relationship.
- The SANREM-sponsored review book is being supported by a chapter on field scale management that is almost complete. We are working on this project with North Carolina State University.

## ***Farm/Enterprise System***

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

### **I. Executive Summary**

WSU's activities under the SANREM project are to contribute to the Knowledge Base and provide two chapters to the book "Innovating for Sustainable Agriculture and Natural Resource Management: The Science of Adaptive Management," one on the current state of knowledge at the farm level enterprise and the other on two case studies. Other activities have focused on participation in SANREM planning meetings and networking with projects in Malawi and Burkina Faso for the development of case studies. Over the past year, work has progressed in all three areas at a pace consistent with the stated objectives and no specific obstacles were encountered except over-commitment of time by the authors.

### **II. Research Outputs, Results, and Impact by Objective**

**Objective 1:** *Review literature reflecting the State of the Science at the farm/enterprise-level system*

Activity in this area focused on reviewing literature and incorporation of the findings in the final draft of chapter 3 of the SANREM book.

- Entering already reviewed literature in the SANREM database has resumed in the last quarter. Fifty relevant citations and literature items (from a total of previously identified 75 projects from Africa and 20 projects from other geographic areas) were prepared and about 15 entered into the SANREM meta-database.
- Specific geographic areas of focus were: Ghana, Niger, Mali, Burkina Faso, Malawi, Afghanistan, Armenia, and Romania.
- The reviewed literature provides information on best farm practices being promoted among smallholders especially on agroforestry, soil and water conservation, small-scale irrigation, aquaculture, and community-based NRM.
- As mentioned in past reports, the most promising practices tested at farm level are agroforestry techniques to improve soil fertility and testing alternative or improved technologies for soil and water conservation and small-scale irrigation.
- Over the past year, work under this objective has lagged due to more focus on the other objectives, but uploading all reviewed materials in the SKB has resumed and will come to completion in the next couple of months. No other specific obstacle was encountered.

**Objective 2:** *Identify state of the art projects for case study analysis*

- Projects pertaining to agroforestry systems, crop-livestock integration systems, soil fertility, and water conservation were investigated and site visits conducted in Africa (Mali, Burkina Faso, Malawi)
- The two case studies identified are: a sequence of USAID-financed agroforestry projects managed by WSU in Malawi and an IFAD financed Special Program for Soil and Water Conservation and Agroforestry in Burkina Faso. Both projects are unusual in that the donors that have sponsored them have been willing to provide support over a considerable number of years – 15 in Burkina Faso and 20 and still counting in Malawi.

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

Data have been collected on the two case studies, but complete drafts have not yet been completed. For the Malawi case, the only obstacle has been a lack of time for writing, but for the Burkina Faso case there has also been an issue with getting collaborators to understand the concept behind the book and how to better report on existing projects.

Key findings include:

- Some agroforestry techniques to build up soil fertility and prevent erosion. These techniques can yield returns that are both substantial and rapid (i.e., profitable within one to three years).
- Farmers more readily adopt new techniques if they feel the researchers and extension agents have properly understood the problems they (the farmers) face and are working with them to find solutions.
- Sometimes this previous point means the project should branch out into new activities that complement its original thrust. In Malawi, the project provides help in small-scale irrigation and natural resource-based income earning activities such as bee keeping and mushroom production that the farmers themselves want.
- The trust between farmers on the one hand and researchers and extension agents on the other develops when the latter are able to continue to work in an area over periods of 10 years or more.
- The implication is that projects are more likely to be successful when both donors and implementing institutions – and the individuals within the latter – are prepared to make long term commitments of finance and time. Where finance is concerned it may mean moderate levels of funding over 10 or more years rather than large amounts for five years or less. While donors often opt for the latter, USAID has taken the latter course with agroforestry research in Malawi.
- Project areas can be defined to coincide with watersheds or other ecologically meaningful areas so that when farmers in those areas improve soil fertility and reduce run-off the effects of each farmer's actions can have a cumulative and mutually reinforcing impact on the area. This approach has been adopted in Malawi where the current USAID-funded project, which was developed by implementing a project team, covers the Chia Lagoon watershed on Lake Malawi. Reduced soil erosion will benefit not only the farmers in the watershed, but the fishermen on the lagoon.

The impacts of these findings depend on the extent to which both donors and implementing agencies put them into practice. As noted under objective 2, success in Malawi has been made possible because of USAID's consistent support over many years. Projects do not always have donors who are this patient, nor are implementing agencies always willing to take the time to learn what their intended beneficiaries really want and then act on this knowledge. However, the current tendency is increasingly to listen more to what the local people have to suggest rather than to bring an apparently good program from the outside.

In addition to the above-mentioned findings for the Malawi project, similar results were found for the IFAD project in Burkina Faso.

- The program generated many positive results. Among the main ones are: (i) an improvement in productive capital (land) for smallholdings; (ii) a 25 percent increase in food crop yields on 20 percent to 30 percent of the land in the 489 villages concerned; (iii) an increase of incomes (FCFA 815 million in benefits derived from micro-credit).
- Food and nutritional security for the households involved rose from 80 percent to 90 percent of yearly coverage;
- The economic situation of women has benefited from the program's voluntarist strategy of support (subsidies and credit) and training;
- The program has also enabled certain techniques to be validated and confirmed in soil and water conservation, agroforestry (assisted natural regeneration), livestock breeding, village water systems, and micro-credit. These techniques can now be replicated on a larger scale;
- On the other hand, the expected positive impact in terms of strengthening social capital and local and collective capacities has not measured up to the investments made; and
- The research and development component has not led to any real innovation in terms of soil fertility, agricultural intensification or reforestation under a medium-term crop settling perspective, in response to farmers' expectations.

Very generally, the principal lessons learned from the 15 years of IFAD program activities in Burkina Faso, which may be applicable to other future projects are as follows:

- It is crucial to prepare an exit strategy for projects or programs to ensure both that achievements are maintained and that the dynamics implemented are pursued and expanded.
- The demand-driven approach should not rule out defining a regional and local strategy for the project. In areas as fundamental as soil and water conservation or agroforestry, if one aspires to achieve clear results in land use management at the regional level, it is essential that a strategy be negotiated on a contractual basis with the communities concerned. This will ensure a measurable approach to economic and technical intervention (with respect to global issues) that is also consistent within the appropriate development unit (a watershed, in the case of soil and water conservation).
- The research and development function remains essential within projects so that the supply of technical services can evolve, but in order to produce the expected results the effort must put forward more pragmatic solutions and be more precise in the financial and economic areas identified by beneficiaries.
- Intensification of agro-pastoral production proposed by the project (land use management, agroforestry, improvements in soil fertility, etc.) must be better integrated with other aspects



of the project in order to maximize synergies. A strategy that seeks complementarities among project components and sometimes concentrates interventions is generally recommended.

**Objective 4:** *Draft synthetic review of the State of the Art and Science.*

The first draft of the farm enterprise-based systems in chapter 3 of the SANREM book was submitted in April and was briefly presented and discussed at the SANREM annual meeting plenary session on April 18. Comments made at the meeting, and others by Keith Moore, are being incorporated into a new draft. The thrust of this chapter is in line with the findings mentioned under Objective 3. Farms, even within a local area, can be so complex and variable that researchers and extension agents cannot hope to always understand all the factors at play. They are more likely to promote higher and more sustained farm productivity if they focus less on bringing innovations to farmers and more on increasing farmers' capacity to make informed choices themselves regarding which innovations to adopt and how best to adapt them to their own needs.

**III. Degree and Non-Degree Training Activities**

No training was planned under this aspect of the project.

**IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products table.

**V. Networking Activities**

Dr Badini participated in the SANREM annual meeting held in Blacksburg from April 18 to 20, 2006. In addition Drs Wyeth and Badini visited Malawi and Burkina Faso consulting with partners regarding the case studies and other collaborative work.

In Burkina Faso, Dr. Badini visited with partners at: INERA (Institut de l'Environnement et de Recherches Agricoles): Drs. Jean Sibiri Zoundi, Babou André Bationo, Robert Zougmoré.

At the Ministry of Agriculture, Water and Halieutic Resources: Lompo Fimba, National Coordinator Soil and Water Conservation and Agroforestry Development Programme; Jacob Ouédraogo National Coordinator Community Investment Programme for Agricultural Fertility (PICOFA).

In Malawi, Dr. Wyeth visited Dr. Trent Bunderson and Mr. Zwide Jere of Total LandCare, a non-governmental organization (NGO) that operates in Malawi, Mozambique, and Tanzania to promote agroforestry and small scale irrigation.

Dr. Wyeth also communicated with Mrs. Elizabeth Manda, Project National Coordinator for IDEAA (Initiative for Development and Equity in African Agriculture), an independent project within Bunda College of Agriculture. The topic was how best to extend to marketing farm products concepts which have been successful in increasing productivity in farmers' fields. He

also met and discussed agroforestry issues with Dr. Henry Phombeya of the Land Resource Center, an autonomous project housed in the Land Resources Conservation Department of the Ministry of Agriculture and Irrigation.

## **VI. Project Impact Highlights**

Projects attain greatest impact when they discard perfectly good ideas in which farmers show no interest and put their effort into facilitating farmer adaptation of innovations that they like.

## ***Watershed System***

**Principle Investigator(s):** Saied Mostaghimi, Virginia Tech

### **I. Executive Summary**

During FY 2006, the Watershed Systems team reviewed the literature concerning the design and implementation of water resource projects in developing countries. Findings were summarized in a chapter for inclusion in a book detailing the landscape systems approach to natural resource management. The chapter has been submitted in draft form for review. Eight case studies were submitted previously and another case study, which reports on the results of a comprehensive long-term study in Zimbabwe, will be submitted before the established deadline.

Key topics from the literature review include:

- erosion and hydrologic processes
- the planning process
- examining land use capacity as a prerequisite to project planning
- use of GIS, remote sensing, and computer modeling in the planning process
- dealing with a lack of data and adapting computational methods for use in developing areas
- the importance of a stakeholder-driven process vs. an agency-driven process  
involvement of ALL stakeholders rather than one particular focus group (such as the poor, women, etc.)
- stakeholder experimentation, evaluation, and adaptation

Some of these topics were very clearly discussed in *Beating Hunger: The Chivi Experience* which describes a sustainability project in Zimbabwe. The new case study was derived from this book.

The main networking opportunity was an authors' meeting on April 19 in Blacksburg, VA. The meeting was held in conjunction with the SANREM annual meeting and allowed the authors to discuss the landscape systems approach and the end product's proposed format, content, and technical vocabulary. In addition, several interactions were made with SANREM investigators from North Carolina, Virginia Tech, and Zambia.

## **II. Research Outputs, Results, and Impacts by Objective**

**Objective 1:** *Review literature reflecting the state of the science in watershed-based systems.*

Dozens of articles were reviewed pertaining to water resource management in developing countries. Twenty-nine of these were incorporated into the watershed systems draft chapter. A total of 15 items were added to the SANREM database during the reporting period. We plan to add more articles to the database during the next quarter. Most of the literature to be included in the chapter has been already reviewed. Additional literature will not be sought until gaps in the draft are identified by the chapter reviewers for which additional information is needed.

No obstacles were encountered and the work is progressing as scheduled.

**Objective 2:** *Identify state of the art projects for case study analysis.*

Eight case studies related to watershed systems were reviewed and included in an Appendix to the first draft of the watershed systems chapter submitted in April 2006. At the April 19 meeting, there was discussion as to whether to have one comprehensive case study that covers all systems or to have separate case studies for each system. Since that time, one additional case study has been identified which fits into the “comprehensive” category:

*Murwira, K., H. Wedgwood, C. Watson, and E. Win, with C. Tawney. 2000. Beating Hunger, The Chivi Experience: A Community-Based Approach to Food Security in Zimbabwe. London, UK. Intermediate Technology Publications, Ltd.*

This decade-long study documents a participatory sustainability project in Zimbabwe. It is the most significant piece of literature reviewed by the watershed systems team and is the only one with enough history for success to begin to be documented. It is hoped that inclusion of this project in the “Case Studies” section of the book will offer inspiration, as well as practical advice to those planning and funding natural resource management projects in developing areas.

This aspect of the project is very well on schedule. A draft of the Chivi project case is ready for submission to the ME. The main limitation is a lack of projects with sufficient history and documentation to analyze their success or failure. In addition, more feedback is needed from project managers and participating authors to make sure we are all in agreement as to the nature and content of the case studies to be included.

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

Please see notes for Objective 2. In addition to the eight case studies that were submitted last April, we have completed one more case study that deals with a comprehensive long-term study in Zimbabwe. A copy of the case study will be submitted to the ME soon.

**Objective 4:** *Draft synthetic review of the state of the art and science.*

The first draft of the watershed systems chapter was submitted in April and was briefly discussed at the SANREM authors' meeting on April 19. A second draft was submitted in August before the original deadline. Results and impacts are unknown due to lack of feedback. We are awaiting feedback from the reviewers and will make the necessary changes as needed. The main obstacles are the lack of feedback on the second draft and the lack of assurance that the end product will be useful to development agents and researchers. It is strongly urged that outside reviewers (such as one of the authors of the Chivi project) be identified to offer suggestions for making the end product useful to the intended audience.

### **III. Degree and Non-Degree Training Activities**

One graduate student is pursuing his Ph.D. and the other an M.S. Both students have been working on the literature review and case study development.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

Other than the draft chapter no other publications were produced from this study this year.

### **V. Networking Activities**

The main networking opportunity was an authors' meeting on April 19 in Blacksburg, VA. The meeting was held in conjunction with the SANREM annual meeting and allowed the authors to discuss format, content, writing style, and technical vocabulary. In addition to interactions with SANREM TC and work plan members, the meeting provided opportunities to work with researchers from North Carolina A and T, assisting them with identifying tools and assessment methods, and from Virginia Tech and Zambia providing guidance on SANREM projects. FY 2006 activities have also included collaboration with the University of Hawaii modeling the effects of agricultural systems on soil erosion and water quality for the Soil Management CRSP.

### **VI. Project Impact Highlights (Bullets):**

Water resource problems are technically and socially complex. The key to solving them is to rely on the ingenuity of the stakeholders to identify strategies that will work for them.

The impacts of this finding are:

- Strategies will be self-perpetuating and locally-appropriate because they are developed and modified by the stakeholders themselves.
- Funding for technical assistance will go where it will do the most good because stakeholders, rather than agencies, will identify where they have need to put technical input to use.

The significance of this finding is that:

- An attitude of partnership needs to replace well-meaning condescension in solving natural resource problems in developing countries.

## **Ecosystems**

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

### **I. Executive Summary**

Several outcomes were produced by Iowa State University within the SANREM CRSP project. The research assistant entered 200 citations into the SANREM CRSP meta-database, 12 projects with elements of ecosystem management approach were evaluated, a field phase for the analysis of three exemplary projects was prepared, and a book chapter on the ecosystem management was drafted for the SANREM book “*Best Practices for Sustainable Agriculture and NRM: The Nested Systems Approach.*” In addition, seven research articles were published, a research assistant was trained, and research relationships were established with three institutions in the U.S. and abroad. The Ecosystem Coordinator led a three week ecosystem study tour to Ghana, West Africa. This involved students from the College of Agriculture at Iowa State University.

### **II. Research Outputs, Results, and Impacts by Objective**

**Objective 1:** *Review of literature reflecting the state of the science.*

*Major tasks completed:* During the period of October 15, 2005 through October 15, 2006, Oleg Stakhanov V. reviewed over 1,300 sources of literature discussing an ecosystem-based approach to natural resource management and 200 relevant citations were entered into the SANREM CRSP meta-database.

*Key research findings:* The evaluation of the literature reviewed during the period covered by this annual report was guided by two primary objectives. First, an attempt was made to identify cutting edge approaches in ecosystems based management. Second, an effort was made to identify relevant literature that discusses the process, principles, and contemporary practices of projects that utilize an ecosystem-based approach to natural resource management.

Findings from the evaluated literature could be categorized into two general groups. The literature tends to agree on the fundamental principles of ecosystem based approach. However, there are apparent differences in the foci of ecosystem management practices in different parts of the world.

First, developed countries put greater emphasis on the restoration and maintenance of ecosystem functions using science-based modeling. Contemporary ecosystem analysis and management practices tend to apply predictive modeling techniques. Such techniques often use integrated knowledge management systems that predict behavior of ecosystems as a result of interventions by stakeholders. Projects in developing countries on the other hand, tend to focus on resolving the conflict between development and conservation agendas using participatory action including collaborative and community-based resource management arrangements as key tools.

*Development impact:* The contribution of the above findings has two dimensions. First, references selected and entered into the SANREM CRSP web-based mega database on

ecosystem based management system will serve as good reference source of ideas, tools, and case studies for ecosystem management practitioners. Second, findings will contribute to the overall research and discussion in the area of ecosystem based approach in development projects. There is an apparent need to balance participatory activities in development projects with wider use of scientific modeling, as well as other enhanced scientific tools of data collection and analysis for effective adaptation of the ecosystem-based approach to natural resource management.

*Project timeline, obstacles and the response to obstacles:* In general, the literature review was carried out within the project timeline. Two minor technical obstacles were encountered. First, an initial restrictive criteria used for the literature search significantly reduced the base of publications for the review. This obstacle was overcome by changing the search criteria. Second, there was a technical problem of uploading resources onto the SANREM database and referencing these resources with internet links in late 2005 and early 2006.

**Objective 2 and 3:** *State of the art projects for case study analysis and case studies characterizing critical SA and NRM system issues.*

*Major tasks completed:* During the period covered in this report, 31 projects throughout the world were reviewed and evaluated according to the criteria of the state of the art projects. Twelve of the projects were closely evaluated for their appropriateness for use as illustrations in the SANREM book “*Best Practices for Sustainable Agriculture and NRM: The Nested Systems Approach*”. Three projects in Uganda and Ghana were selected to be used as state of the art illustrations in the above book. A field evaluation of these projects will be carried out in October-November 2006.

*Abstract key research findings:* The following factors/conditions appear to be contributing to ecosystem management project successes: (a) scientific assessment; (b) interdisciplinary approach; (c) incorporation of socio-economic aspects and public education; (c) effective communication strategies; and (d) use of adaptive management. The most common factors that hinder project implementation are: (a) coordination of stakeholders; (b) interpretation of results of ecosystem analysis; and (c) competing and sometimes conflicting strategies for ecosystem management promoted by different stakeholders.

In addition, several lessons appear to emerge from the analysis of these projects that tend to shape the development agenda: (1) conservation and development agendas are rarely reconciled in such projects due to the lack of ownership of the objectives and processes by all stakeholders; (2) the priority of conservation agenda over the development agenda is a potential threat to the long term sustainability of ecosystem and NRM projects in developing countries; (3) capacity building of all stakeholders in areas critical to the implementation of the project is important to the success of the project; (4) adapting the management strategies to the needs of key stakeholders and to the changes in ecological or human system is critical for the success of the project (adaptive management); and (5) enabling policy framework is a necessity.

*Development impact:* Two types of impacts could be identified. First, the case studies selected for the review will illustrate the rationale and the process behind the decision making in

ecosystem management projects. Practitioners will be able to visualize the entire process of ecosystem-based project design and implementation, while acquiring hands-on experience. Second, the evaluation of the case studies will confirm the need for the further research and identification of effective models of participatory action in ecosystem management projects.

*Project timeline, obstacles, and response to obstacles:* In general, this work was carried out within project timeline. One obstacle was the identification of a prototype for writing case studies for the SANREM book “*Best Practices for Sustainable Agriculture and NRM: The Nested Systems Approach.*” Secondly, evaluation of ecosystem and NRM projects in developing countries suggests that they have evolved from simple resource substitution types of projects towards more integrated ecosystem management projects in the last decade. The main problem, therefore, is insufficient duration of the latter type of projects to evaluate their outcomes in case study analysis. To overcome this problem, the iterative approach to project selection was used. First, potential projects were evaluated from the point of view of their objectives and outcomes. Second, projects were evaluated relative to ecosystem management principles and outcomes. Third, the selected projects were evaluated from the perspectives of ecosystem management processes and outcomes. Three projects will be summarized in the SANREM book “*Best Practices for Sustainable Agriculture and NRM: The Nested Systems Approach*” based on these three stipulations.

**Objective 4:** *Draft synthetic review of the state of the art and science in your system.*

*Major tasks completed:* The substantial review of the first draft of the “Ecosystem and Ecosystem Management” chapter for the SANREM book “*Best Practices for Sustainable Agriculture and NRM: The Nested Systems Approach*” was carried out in May-September 2006 to address the suggestions from previous editing. The chapter now reviews principles, tools, and processes of the development and implementation of projects based on the principles of ecosystem-based management. Arrangements were made for field evaluation of three case studies in Ghana and Uganda in October-November.

*Abstract key research findings:* The analysis of the field phase of the case studies analysis will be completed in November/December 2006.

*Development impact:* The ecosystem management section of the SANREM book “*Best Practices for Sustainable Agriculture and NRM: The Nested Systems Approach*” will serve as a step-by-step guide for the ecosystem management practitioners. This will contribute to the sustainability and effectiveness of the development projects in the future.

### **III. Degree and Non-Degree Training Activities**

During the period covered in this report, research assistant Oleg Stakhanov continued his training in the Pd. D. program in the Sociology Department at Iowa State University.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products table.

Mr. Stakhanov has prepared a conference paper in cooperation with another ISU Sociology Department faculty “*Prospects for Enhancing Livelihoods, Communities and Biodiversity in Africa through Community Based Forest Management: A Critical Analysis*” for the XVI ISA World Congress of Sociology International Sociological Association in Durban, South Africa 23-29 July 2006.

## **V. Networking Activities**

During this reporting period, we strengthened the collaborative relationships that were established during the planning phase of the project. We reinforced relationships with scientists in Ghana, Uganda, and Kenya. New contacts were made at the Kwame Nkrumah University of Science and Technology at Kumasi, Ghana School of mines at Tarkwa, Ghana. We are currently studying the impact of local micro-enterprises (small scale gold mining and local vehicle repair shops) on soil and water quality in Ghana.

## **VI. Project Impact Highlights:**

Deliverables:

- 200 resources on ecosystem approach were identified and added to the SANREM CRSP meta database. This literature will assist development practitioners in the design of more sustainable and effective projects.
- A chapter on Ecosystem-Based Management was drafted. The chapter provides a step-by-step guide for the development and implementation of ecosystem based management projects.
- Seven research articles and conference proceedings were published. These publications will contribute to the discourse on effective models of development.

Research findings:

- The ecosystem approach in developing countries appears to rely primarily on participation and seems to be lacking in science-based ecosystem management. This may partially explain the limited accomplishments of many ecosystem-based development projects; and
- The participatory model that is used in ecosystem based management needs further development to increase the effectiveness of the projects.

## ***Policy/Governance System***

**Principle Investigator(s):** Gerald Shively, Purdue University

### **I. Synopsis**

The system coordinator activities focus on documenting and summarizing the current “state of the science” regarding the ways economic policies and governance influence incentives for



sustainable agriculture and natural resources management. This work is coming to fruition in the form of a book chapter. Information resources have been identified and entered into the SANREM knowledge base. Case study summaries were initiated: one for the Philippines relating tariffs and forest clearing and the other for Egypt on water management. Work has progressed in a manner consistent with the 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. One is currently working on the project. Meta-data entry has taken place and source material is being used for background for the book chapter highlighted below in Objective 4.

**Objective 2:** *Identify state of the art projects for case study analysis.*

A chapter has been developed that highlights 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. It is unclear whether any “state of the art” projects exist at the level of policy/governance, but lessons are being distilled for inclusion in the book.

**Objective 3:** Develop case studies characterizing critical SA and NRM system issues. We identified two 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 plan to add case studies from Africa and Latin America. In all likelihood, these case studies will be developed in the form of side-bars or boxes to be included in the chapter.

**Objective 4:** *Draft review of state of science. This is incorporated in the book chapter, which is currently in its second draft.*

## **III. Degree and Non-Degree Training Activities**

In 2005-06, two Ph.D. students in Agricultural Economics worked on the project. One Ph.D. student in Agricultural Economics is currently working on the project. One M.S. student completed a thesis this year. One M.S. student will complete a thesis in 2007. No non-degree training took place during the year. (For more information, see accompanying table)

## **IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products table. Four new journal articles have been produced and a number of research articles and working papers are in progress.

## **V. Networking**

Networking activities include the following:

1. The PI participated in a wide range of meetings, sessions and events at the World Congress of Environmental and Resource Economists in Kyoto, Japan in July 2006. The PI presented a paper (co-authored with Monica Fisher of Oregon State University) entitled “Agricultural Subsidies and Forest Pressure in Malawi’s *Miombo* Woodlands.”

2. Research collaborations include the World Bank and CATIE (for research in Guatemala, Honduras and Nicaragua), MARS/Masterfoods (for research in Indonesia), and ICRISAT (for research in India).

3. Shively is currently serving as the Editor-in-Chief of the journal *Agricultural Economics*, the journal of the International Association of Agricultural Economists. He is also serving as an Associate Editor of the journal *Environment and Development Economics*.

## **VI. Project Highlights**

In August 2006 Richard Yao, a M.S. student at Purdue University won the American Agricultural Economics Association’s annual award for the Best M.S. Thesis. The thesis was entitled “Impacts of Irrigation Development on Agricultural Productivity, Resource Allocation and Income Distribution: A Longitudinal Analysis from Palawan, the Philippines.” Richard’s research was supervised by Gerald Shively and was partly supported by the SANREM project.

## ***Technology Transfer System***

**Principle Investigator(s):** Devona Bell, Winrock International

### **I. Executive Summary**

The sub-award to Winrock International focuses on developing a knowledge base regarding innovation systems and technology transfer methods for establishing sustainable agriculture and natural resource management practices in the field. Our activities, approach, and the content of the book chapter was presented for discussion and inputs for improvement at the Annual SANREM meeting plenary session on April 18 and the authors’ meeting on April 19 in Blacksburg, VA. Since that time, we have had several iterations of the book chapter and now have a solid framework for developing a complete chapter for the SANREM practitioner’s book: *Innovating for Sustainable Agriculture and Natural Resource Management: The Science of Adaptive Management*.

There have been challenges in meeting the original timeline set out given turnover of the management of the sub-award. In order to deliver a high quality book chapter, Winrock has partnered with Ecoagriculture Partners (EP) to write the innovations systems chapter: *Innovation Systems for Agriculture, Natural Resources and Ecosystem Services*. Ecoagriculture Partners and WI will submit the Innovations Systems chapter by the final chapter submission deadline of January 15, 2007, with a chapter that is fully consistent with, and complementary to, the rest of the book chapters.

## II. Research Outputs, Results, and Impacts 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, WI completed the literature review of transfer technology and innovation systems methods. The literature review is a component of the Innovations Systems chapter.

**Objective 2:** *Case study analysis.*

During the last quarter of FY 2006, WI staff traveled to Bangladesh for an in-depth case study analysis of the Management of Aquatic Ecosystems through Community Husbandry (MACH) project. This case study focuses on the achievements of a community-based wetlands project in Bangladesh that utilizes participatory incentive based approaches to reach its objectives of both improved sustainable resource management and improved livelihoods. The case study is in the final stages of development and anticipated completion is the first quarter of FY 2007.

**Objective 4:** *Draft of the state of the art and science Innovations Systems chapter.*

Winrock has partnered with Ecoagriculture Partners (EP) to write the innovations systems chapter: *Innovation Systems for Agriculture, Natural Resources and Ecosystem Services*. Ecoagriculture Partners in collaboration with WI will submit the Innovations Systems chapter by the final chapter submission deadline of January 15, 2007, with a chapter that is fully consistent with, and complementary to, the rest of the book chapters.

- This chapter sheds light on the question: what are characteristics and capacities of innovation systems that can support the development and management of complex adaptive systems (CAS)? What should innovation systems look like that can facilitate communication, learning, and knowledge generation in these complex environments?
- Our goal is to lay out a framework and recommendations for mobilizing communication and information to support innovation in the management of landscape level CAS. In so doing, we encompass knowledge and information about innovation processes at sub-system levels, particularly the farming system. Our emphasis is on processes of innovation that engage the people who will manage the innovation, and include others who will be affected by it.
- We relate characteristics of the innovation system needed to support landscape level CAS to the past technology transfer approach and associated linear model of knowledge management, to highlight different ways of organizing communication and learning to support innovation.
- We characterize the competencies that are commonly needed to practice communication for innovation in CAS landscapes.
- We identify some specific ways to “get knowledge moving” throughout the landscape, by overcoming common barriers.
- We conclude from the discussion and illustrative cases the types of roles and competencies that are required of facilitators of innovation, and tools and techniques needed to fulfill these requirements.

- Finally, we suggest that the on-going development of methods for supporting innovation is part of an effective innovation system for CAS.

### **III. Degree and Non-Degree Training Activities**

N/A

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

N/A

### **V. Networking Activities**

Devona Bell participated in the SANREM-CRSP annual meeting, the book authors' meeting, and the Technical Committee meeting held in Blacksburg, VA in April. She also traveled to Bangladesh to document the MACH project and met with a multitude of local stakeholders, including USAID-Dhaka.

### **VII. Project Impact Highlights:**

- Understanding how to catalyze and support innovation is a key to the successful management of complex adaptive systems (CAS). Translating research ideas and products into practical innovations, and enhancing the roles of local people in innovation processes are complementary elements of innovation systems.
- Landscape level innovation requires cross-scale, cross-sectorial, cross-disciplinary, multiple level, multiple stakeholder communication and knowledge sharing.
- To stimulate the development of innovative farming practices, marketing strategies, institutions, and policies, and transform their potential into public and private, local and non-local benefits that manifest at landscape level, learning is needed that links the experience and capacities of multiple institutional actors.
- To bring about the communication, learning, and knowledge generation that can sustain innovation, frameworks and tools are needed that can focus the perspectives, objectives, and knowledge resources of multiple actors and stakeholders toward common goals for the landscape, and enhance collective capacities for management.

In sum, to achieve landscape level impact, a multi-faceted approach is needed that integrates economic development, environmental conservation, and governance through social learning and adaptive management. This has implications for the organization of innovation (how innovation systems are organized).



## **Appendix B: Bridging Activity Reports, FY 2006**



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

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

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

### **I. Executive Summary**

This work aimed to bring to fruition several activities initiated in SANREM II, and to provide continuity for ongoing initiatives in what has become a highly visible research program in the region. We had 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 and 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. PI Coxhead (University of Wisconsin) and Co-investigator Bui Dung The (University of Hue) coordinated the collection of commune-level and district level data on land use and aquaculture activity in Central Vietnam, and undertook econometric analysis of the aquaculture area response to prices, as the key indicators of increasing globalization of the industry. This work is now being written up as a manuscript in preparation. An applied general equilibrium model of trade, development policy, resource allocation, and the use of environment and natural resource assets was constructed for Vietnam. It is now in the testing and validation stage at UW and the National Economics University (Hanoi). A training session on the model and software was held in Hanoi, July 2006. The SANREM-funded work became the basis for a successful application for grant funding to the Ford Foundation. A grant for 3.5 years work, starting mid-2006, was issued in February 2006. The draft book on research lessons from the Philippines is almost completion; an authors' meeting in July 2006 assembled a 95 percent complete draft. The completion is scheduled for December 2006.

### **II. Research Outputs, Results, and Impacts by Objective**

1. Policy-oriented research in Vietnam directed at contributing to knowledge regarding globalization, vulnerability, and risk. One focus of our efforts 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 conducted 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 the bridging activity, they continued this work, and undertook parametric and non-parametric analysis of the efficiency of smallholder coffee production, and then extended their methodology to allow cross-country comparisons using data from smallholder coffee farmers in Latin America. In the second strand of this activity, building on the site-specific work, we collected and analyzed secondary data in Thua Thien Hue province. These data cover agricultural land use in lowlands and uplands, and the use of aquaculture area in the ecologically important coastal lagoon, the drainage area for several key rivers covered by the data set. The third strand of this work related 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 constructed a prototype model, validated its structure and data at a workshop in Hanoi (July 2006), and began research with the model as a simulation tool late in 2006.

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 professional, academic, and policy communities of which we are a part. During the bridging activity, we completed a technical volume reviewing a decade of research in the SANREM II Philippine site, the Manupali River watershed (Coxhead and Shively, 2005). We are close to completion of new and additional research lessons from Manupali in a new book authored by Coxhead and Rola. The final manuscript is scheduled for completion in December 2006.

Both Coxhead and Shively presented papers at the Third World Congress of Environmental and Resource Economists (Kyoto, July 2006) based on SANREM-funded work in SE Asia.

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 III knowledge base. Relevant metadata from SANREM II SE Asia were consolidated and supplied to the ME.

### **III. Degree and Non-Degree Training Activities**

See Degree and Non-Degree Training tables.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products table.

## **V. Networking Activities**

The UW team undertook formal and informal training activities, based on seminars and some more technical approaches, at several locations in Vietnam during 2004-06 (Hue University College of Economics; Thai Nguyen University; Hanoi National Economics University).

Papers were presented at international conferences in Kyoto, Japan, and in the U.S. at the Midwest Conference on Development Economics (April 2005, April 2006).

## **VI. Project Impact Highlights (Bullets):**

The Coxhead and Shively volume, *Land Use Changes in Tropical Watersheds: Causes, Consequences and Policy Options* appeared in late 2005. Several other publications from SANREM Phase II also appeared in print.

Additional human resources: Two additional Vietnamese scholars were 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 joined UW in November 2005. Two graduate students from Vietnam were undertaking graduate training at UW by 2006.

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, total about \$25,000. A research proposal based upon SANREM research was submitted to Ford Foundation and funded in February 2006. This grant is for 3.5 years, and a total of \$440,000 to conduct collaborative research and train students on “Globalization, Poverty and the Environment 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).

### **I. Executive Summary**

This report summarizes the accomplishments of the bridging project “Sustainable Land Use and Biodiversity Conservation in the Andes: Scaling-Up SANREM-Andes Research.” The three objectives are: 1. development of watershed visualization tools for LUC modeling and scenario planning, including climate change issues; 2. creating guidelines and methods for biodiversity conservation, especially related to in situ/ex situ complementation and local needs of Andean crops; and 3. delivery of SANREM-Andes data and meta-data for SANREM knowledge base.

LUC/Scenario tools (future visioning, 3-D physical modeling, multisource climate change method) have been disseminated through networking with collaborators in the Andes, publications in books and journals, farmer workshops in Ecuador, and presentations at several international and national conferences. The biodiversity conservation objective, with an emphasis on repatriation of native crops, was facilitated through an institutional agreement between UGA, CIP (International Potato Center), and Asociación Andes (Cuzco, Peru). The partners developed a joint repatriation website, initiated field research in Cusco with communities of the Potato Park, held a seed fair and farmer-gene bank exchange in Ecuador, published numerous publications, and gave presentations at international and national conferences. The SANREM-Andes database in a “toolbox” CD form “People, Land and Resources of Cotacachi, Ecuador” was completed and distributed. The Cotacachi Atlas (El Canton Cotacachi: Espacio and Sociedad) was published and integrated into the Cotacachi Canton environmental information system for policy and planning.

### **II. Research Accomplishments by Objective**

#### **Objective 1: *LUC/Scenario Tools***

The purpose of this objective was to scale-up SANREM-Andes LUC modeling/future planning for Multiple Stakeholder Watershed planning. A special focus is on the human dimensions of climate change. This scaling-up has occurred through the following activities and linkages:

*Major Tasks Completed:* The major tasks outlined in the original proposal were: 1. advise collaborator network and sign MOUs (TMI, CIP, Ecuadorian indigenous organizations); 2. conduct LUC/scenario research on climate change in Cotacachi with participatory workshop in Cayambe; and 3. write-up and disseminate DDS tools through conferences, publications, and video (3-D physical model; future scenarios; multi-source climate change research method). Although continued improvement of products continues, all major tasks have been completed.

*Key Findings:* Field research on human dimension of glacier retreat and climate change in the Andean region was conducted during the bridging research period. This research documents the rapid decline of Andean glaciers, especially those areas below 3500 m msl 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. This drying up of water sources and lack of reform in water allocation has led to conflicts between stakeholders (indigenous communities, former haciendas, urban areas, and floriculturists). A multi-source methodology for study of human dimensions of climate change and social impacts was developed. Participatory workshops were held with local communities in Cotacachi and Cayambe, Ecuador. Farmers and local leaders who attended the workshops defined similarities and differences between Cayambe and Cotacachi. Both regions are starting to suffer considerable water deficiencies due to the loss of the mountain glacier.

#### System Levels:

**Global:** Working with The Mountain Institute (TMI) and their global programs we have been able to extrapolate and begin wider utilization of our SANREM-Andes data and methods, especially for the study of societal impacts of climate change in mountain regions. TMI utilized the future visioning methods in the Cordillera Blanca (Peru) and in the Sagarmatha (Mt. Everest) region of Nepal on human impacts of climate change. Robert Rhoades is now a trustee of TMI, a role which will further expand the application of SANREM research. In addition, Robert Rhoades—along with Jorge Recharte of TMI—is participating in a Global Mountain Initiative (GMA) on Science and Stakeholders to enhance social science input in Andean global change research. SANREM-Andes modeling, participatory methods, and future visioning will be a part of this effort. In addition, Rhoades has participated in the Global Mountain Agenda (GMI) to enhance social science input in Andean global change research. He contributed to the preparation of the document “Global Change and Mountain Regions: Research Strategy,” a strategic planning document for guiding research in mountainous regions.

The Cotacachi research has been globally disseminated through public outreach activities of the Radio Project in conjunction with National Public Radio. SANREM-Andes research was featured in a 15 minute special on “Living on Earth” on April 17, 2006 (see <http://www.loe.org/shows/shows.htm?programID=06-P13-00014#feature5>). Other spin-off programs and web-based stories by the producers of the NPR program have also been released. Earthwatch Radio is in the process of producing a radio program on the Cotacachi glacier to air nationally in the U.S.

**National:** Within Ecuador, our team (R. Rhoades and Xavier Zapata) had considerable interaction with Ing. Bolivar Caceres Correa of the National Glacier Program. The work is largely biophysical and our information on human impacts of climate change, deglaciation, and water loss has broadened the thinking of the national program.

**Local:** Today, in the training headquarters of UNORCAC (Union of Organizations of Peasant and Indigenous Communities of Cotacachi) are housed the 3-D physical model of the region which is used intensively in training. Also, the products of the future scenario work hangs on the

wall. All data has been distributed and is being used in the planning for the Canton. The Atlas and Toolbook CD are integral parts of the cantonal participatory planning process.

*Development Impact:* SANREM information has played a key role in Cotacachi becoming an “ecological canton.” DDS tools, data, information, and publications are used in the Canton for planning. More extensive information on SANREM’s role is found in Rhoades (2006), an edited volume reporting on SANREM research since 1997.

In the U.S., Oglethorpe County, Georgia utilized the Future Visioning Methodology and in its integrated planning effort. Data and text from a report prepared by a graduate class of R. Rhoades was utilized in the appendix to the report.

*Timelines:* The project timelines were met and no major obstacles were encountered.

## **Objective 2: Biodiversity Conservation**

The purpose of this objective was to conduct research to enhance effective policy and scientific guidelines for in situ biodiversity and repatriation of native crops to indigenous communities.

*Major Tasks Completed:* The major activities proposed were: 1. develop collaborative agreements with Peru and Ecuador collaborators; 2. facilitate exchange visits between gene banks and local communities; 3. publish “Recipes for Life” based on Cotacachi research; 4. prepare and publish volume on In Situ conservation and repatriation; and 5. publish guidelines for community gene banks. Although the refinement of products continues, all of these objectives have been met.

*Key Findings:* Institutional linkage between UGA, International Potato Center (CIP), and Association Andes (Peruvian NGO) was established to conduct research on repatriation of Native Andean crops. A repatriation website was developed and evaluated by the partners. Gene bank and community exchanges were completed in Ecuador and facilitated in Peru under the leadership of CIP and Asociación Andes. 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 published by Abya Yala Press in Quito (2006). Copies of the book “Recetas Para la Vida” were distributed in Cotacachi during our last Ecuador trip in June. 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. Virginia Nazarea’s invited paper “Local Knowledge and Memory in the Conservation of Biodiversity” was published in October 2006, in the *Annual Review of Anthropology*, considered to be one of the most prestigious publications in anthropology.

## System Levels

**Global:** In light of the Convention on Biodiversity and increasing concern with intellectual property issues, our research has shed new light on issues surrounding in situ conservation and repatriation of native crops. The research has reached a global audience through publications and presentation in international fora (see presentations and publications).

**National:** Increased flow of germplasm between the Ecuadorian national genebank and indigenous communities has been stimulated through our genebank-local community exchanges.

**Local:** In the Cotacachi region, local informants report an increase in the number of varieties locally planted, as well as recuperation of lost local varieties as a result of the SANREM project.

**Development Impacts:** This objective informs policy, programming, and technologies related to insitu conservation and repatriation.

**Timelines:** The project timelines were met and no major obstacles were encountered.

### **Objective 3: Knowledge Base**

**Tasks Accomplished:** The activities of this objective were: 1. complete the CD "People, Land, and Resources of Cotacachi, Ecuador"; 2. Publish Cotacachi Atlas; and 3. deliver data to SANREM ME. All activities have been accomplished.

**Key Findings:** The activity "Sustainable Mountain Futures: The SANREM Knowledge Base for Cotacachi in Toolbook CD-Rom" is completed with 400 copies of the CD released by Abya Yala of Quito. The toolbook CD presents (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 in an integrated way. The product is user friendly for both policy makers and scientists. The toolbook approach was an effective interaction tool for helping the SANREM-Andes team integrate their data. The CD is in both Spanish and English. Copies of the CD will be sent with the English CABI publication and the Spanish version. Four hundred copies have been produced.

The Natural Resource Atlas of Cotacachi (CD-Rom and hard copy Atlas) entitled *El Canton Cotacachi" Espacio y Sociedad* has been published by Ediguas 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 (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.

The toolbook CD and atlas have been delivered to the ME.

**System Level:** While the SANREM CD on Cotacachi will receive global distribution (along with the project book in Spanish and English), the atlas is mainly for local consumption. Within

Ecuador, the Cotacachi study provided the best documentation on integrated conservation in development in the country and will serve as a model for other projects.

*Development Impact:* Excellent examples for other development projects on how to integrate interdisciplinary data at multiple scales.

*Timelines:* All project timelines were met and no major obstacles were encountered.

### **III. Degree and Non-Degree Training Activities**

One Colombian Ph.D. student (Juana Camacho) began her dissertation with SANREM, but due to illness in the family decided later to do research in Colombia and thus dropped the Peruvian research. 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. Virginia Nazarea fielded a graduate student, Kristine Skarbo, on an NSF Ethnographic Training Grant to work in the Potato Park, Cusco, Peru, from May-August 2006. Although not part of the SANREM-Andes program, Robert Rhoades served as thesis advisor and major professor for Todd Crane who worked in Mali with SANREM-West Africa project in Phase II of SANREM. His dissertation “Changing Times and Changing Ways: Local Knowledge, Political Ecology and Development in the Niger River Inland Delta of Central Mali” was approved and Todd received his PhD in August, 2006.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products table.

### **V. Networking**

Networking has been with the Global Mountain Initiative and The Mountain Institute on using SANREM-Andes methods and tools. Collaboration has been with Asociación Andes (NGO) and International Potato Center on repatriation and in situ conservation in the Andes. Dr. Nazarea was an invited guest speaker at a U.S. 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 developed and disseminated.
- Institutional agreements on repatriation of native crops signed between the International

Potato Center, Asociación Andes (NGO) and the University of Georgia Ethnoecology/Biodiversity Lab.

- First significant research on human dimensions of climate change in the Andes conducted, written up, and published.
- Global alliances for extrapolation of SANREM research developed, especially for mountain areas.
- Research on in situ conservation and repatriation conducted in Peru/Ecuador and genebank-community exchanges arranged.
- Policy guidelines for community gene banking developed and disseminated.
- Project yielded five books, one journal article, five book chapters published, and eight conference presentations.
- Two national radio programs (NPR and Earthwatch radio) developed on SANREM-Andes research



## ***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, Fundación Antisana, Ecuador.

### **I. Executive Summary**

Carried out in the vicinity of Quito, Ecuador, this bridging activity demonstrated the potential for local financing of watershed conservation, through the use of payments for environmental services and other innovative approaches. Household-level surveying required for this study was completed in Paquiestancia (a rural community upstream from the small city of Cayambe and an important source of drinking water in the region) in early 2006. From April to June, survey data were analyzed and a manuscript was submitted for peer-review to *Land Economics*, a leading journal in the field of environmental economics. In addition, research results were shared at a workshop held in Quito on June 26, as well as in meetings with USAID staff and local stakeholders. The terminal date of this project has been extended to November 30, to allow for preparation, printing, and dissemination of the workshop proceedings to key stakeholders in the country.

### **II. Research Outputs, Results, and Impacts by Objective**

The fundamental purpose of this bridging activity was to demonstrate the degree to which watershed conservation can be financed locally – specifically, through the use of PWES 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 the customers of potable water systems would pay (WTP) for the sake of conserving water sources. With concurrence from the Management Entity (ME), this objective was dropped a few months into the project because of political realities in the small city of Cayambe, Ecuador (northeast of Quito), which was the site chosen for WTP estimation. The municipal government of that city had recently raised prices charged for potable water, thereby eliminating all subsidies. To win acceptance of this policy-change, local officials promised a multiple-year moratorium on additional price increases. As a result, they were unenthusiastic about any research, such as ours, that suggested higher prices might be in the offing. Since these officials facilitated our research in various ways, we decided to agree to their request not to ask about WTP.

That left another specific objective of the project having to do with economics, which was to estimate the compensation that people in the upper reaches of drainage basins would accept in

return for altering resource use for the sake of watershed conservation. The sensitivity of this compensation – willingness-to-accept (WTA) – to household-level livelihood strategies was a particular concern of this study.

An additional objective of this project was to identify legal issues associated with the implementation of PWES.

### **Objective 1: WTA Estimation**

A primary contribution of this bridging project has been to produce empirical evidence concerning the linkage between household-level livelihood strategies, on the one hand, and conservation payments, on the other. To be specific, household data collected under the auspices of this project in rural communities close to Cayambe have been used in econometric analysis that has yielded two general lessons.

1. Households that are highly dependent on farming, with very limited non-agricultural earnings, use conservation payments to diversify income-sources. By and large, the payments they demand in exchange for reducing farmed area are relatively low.
2. Households with diversified earnings place a high value on resources that can be harnessed for subsistence production, especially during periods of below-normal, non-farm income. As a result, they demand high payments in exchange for reducing agricultural land use.

These findings, which fall into SANREM's farm-level category, while also having direct implications for the management of watersheds, as well as policy and governance, are reported in a manuscript written by D. Southgate, T. Haab, J. Lundine, and F. Rodríguez, "Responses of Poor, Rural Households in Ecuador and Guatemala to Payments for Environmental Services," which was submitted to *Land Economics* on June 8, 2006. Reviews were received in August, and the manuscript is currently being revised in anticipation of resubmission to the same journal.

The main impact of this research in terms of development is to introduce a note of caution concerning PWES. Some advocates of payments suggest that actual compensation levels need not be very high – generally reflecting average levels of output from land being taken out of production. This standard for determining compensation overlooks the de facto insurance value of resource-access to rural households, and therefore underestimates minimally acceptable levels of conservation payments.

The schedule originally envisioned for data collection was delayed slightly, because of leadership changes in the rural communities where household surveying took place. Once the project was explained, however, data collection was accomplished without any problems. Subsequent analysis and the writing of reports and scholarly papers happened on schedule.

### **Objective 2: Legal Analysis**

Alegría Corral, who received a J.D. from the Catholic University of Quito with a focus on environmental law in 2005, was commissioned to prepare an assessment of laws and regulations

bearing on the use of payments for environmental services (PES) in Ecuador. This assessment, which relates to the “policy and governance” level in the SANREM hierarchy, was completed on time.

One of Dr. Corral’s findings is that constitutional provisions and other legal arrangements related to PES are focused on foreign payments for environmental services of global significance produced in Ecuador. The conclusion is unmistakable. The Ecuadorian state has been much concerned with establishing the institutional framework required for it to profit from the production of these services. In contrast, existing legal arrangements for PES within the country, specifically including PWES, are poorly developed, although legislation on municipalities gives local governments’ wide latitude to employ PWES. Several municipalities have chosen to do exactly that.

Along with the results of economic analysis, Dr. Corral’s report has been used to help guide decisions made by local governments interested in PWES. Among these is the government of Cayambe. Under the auspices of this project, similar policy-dialogue was undertaken with local authorities in Gonzalo Pizarro and other locations.

Dr. Corral presented her findings at the June 26 workshop, which is described in greater detail below, and her written report will be included in the volume of workshop proceedings that will be published in November 2006.

### **III. Degree and Non-Degree Training Activities**

No degree training was provided under the auspices of this project. Non-degree training occurred during a workshop on watershed conservation held in Quito on June 26, 2006 and organized by Fundación Antisana. The program for the workshop is attached. As indicated in the attached table entry, approximately 75 representatives of governmental agencies, NGOs, educational institutions, and other stakeholders participated in this event.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

All publications and presentations are listed in the Publications, Presentations, and Other Products table. All but three of the publications have been provided already to SANREM, accompanying previous quarterly reports. One of the other two is a lessons-learned document (attached) that was completed and submitted on August 1.

The manuscript is currently being revised before resubmission to *Land Economics*, which is a peer-reviewed journal. The other publication is the proceedings of the June 26 workshop, which will be published and distributed by November 30<sup>th</sup>, as made possible by an extension of this bridging project.

### **V. Networking Activities**

Much of the networking that took place in this project occurred in the aforementioned workshop that Fundación Antisana organized in Quito on 26 June 2006. This event – titled “Experiencias de Manejo de Cuencas Hídricas en el Ecuador” (Experiences with Watershed Management in

Ecuador) – was attended by approximately 75 individuals and featured presentations by representatives of various local governments that have implemented, or are implementing, payments for environmental services for the sake of watershed conservation. SANREM investigators Alegría Corral (environmental attorney), Fabián Rodríguez (natural resource specialist), and Douglas Southgate (economist) also made presentations.

In addition, María Helena Jarvis (executive director of Fundación Antisana) and Dr. Southgate met on multiple occasions with the mayor of Cayambe, Dr. Diego Bonifaz. Lessons learned from SANREM-funded bridging project that are relevant to watershed conservation in and around Cayambe were discussed, as were opportunities for implementing PWES. Also, Dr. Southgate made a presentation at USAID on June 30, 2006. The mission's biodiversity strategy was discussed, as were the implications of SANREM-funded research.

## **VI. Project Impact Highlights (Bullets):**

Economic research in the vicinity of Cayambe, Ecuador suggests that rural households that are highly dependent on farming, with very limited non-agricultural earnings, use conservation payments to diversify income-sources. By and large, the conservation payments they demand in exchange for reducing farmed area for the sake of watershed management are relatively low.

The same economic research also indicates that rural households with diversified earnings place a high value on resources that can be harnessed for subsistence production, especially during periods of below-normal non-farm income. As a result, they demand high payments in exchange for reducing agricultural land use.

As in other countries, national legislation in Ecuador about PES largely reflects the desire of the national government to capture international payments for services of global significance produced inside the country. This legislation has little to say about the potential of PES inside the country, including watershed conservation. Nevertheless, local governments are proceeding with PES schemes; making use of the power they have under Ecuador's municipalities' law to safeguard local water-sources.

## ***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. Executive Summary**

The overall goal of this project was to support the SANREM mission of effective knowledge dissemination in the domain of sustainable agriculture and natural resource management. To accomplish this, the objectives were to: a) define a metadata structure for SANREM resources that facilitate access to and dissemination of materials; b) catalog existing SANREM resources generated in the previous project phases; and c) develop a guidance document for those defining and entering the metadata.

The metadata structure has been refined and is stable, with over 1,000 records entered to date by a range of individuals including project personnel, office staff, and SANREM researchers. The guidance manual was revised to clarify data entry with the release of Version 2. The resources referenced on the original UGA SANREM website were cataloged and, of almost 900 resources evaluated, over 400 were identified as having archival value and were entered in the SANREM Knowledge Base (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, was defined and implemented in the SANREM Knowledge-base. The template was revised as the process of entering various types of data records brought new issues to light. For the past year, the template has been stable. Well over 1,000 entries are in the SKB and many now being entered by the intended end users—the SANREM researchers.

**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 and, in most cases, have been copied and stored in the SKB for permanent archival. These resources were screened to identify those of referenceable and archival value, 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 VT database, providing a permanent archive. For resources that cannot be stored in the

SKB due to copyright, format, or availability issues, a permanent reference to access the resource is included. Around 400 resources were selected and cataloged from the UGA website. All records have been entered, reviewed, and “published” as available for public access. The distribution of the types of materials from the previous SANREM phases are as follows:

- 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)

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

A SANREM metadata document was revised based on feedback from this first year of broader use. Version 2 of the document is submitted as the final step of this project requirement.

## **V. Networking Activities**

The background, goals and entry procedures for the SKB were presented to the SANREM partners at the annual SANREM meeting in April. Three undergraduate students received training and contributed to the resource cataloging and review process.

## **VI. Project Impact Highlights**

- A metadata structure has been defined that is effective for cataloging currently available SANREM data and providing a flexible framework for the future.
- The SKB 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. Around 900 resources have been screened, with over 400 selected for entry in the SKB. These resources have been through the final review and “published.”
- A guidance document for entering SKB metadata was developed, revised, and released as Version 2.



**Appendix C: Long-Term Research Activity Reports, FY 2006**





## ***LTR-1: Decentralization Reforms and Property Rights: Potentials and Puzzles for Forest Sustainability and Livelihoods***

Principal Investigators: Elinor Ostrom, Indiana University  
Krister Par Andersson, University of Colorado  
Ruth Meinzen-Dick, CGIAR Systemwide Program on Collective Action and Property Rights (CAPRI)  
Esther Mwangi, CGIAR Systemwide Program on Collective Action and Property Rights (CAPRI)  
Bruce Campbell, Center for International Forestry Research (CIFOR)

Host Countries: Uganda, Kenya, Mexico, Bolivia

### **I. Executive Summary**

In this initial year (from January 1 – September 30, 2006), this project has been able to achieve most of its objectives – particularly the crucial elements of establishing a good organizational structure among eight units located in diverse settings. National Advisory Committees were established and initial meetings held in all four countries (Bolivia, Kenya, Mexico, and Uganda) leading to plans for future research of most direct interest to policy makers in these four countries, as well as the USAID missions in each country. Research in at least one site was completed in all four countries.

The household survey that was developed went through several rounds of pre-testing in Bolivia, Kenya, and Uganda and is being finalized for administration during the second year of the project.

At the first annual meeting of the participating partners of this project (held in June in Bali, Indonesia during the biennial meetings of the International Association for the Study of the Commons), a very interesting plan was presented by Krister Andersson of the University of Colorado for the Mexico Collaborating Research Center (CRC). This would be a large-N nationwide survey of the forest communities in each country. The Mexico CRC agreed to take the lead in developing this survey and has been actively pre-testing the survey this summer. The survey will be adopted as part of this project by the Mexican CRC and the Bolivian CRC. The Kenyan and Ugandan CRC will seek additional funding to add this survey to their research and policy agenda in the future.

In addition, our host country partners conducted extensive training. We trained a total of 89 community members and host country researchers in varying topics, from research methods to tree and soil management. Of these trainees, 39 (or roughly 43 percent) were women. The creation of the NACs in each country established a regular means of networking with key players in forest policy in each country. Host country partners also networked with varied other actors at the local, regional, and state level.

Our most important finding so far is that decentralization policies have widely disparate forms and correspondingly disparate effects on livelihoods and natural resource management. Other findings include a high level of interest on the part of community members and policy makers in acquiring additional tools that will enable policies to work more effectively, and that the IFRI protocol is well-suited to studying the proposed problem statement.

## **II. Research Outputs, Results, and Impacts by Objective**

**Problem Statement:** Decentralization and property rights reform policies formulated at the national level for large geographic domains often fail to account for the complexities involved in land use at the local level, and can thus fall short of their goals of sustainable natural resource management (NRM) and improving local livelihoods.

**Principle project goal:** Improve natural resource policy by developing and disseminating knowledge about the institutional conditions and interactions that will deliver benefits equitably to local people while sustaining natural resources, with particular attention to the gender impact of natural resources policy.

In the interest of general project coordination, we conducted a number of activities during this first nine months of the project. We attended the SANREM annual meeting at Virginia Tech in April. In addition, we held a meeting of all partner organizations in coordination with the biennial conference of the International Association for the Study of Common Property (now the International Association for the Study of the Commons) in Bali in June.

Project partner IFPRI (the International Food Policy Research Institute) held project inception meetings in Kenya and Uganda to review project goals and methods and to identify a national advisory committee. The University of Colorado conducted similar meetings in Mexico and Bolivia.

**Objective 1:** Develop capacity within resource user groups at the selected forest sites to enable differentiated actors (particularly women, the poor, and other marginalized groups) to identify, understand, and participate in forest governance, benefits, and policy processes.

*Describe the major tasks completed:*

IFRI community and household studies -

- The IFRI household survey instrument was developed. The form was pre-tested in Bolivia, Uganda, and Kenya, and comments from field researchers were incorporated into a final form.
- In cooperation with the National Advisory Councils (discussed under Objective #2), project partners selected initial study sites in all four countries.
- IFRI data was collected at the Mabira site in Uganda, two sites within the Yuracare territory in Bolivia, Kakamega in Kenya, and in Ejido El Paso in Mexico.
- Kenya produced a draft post-site visit report for their first site and shared it with the District Forest Officer and the Kenya Wildlife Service. They also held a meeting in the community prior to the site visit that was attended by roughly 50 people (including an area chief and

assistant chief); a similar meeting will take place once the report is finalized to distribute it to the community and to obtain their comments.

- “Resource and recourse” diagrams were completed for the first sites in Kenya and Uganda. Drafts of the diagrams are included in Appendix A.

#### PEN studies -

- Two Poverty Environment Network (PEN) studies have been initiated in Bolivia, one of which will utilize SANREM funds. The second study was made possible because the student conducting the first study was able to obtain external funding, freeing up additional CIFOR funds for a second study. Communities targeted in the first PEN study are: La Mision, Victoria, Galilea, San Marcos, Puerto Chimore, Progreso, Estano Colorado, El Jichi, and TIM Ivirgarzama (which will also be studied using the IFRI protocol).
- Pam Jagger and Marty Luckert of CIFOR met in Uganda in September, and fieldwork on the Uganda PEN study has begun. Field sites for this study are located in the following districts: Kasese, Kabarole, Bundibugyo, Kibale, Hoima (sites in Kibale and Hoima will also be studied using the IFRI protocol) and Masindi. In conjunction with this study, researchers have conducted intensive training, described in detail in the non-degree training table.

#### Project methodology -

- Project partners agreed in part to modify the research methodology as follows. At the June Steering Committee meeting in Bali, partners discussed the concept of a large-n, nationwide survey of forest communities in all four countries. Such a survey would contextualize the data gathered through this project and help policy makers understand the nationwide implications of policy decisions. Because of the timing of this suggestion (which originated in meetings with Latin American National Advisory Councils and other partners), Uganda and Kenya elected not to implement such a survey at this time, and will instead pursue external funding to enable them to conduct the survey in the future. Mexico and Bolivia decided to undertake the survey. As a result of this change, both countries will complete six site visits (instead of the original eight) in the course of the SANREM project.
- In preparation for this change in methodology, our partner in Mexico (UNAM) has initiated the challenging task of devising and pre-testing the survey instrument to be used in Mexico and Bolivia initially (and hopefully in Kenya and Uganda if additional funding is obtained). This will be used in a national survey to gather information about forest communities throughout the country. They expect that the survey will be completed in March 2007.
- In addition to the nationwide survey, Mexico will also document existing public policy programs in Mexico that target forest communities. By comparing the existing policy programs with the results of the survey, we will be able to identify the areas and programs that are in need of policy responses and adjustments.

#### Dissemination -

- Ugandan partners wrote a newspaper article on the role of the Mabira forest in the livelihoods of local communities and the protection of biodiversity
- The Kenyan CRC wrote a brief on the role of community based organizations on the sustainable management of Kakamega forest

*Abstract key research findings:* Uganda partners found that, despite the fact that decentralization

policies are “fully institutionalized” in the area studied, there is no significant involvement in resource management by local communities (governance/policy system level). Further, they found that the forest in the area is so degraded that the government plans to de-gazette it and lease it for sugar-cane growing. Given this, they find that decentralization has had limited impact on the livelihoods of women, the poor, and marginalized groups (farm level). Nevertheless, community members expressed interest in greater participation, specifically in the form of managing a buffer zone around the forest, involvement in increased monitoring and enforcement, and involvement in allocation of licenses for commercial firewood collection.

On the other hand, our Kenya partners had different findings. They found that many community groups are active in NRM, that communities participate in at least some aspects of forest management, and that communities have been able to organize and act collectively (governance/policy level). Despite the absence of policy and legal documents on decentralization, communities have been involved in the management of Kakamega forest (the first study site) in many ways such as free collection of firewood, thatch grass and medicinal plants. They have also been involved in fighting forest fires when these occurred. In addition, many community-based organizations have been formed mainly to provide labor and expertise in ecotourism and scientific research which have been going on for sometime now in the forest. These organizations are now in the process of defining their roles in the emerging scenario where the new forest policy has now legalized community participation in the management of indigenous forests in Kenya. It was further noted that the participation by the community did not include managerial decision making since the forest and the land on which the forests are growing are still government-owned. The issue of tenure and rights of ownership is still important and will require further discussion with the forest authorities since this will eventually affect the extent to which communities can participate in the management of the forest.

This contrast in findings is interesting given that Uganda has been experimenting with “decentralization” for many years, while Kenya has only recently begun to explore it as a method of managing resources.

In Bolivia, where decentralization is deeply ingrained in forest management, researchers found that a previously created forest management plan has not been implemented as planned in the area studied (governance/policy level). Community members, who participated closely in its creation, are very interested in exploring why not.

In Mexico, the decentralization process is different in at least two ways. First, the transfer of governance responsibilities, to the extent that it actually occurs, targets state governments. Second, forest property rights have to a large extent been devolved to local communities (ejidos and indigenous communities) and, as such, it seems reasonable to assume that most Mexican forest communities enjoy a higher level of forest tenure security than do communities in Bolivia, Kenya, or Uganda. This would imply that we would expect Mexican forest user responses to policy actions by the state and federal levels to be quite different than in countries where the property rights structure is more ambiguous for rural communities. This will be an interesting hypothesis to test with data from all four countries, possibly in year two or three of this research project. (Governance/policy level)

*Describe how the research provides development impact following the pathway developed with the TOP Table:* The research team impacted development by implementing extensive training of community members in all four countries related to data collection and research methods. In addition, partners in Uganda conducted skill-building trainings on tree, water, and soil management and on the role of communities in natural resource management. Kenya conducted training addressing leadership, gender analysis, and NRM at the community level. This, along with the contact involved in each site visit and the PEN study, takes steps to accomplish the following practice changes:

- Differentiated actors regularly and actively participate in decision making forums and other interactions within/ between communities, forest agencies, and NGOs
- Local-level rules for forest use and management reflect the needs and preferences of differentiated actors (because of their increased awareness and participation)
- User groups adopt, implement, and sustain forest resource enhancing/conserving practices (e.g., planting trees), including norms and enforceable rules
- Resource user groups have improved decision-making authority over their forests

*Note the extent to which the project timeline is being met, any obstacles encountered, and the actions taken or proposed to respond to obstacles:* Overall, we are meeting the project timeline as expected. One significant delay occurred in completing the household survey form, but this has now been completed and pre-tested, and our partners will proceed with data collection early in year 2.

Also related to the household survey, Mexico has taken the lead in developing the large-n, nationwide forest community survey, and so has been unable to dedicate staff to the household survey as of yet. They will proceed with pre-testing and data collection early in year 2.

In addition, PEN researchers in Bolivia note some difficulty in gaining access to community information. In order to proceed with data collection, researchers went through a long negotiation process with community members. Once the community agreed to allow the researchers to proceed, they encountered additional obstacles in individual households who were frustrated with the detail and length of the questionnaire. While both of these obstacles caused delays, researchers indicate they have managed to maintain good relationships and are still able to proceed with data collection. Kenya researchers echoed these difficulties, with certain households reluctant to share certain information, as well as difficulty gathering detailed income and expenditure information. Further, community members sometimes found the questionnaire to be exceedingly long. We are discussing methods of reducing these frustrations while still gathering meaningful data.

Finally, researchers in both Bolivia and Mexico cite problems with escalating costs as a barrier to completing all tasks proposed. To address this problem, and in recognition of the fact that Mexico is also undertaking the nationwide survey discussed above, we have proposed that both Mexico and Bolivia reduce the number of required sites from eight to six.

**Objective 2:** *Develop capacity within key organizations (esp. government agencies and NGOs) in the forestry sector to understand the impacts of policies on differentiated local actors and to adopt strategies for inclusion of such actors within broader policy processes.*

*Describe the major tasks completed:*

- Tasks described above under Objective 1 are related to community-level data collection support Objective 2 as well. See above for details.
- National Advisory Councils (NACs), made up of key policy makers and practitioners, were formed in each country. The NACs will advise on project implementation, review research results, and translate the findings of the project into real-world policy impacts. Mexico and Bolivia held one meeting of the newly formed NAC; Uganda and Kenya held two. Lists of NAC members and their affiliations are included in Appendix B.
- CRC partners in Kenya were trained in how to complete a “resource and recourse” diagram and a diagram was completed for the first sites in Kenya and Uganda. These drafts were provided to other partners as a template. Drafts of the diagrams are included in Appendix A, and the training is detailed in the non-degree training table.
- We discussed the idea of a nationwide forest community survey with numerous contacts in each country and received positive feedback.
- Uganda conducted training with members of the District Forest Office and the National Forest Authority. Training topics included forest mensuration, communication skills, biodiversity use and monitoring, and methods of increasing awareness of community roles in decentralized forest management.

*Dissemination:* Mexico presented papers on our current and future research activities at two conferences:

- IACS meeting in Bali, Indonesia, June 2006.
- World Bank Meetings on Community Forestry in Mexico, Sept, 2006

*Abstract key research findings:* We are finding through our contacts with the NACs and other organizations that there is a great deal of interest in decentralization policies and their effects in all countries. This initial step helps us to ensure that future research conducted in conjunction with this project will be helpful in addressing important policy questions related to forestry governance in each country. (Governance/policy level)

More specifically, in Mexico, despite the positive disposition of the federal government to hand over governance responsibilities for forestry sector affairs to the states, only one state has agreed to accept these new responsibilities and the corresponding resources. It is the State of Mexico (in the center of the country) that is now formally in charge of governing the processes of harvesting permits, taxation, conservation planning, as well as the monitoring and enforcement of the formal rules and regulations in the sector. Because of these differences in official mandates between states, we intend to draw a significant sample for our large-n study from forest communities in this State. This will enable us to simulate a natural experiment of sorts by comparing measures of cause and consequence related to forest governance in Mexico with the rest of the country. (Governance/policy level)

*Describe how the research provides development impact following the pathway developed with the TOP Table:* The formation and meetings of the NACs have allowed our partners to take steps toward developing capacity within key organizations in the forestry sector to understand the impacts of policies on differentiated local actors. For example, these meetings help make policy

makers aware of and help them utilize and interpret empirical research. They also create greater communication between important players, increasing the likelihood that policies and policy implementation will be compatible and effective.

The research has direct links to policy since key policy makers in the NRM sector in the country are either members of the NAC and/or are directly represented. In Kenya, for example, the research team was accompanied by the Senior Deputy Chief Conservator of Forests to one of the proposed research sites, where he noted the advance status of Indigenous Knowledge systems of the Loita Maasai of Kenya in issues on NRM.

This regularization of contact with key policy makers and practitioners will help us to accomplish the following practice changes:

- Policy makers incorporate local practices and interests in policy design and implementation where these practices are consistent with sustainable forest management and resource conservation;
- Forest agencies implement policies that secure access and rights of differentiated actors to forest resources;
- Policy makers ensure that new policies are communicated clearly and expeditiously to user groups;
- Policy makers refer to empirical research, training and analytical tools;
- Policy makers respond to community demands in a timely and effective manner; and
- Policy makers ensure that diverse groups are represented in decision making at local and national levels.

*Note the extent to which the project timeline is being met, any obstacles encountered, and the actions taken or proposed to respond to obstacles: See delays mentioned under Objective #1.*

In addition, Bolivia's recent political upheaval (in the form of the election of their new president) presented considerable challenges to the team there and forced the delay of the formation and inaugural meeting of the NAC. Nevertheless, CERES (the Bolivian CRC) was able to hold the meeting in August, complete the pre-test of the household survey, conduct an IFRI site visit in two communities, and initiate the PEN survey.

**Objective 3:** *Develop effective monitoring techniques for use by resource user groups and their partners (including NGOs and local-level agencies) at the community level to assess the impacts of decentralization and other property rights reforms on natural resources (including biodiversity) and livelihoods.*

*Describe the major tasks completed:*

- As discussed above, Uganda conducted training with members of the District Forest Office and the National Forest Authority. Training topics included forest mensuration, communication skills, biodiversity use and monitoring, and methods of increasing awareness of community roles in decentralized forest management.
- Uganda also conducted a post-site visit training for community members at the first study site. Attendees expressed interest in being more involved with enforcement and monitoring



- The NACs were formed in all four countries, as discussed above and initial contact made with user groups during the site visits.

*Abstract key research findings:* Beyond observing a genuine interest in becoming involved in monitoring from some of our initial communities (governance/policy level), we have limited research findings related to this objective at this time. We expect to have substantial findings once we complete additional sites and carry out in-depth trainings, particularly those involving multiple communities.

*Describe how the research provides development impact following the pathway developed with the TOP Table:* The formation of the NACs and initial contacts with communities constitute the initial steps toward accomplishing the following practice changes:

- Researchers and policy makers integrate local knowledge and techniques in the design of a community resource monitoring strategy.
- Resource users, forest management agencies and researchers create a regular and reliable mechanism to communicate information on resource condition, threats, etc.
- Resource user communities participate in policy formation and evaluation.
- Improved overall communication with policy-makers.
- Resource user groups commit resources to monitor forests and policies with regularity.

*Note the extent to which the project timeline is being met, any obstacles encountered, and the actions taken or proposed to respond to obstacles:* As much of the work related to monitoring will take place later in the project, we have not yet encountered any obstacles in this respect.

### **III. Degree and Non-Degree Training Activities**

See Degree and Non-Degree Training tables.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products Table.

### **V. Networking Activities**

In all of the sites where SANREM research was initiated during the reporting period, we hold a series of meetings with local stakeholders, primarily community members. At the onset of each site visit, we hold a community-wide meeting in which we present who we are, where we come from and what our research is about. We explain how our research can help improve future decisions about how forests should be managed—decisions made at the community level, as well as at the governmental levels. Participants are invited to participate in our study by helping us map out the community history, the community and forest boundaries, as well as helping us conduct a forest inventory. The latter is often the most popular activity to participate in among community members. In addition to this general IFRI protocol, we have undertaken the following networking activities.

- All four countries formed a NAC and hosted inaugural meetings with this group of policy makers and practitioners involved in forests and natural resource management. These meetings are discussed above under Objective #2. Mexico and Bolivia each held one meeting of the newly formed NAC (as planned); Uganda and Kenya each held two. See Appendix B for more information.
- In the two sites studied in Mexico, a total of eleven community leaders have actively participated in our training, as well as actual field research activities.
- In Bolivia, partners have signed agreements with the Syndicate of Estano Colorado and Progreso, representing two local communities participating in the research.
- A coordination meeting was held with the Kenya USAID mission, which was unable to send a representative to the NAC meeting there. A meeting was also held with the World Bank in Nairobi to discuss coordination of SANREM with the World Bank's new project on forest and watershed management, which will overlap with several SANREM project sites.
- In Bolivia, partners have signed agreements with Jatun Sach'a (another USAID-funded, forestry-related project), with the Union of Municipalities of the Tropic of Cochabamba, and with UNAFOR (the Union of Forest Associations in the Tropic of Cochabamba). Partners are also participating in a newly formed Institute of Forest Research at the University Major de San Simeon and in a network established to advise the Forest Superintendence on the Community Forestry strategy.
- In Uganda, partners met with the National Agricultural Advisory Service to discuss the role of the agency in providing advisory services in the forest sector.

## **VI. Project Impact Highlights:**

Our preliminary findings are as follows.

- The most notable finding to date is that, even within the first study sites, we are seeing decentralization policies that have widely disparate forms and correspondingly disparate effects on livelihoods and natural resource management. In a policy environment where "decentralization" is thrown around liberally as an approach to governance, this is highly instructive, and points to a need for greater attention to detail in implementing such policies.
- We are finding that some users and policy makers are very interested in further training in methods that will enable them to monitor forest conditions more effectively. This will be important in ensuring that involved organizations acquire the tools they need to participate regularly in the policy and governance process.
- The methods that the International Forestry Resources and Institutions (IFRI) research program, developed over more than a decade at the initiation of FAO, have initially proven themselves to be very appropriate and useful for addressing the central questions of this project.

## ***LTR-2: Developing a Participatory Socio-Economic Model for Food Security, Improved Rural Livelihoods, Watershed Management, and Biodiversity Conservation in Southern Africa***

Principal Investigators: Alex Travis, Alfonso Torres, Cornell University  
Dale Lewis Wildlife Conservation Society

Host Country: Zambia

### **I. Executive Summary**

Progress is being made on all objectives described in our proposal. All items listed in the Year 1 scope of work have been started and/or completed as appropriate. Business economic data are being gathered from the regional trading centers to evaluate the potential for economic self-sufficiency. Notable research progress has translated into impact regarding the integration of new technologies into COMACO's activities. For example, the production of value-added food products at the Lundazi Regional Trading Center has been evaluated. Significant details regarding hygiene/safety have been identified and corrected. Large-scale experiments to quantify maximum soil yields over diverse agroecozones and to evaluate the efficacy of different soil amendments have begun. Because of the scope of these efforts, and through partnerships with TSBF and a host-nation organization, the Conservation Farming Unit, these findings should be applicable through much of southern Africa. Extensive data collection has been coupled with significant training of over 500 villagers in methods to improve poultry production. Anecdotal accounts suggest an increase in poultry production of over 50 percent in the trained areas as a result of this research and the implementation of corrective measures. More extensive training of COMACO extension officers as veterinary para-professionals and the set up of a small field laboratory should result in longer-term improvements in diagnostic capability. Our social scientists have evaluated COMACO's extensive survey data, leading to new survey designs. Quantification of COMACO's effects on biodiversity conservation has been greatly improved through the collection of data from control areas (both before/after and within/without). Data analysis in that area is underway and will continue. Additional research expertise in watershed evaluation/monitoring has been identified (Conrad Heatwole, Virginia Tech), and preliminary investigations using satellite imagery have begun in anticipation of "ground-truthing." Numerous miscellaneous items needed to support the research have been purchased and installed. In this regard, a V-sat broad-band satellite internet linkage has improved communications immensely between two of our main sites in Zambia with our researchers in the U.S. Introduction of this represents a "technology leap" for the area, providing an enormous improvement in COMACO's business operations as well. Progress made on all objectives has been above expectations considering the shortened term of the first year, and no significant obstacles have been encountered that will prohibit this progress from continuing in year 2.

## **II. Research Outputs, Results, and Impacts by Objective**

**Objective 1:** *To determine the extent to which the COMACO model can be economically self-sustaining and the effectiveness of the different COMACO model components.*

*Outputs, Results, and Impacts:* MBAs John Fay and Sarah Katt (the latter funded separately through a Cornell grant) have collected data for business assessments and marketing analyses of the regional trading centers (CTCs) and the bush lodges. Additional support in these efforts was provided by a separate team of researchers from the Haas School of Business at the University of California, Berkeley, representing further cost-savings for our work. Initial assumptions regarding produce volume at the Lundazi CTC were found in several cases to be underestimates, leading to a projected shortened horizon to profitability in the absence of confounding factors. These increases in capacity have pointed to new production “bottlenecks” that will limit economic growth potential in the absence of mitigation; however, new food production technologies (described below in Objective 2) should also facilitate both short and long-term improvements in rural incomes as new markets are opened. These research findings have been incorporated into a five-year strategic business plan for COMACO. Our business research team has also recognized that the rapid scaling-up of COMACO activities has exposed new areas where capacity building must take place for COMACO to realize the economic potential offered by these technologies. In particular, training workshops in presentations, marketing, and contract negotiations are critically needed for business expansion.

The second component of our economic research is a cost analysis of biodiversity conservation outcomes. This research will lead to the generation of an “equation” for the costs and benefits of the COMACO conservation model. This work is significantly ahead of schedule in that a student (Samuel Bell) has already been identified, has traveled to Zambia, and begun to collect data. Continuously improving relations with the Zambian Wildlife Authority and partnership with them have opened new data sets to contribute to this analysis. For example, data are being collected on the number of poaching arrests before and during the COMACO intervention, the length of incarceration, and the associated costs. Additional data relevant to this research are being collected from the business analyses (above), the social surveys (described below in Objective 3), and the wildlife population analyses (described below in Objective 4).

*Extent to which project timeline is being met:* All aspects are running on time and, in some respects, are ahead of schedule.

*Obstacles encountered, actions taken and lessons learned:* Data for the different National Parks and ZAWA anti-poaching activities are not centralized and will take time to gather from appropriate regional offices; however, to date, this has not introduced additional variables/sources of delay beyond time.

**Objective 2:** *To identify and integrate new technologies into the COMACO model to improve its profitability, food security, and rural incomes.*

*Outputs, Results, and Impacts:* An evaluation of the production of value-added food products at the Lundazi CTC identified several aspects in need of improvement. These included

implementation of several sanitation measures, changes in the preparation/composition of specific products, changes in production line behaviors and facilities design/management, and use of different product packaging to improve food product safety and lengthen shelf life. COMACO has embraced these suggestions and implemented them, resulting in immediate impact for our activities. A significant increase in production volume has resulted in new restraints on production, particularly with regard to the drying of rice. Potential solutions are currently being explored. By means of this award, COMACO has obtained the ability to make soy milk, and through other funds, COMACO has procured an extruder. This advanced instrument has the potential to make a large number of additional products, including HEPS (high energy protein supplement), which is particularly important for the care of HIV/AIDS patients. Generation of new value-added products for food crops will improve rural incomes and food security, while simultaneously helping public health.

Soil and crop science research is proceeding along two major lines of investigation. In the first, the maximum crop yields are being calculated in different agroecozones in the presence or absence of different soil amendments. In the second, the effects of use of different forms of composting are being compared by COMACO's farmers. This investigation is to be supervised by co-PIs Delve, Lehmann, and Lewis, but is to be led by the District Agricultural Officer, Mr. Ngulube, who we hope can use this research for a Masters thesis. Talks with the University of Zambia to set this up will take place early in year 2 (October 2006).

As one item of cost-sharing, Ms. Erin McDonald, a Cornell veterinary student, received significant additional training from Benjamin Lucio and Beth Buckles in poultry medicine, husbandry, and pathology, enabling her to perform both survey-based and diagnostic research to evaluate historical causes of mortality in different villages. These data were then used to help Ms. McDonald devise a training manual which served as the basis for the training of over 500 villagers (approximately equal numbers of men and women). In addition, she trained six COMACO extension officers to serve as veterinary para-professionals, able to assess clinical signs, evaluate husbandry conditions, and perform simple diagnostic and post mortem procedures. To support these activities, she set up a small laboratory equipped for on-site parasitology and post-mortem animal examination, which is also stocked with necessary consumables, reagents, and reference texts. Based on her research findings, Ms. McDonald has written a series of lab protocols to be used for routine diagnostics expected to be encountered. Training in this area will continue in year 2. Additional support via virtual, "web-based" diagnostics is now available via the V-sat linkage. Digital images can be sent from the field to pathologists and poultry experts at Cornell if unusual pathologies arise. The results of this research will then form the basis for new veterinary and animal science interventions, of which the economic cost-benefits will also be analyzed. Anecdotal information suggests significant decrease in poultry mortality in the short term since this research/training.

*Extent to which project timeline is being met:* We have exceeded our projected timeline.

*Obstacles encountered, actions taken and lessons learned:* Plans to train Zambians in food safety and production at Cornell were altered because of more stringent federal homeland security guidelines. We adapted by planning a year 2 workshop in Zambia to cover these same topics,

while also addressing new opportunities afforded by the extruder. We are currently designing the materials for this training, which is on schedule.

**Objective 3:** *To determine the extent to which the COMACO model provides self-sustaining social institutions and meaningful roles for COMACO participants.*

*Outputs, Results, and Impacts:* Co-PI Eloundou-Enyegue and Zimbabwean graduate student Vongai Kandiwa have evaluated COMACO's extensive survey data, and identified its strengths and weaknesses. Great strengths include their extension network's ability to conduct surveys and enter data and their very positive relationship to the community. Improving survey design and consolidation of new surveys have been identified as the means to improve the utility of future efforts. In this regard, a previously planned COMACO survey was edited by Ms. Kandiwa to improve the ability to interpret future data collected. Preliminary research independent of COMACO (performed by Ms. Kandiwa, making clear that she was not affiliated with COMACO) has not detected overt bias (either conscious or sub-conscious) in the responses of stakeholders to COMACO survey questions regarding broad indicators of well-being including family incomes and food security. Areas of particular attention for future surveys include education and public health.

There has been an impact on COMACO's gender sensitivity as a result of the SANREM annual meeting. At that time, discussion of the effectiveness of gender sensitivity, not just in how information is presented to farmers, but also sensitivity in selection of the trainers and its effect on how information is received by female farmers, made a significant impression resulting in new efforts to diversify COMACO's extension officer pool. These efforts will take place into the future. Further demonstrating attention to gender issues (although non-SANREM funds were used), WCS-Lusaka employee Ruth Nabuyanda was selected to receive intensive, certificate-degree training in development (including community-based projects, proposal writing, etc.).

*Extent to which project timeline is being met:* All work toward this Objective is on time.

*Obstacles encountered, actions taken and lessons learned:* A COMACO officer, Fanwell Hamusonde, has resigned his position to take another job. Therefore, COMACO has another officer working with Vongai Kandiwa to coordinate review of social data.

**Objective 4:** *To determine the extent to which the COMACO model improves biodiversity and watershed conservation.*

*Outputs, Results, and Impacts:* SANREM support has enabled significant additions to be made to COMACO's biodiversity conservation assessments. Aerial censuses have been greatly extended to include new regions. These will not only provide multi-year baseline data in areas where COMACO will be entering, but will also provide comparative control regions where COMACO is not active. Furthermore, expanded censusing will now indicate the effects of poaching on the Lukusuzi National Park, whereas previous censusing only occurred in Game Management Areas. This addition will indicate the effects of human activities beyond buffer zones into protected areas. Finally, our multi-species assessment has continued to expand. Most recently, we have purchased aerial imaging software that allows image linkage and GPS coordination for fine

mapping and counting of riverine animals such as hippopotami and crocodiles. A future focus on ground-based assessments on carnivore populations has been targeted. Data from the most current surveys are being analyzed, but will only become significant in context of several years' time. However, even on a yearly basis, they might suggest regions of continued poaching, as well as potentially revealing unknown threats to the wildlife in the Valley. These data will directly translate into impacts regarding governance, forming a cornerstone for future natural resource management plans involving wildlife and related economic opportunities.

Meetings and workshops with Zambian Wildlife Authority (ZAWA) officials including the Director General have helped contribute to a mutually-beneficial partnership between this government agency and COMACO. As noted above in the economic analysis, this has opened up new sources and types of data. Surveys to collect historical data from reformed "professional" poachers in comparison to farmers who poach as a coping mechanism are being designed and should provide improved understanding of the nature and scope of poaching threats. Because these individuals have already received training in other professional skills, and trust has been established (i.e., they do not fear incarceration for honest historical answers), we hope to gain significant new insights into this unsustainable economic strategy. These data can then be used in other communities in southern Africa that face this problem and can also help identify emerging threats that could be uncovered by future wildlife censuses. For example, loss of a particular species could suggest the re-emergence of poaching done as a coping mechanism or as a profession. Such data would be extremely useful to generate an ecosystem-wide management plan, involving stakeholders including COMACO participants and other villagers, ZAWA, safari hunting concessions, photography-based ecotourism lodges, traditional rulers, and local/regional/federal government.

We have been fortunate to receive additional support to improve our watershed analysis and modeling with the help of Conrad Heatwole (Virginia Tech). "Ground-truthing" to verify the interpretation of satellite imagery will commence in 11/2006. In addition, water run-off and soil erosion will be investigated in context of deforestation and land-use strategies.

*Extent to which project timeline is being met:* This work is progressing as planned in our work scope for this year.

*Obstacles encountered, actions taken, and lessons learned:* Flawed data in a previous survey have led to the removal of one data set from 2004. This has not affected survey design or efficacy, as our goal remains the detection of changes over time, and survey data exist both before and after this year. Previously, COMACO had hired ZAWA officers to perform the survey so that data collection would avoid the appearance of bias. However, different goals and the potential for confusion exist with this kind of approach. An expert in aerial animal counts with considerable experience in Africa (Howard Frederick) has agreed to help our study design and analysis. In addition, we have observed potential seasonal effects from shifts in dates as short as a few weeks. Every effort will be made to better standardize the timing of future surveys.

### **III. Degree and Non-Degree Training Tables**

In addition to training of individuals, we have incorporated lessons from this long-term research project into several different courses at Cornell. These courses are each based in different departments across campus (and across two colleges), showing both the diversity of the project and its broad applicability to issues of sustainable agriculture and natural resource management.

- Veterinary Medicine in Developing Nations (VetMed 615), two hours of lecture and discussion, and 1 hour of a panel discussion
- Environmental Strategies (NTRSE 431), two hours of lecture and discussion
- Environmental and Resource Economics (AEM 250) one hour of lecture

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

Two seminar presentations regarding this long-term project have been presented and extension publication on poultry husbandry prepared.

### **V. Networking Activities**

All researchers and teams of researchers began their work in year 1. Detailed lists of their contacts made can be seen in their trip reports. Summarized for this Annual Report, are two key contacts whose assistance will allow this project to have substantially greater impact.

First, researcher Sam Bell established contact with Edwin Matokwani, Regional Manager of the Zambian Wildlife Authority. Mr. Matokwani gave Sam unlimited access to ZAWA's regional data on the costs and logistical operations of its anti-poaching efforts, among other things. These data will greatly enhance our ability to establish an equation for the overall "cost" of biodiversity conservation through the COMACO model.

Second, researchers Johannes Lehmann, Robert Delve, and Lydiah Gatere have begun to collaborate with Peter Aagard of the Conservation Farming Unit. Dr. Aagard has numerous test plots in regions outside the Luangwa Valley in Zambia. Data obtained from widely divergent agroecozones will enable their findings to be scaled up and out to wide regions of southern Africa.

### **VI. Project Impact Highlights**

#### Poultry:

- Examined current poultry husbandry and veterinary medical practices
- Identified the major causes of poultry morbidity and mortality
- Designed a training manual to assist villagers with poultry production
- Trained over 500 villagers in improved poultry husbandry
- Trained six COMACO extension officers in rudimentary veterinary diagnostics
- Set up a field laboratory at the Mfuwe Community Trading Centre to perform routine veterinary diagnostics (e.g., fecal flotations for parasites, gross post-mortem exams)



*IMPACT:* Statement by COMACO Regional Extension Coordinator that poultry numbers have increased 50 percent over this time last year. This change represents a tremendous increase in available dietary protein and family income, both of which should dramatically lessen the need for bush meat (obtained through poaching).

#### Food Sciences:

- Examined the production practices for rice, honey, peanut butter, and peanut oil
- Identified significant deficits in hygienic food production
- Designed a series of “first step” measures toward safe production of value-added foodstuffs

*IMPACT:* COMACO has embraced the suggested changes in their food production protocols and facilities management. Coupled with current new equipment purchases and continued training in food technology/safety, this will help COMACO establish new food products and wider markets, which are essential for economic self-sufficiency.

#### Supporting Technology:

- Broadband internet access has been established at two locations via satellite linkage

*IMPACT:* This technology leap facilitates future research communications between the field and investigators at Cornell, as well as around the world. It saves innumerable hours of travel and thousands of dollars in fuel costs alone.

#### Biodiversity Conservation:

- Performed first aerial surveys of control regions (Game Management Areas where COMACO is not yet active), as well as coverage of the COMACO core and extended areas.
- Analyzed current and previous survey data

*IMPACT:* Although results will clearly need to be obtained over longer time scales, the integration of data collected from throughout the valley enable an ecosystem-scale natural resource management strategy to be devised. Numerous stakeholders at multiple levels of governance will need to participate. A combined meeting with these stakeholders will be a goal for year 2.

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

Principal Investigator: Jeffrey Alwang, Virginia Tech

Host Countries: Ecuador, Bolivia

### **I. Executive Summary**

During the first year of the project, a number of important activities were undertaken and milestones were passed. Administrative arrangements were completed, regional offices were equipped and opened, personnel were identified and hired, and field research activities commenced. In both sites (Chimbo, Ecuador and Tiraque, Bolivia) comprehensive participatory assessments and planning activities were completed (a draft of the PA for Ecuador is available in Spanish). These activities helped prioritize research, sensitize residents about project objectives and methods, and build political support. A full team of U.S. investigators visited the Chimbo watershed in June, where they collaborated with Ecuadorian and Bolivian counterparts. Problems related to soil retention and productivity, options for higher-valued agriculture, water availability and drinking water quality, market access, and the presence of few alternative income-generating activities were identified. The research agenda was subsequently designed to address these issues. Obstacles to effective local governance and institutional issues were also identified. A comprehensive baseline assessment was designed and started in both sites (both of these survey instruments are now available). The data from this assessment, when available in November-December this year, will provide the basis for subsequent monitoring of project impacts, but are also essential inputs into household and watershed modeling. Data for GIS modeling were assembled and collected in Ecuador; GIS data gathering started in Bolivia. A comprehensive training program was created and degree training begun at U.S., Latin American, and European Universities. Several non-degree training events were also held to build a common base of knowledge among collaborators, sensitize local stakeholders, and build institutional support.

### **II. Research Outputs, Results and Impacts by Objective**

**Objective 1:** *Create options for more effective management of natural resources and sustainable use of natural resources in livelihood activities in Chimbo, Ecuador and Tiraque, Bolivia.*

Livelihood alternatives currently in use at both sites are currently being analyzed (additional analysis requires baseline data which will only be available during year 2 of the project). Existing livelihood patterns were identified through the PA in Ecuador, which was conducted jointly with all the Ecuador partners (INIAP, ECOCIENCIA, ECOPAR, and the State University of Bolivar), the U.S. investigators, and two representatives from Bolivia (PROINPA). The Bolivar provincial government also participated in these activities. Over-dependence on subsistence and low-return agriculture is associated with extreme degradation of the natural resource base. Crop diversity is minimal and non-farm income-generating activities in the area are extremely limited. In Bolivia, the residents of the Tiraque watershed are almost completely

dependent on agriculture, but research themes to analyze potential improvements were identified. Access to markets, information, and new technologies were identified as constraints to improved well-being in both sites.

Soil erosion and soil fertility were identified as major constraints to improved levels of well-being in Chimbo, Ecuador. Research will be conducted on erosion-reduction measures, appropriate tree varieties, and on higher-valued crops and their relationship to profitability and soil loss. Andean Fruits are a distinct possibility at the site in the lower Chimbo watershed (Chillanes). Four research protocols have been designed to address agronomic needs in the watersheds. Bio-products, such as medicinal plants, are a possibility and the SANREM project will look into feasibility and market-related constraints.

Penn State identified high carbon concentrations in the volcanic soils in the upper portion of the Chimbo watershed (between 1800 and 3500 meters of elevation) and will conduct an analysis of the use of the soils as a carbon sink. Soil samples were collected in 22 sites (3 samples per site) in the watershed. This is an area of high erosivity, with slopes averaging 60-70 percent. Analysis to date indicates that natural forest and pasture sites had the highest organic matter, with increased organic matter in the topmost parts of the soil profile. Lowest organic matter content was observed at sites with tree plantations. Soil and plant samples are currently being analyzed at Penn State. The collection sites were geo-referenced and will form a part of the project GIS. Soil compaction and the relationship between land use and soil depth and fertility were also analyzed. More intensive land uses are associated with increased soil degradation.

In Bolivia, six specific research themes were identified: soil-quality enhancements and erosion reduction measures, potential for seed-potato production in the extreme elevations, alternatives for forage sales throughout the watershed, integrated management of the potato crop at the medium and lower elevations, and integrated management of and potential for fava bean seed production. Soil erosion and degradation of the natural resource base are also important constraints. PROINPA has a solid research base on which to build and design agronomic research activities to complement existing information.

A methodology/protocol for biodiversity measurement and monitoring was established in Ecuador. LANDSAT images have been incorporated into the ECOCIENCIA-led GIS and an analysis of changes in vegetation coverage over time will help researchers understand the dynamics of biodiversity in the region. A plan for biodiversity sample collection in the area was established; data collection will begin in the near future. An analysis of stream biodiversity is being undertaken. The extended visit to the region led to the conclusion that non-aquatic biodiversity is limited and that research should examine the impacts of human encroachment on the high plains where the watershed begins. Biodiversity is not a major concern in Tiraque, due to the relative low amounts of biodiversity in the watershed.

**Objective 2:** *Identify, evaluate, introduce and propagate alternative sustainable natural resource-based livelihood strategies*

Participatory appraisals were used to identify livelihood strategies, natural resource bases (inventories), and social and institutional conditions in Chimbo, Ecuador and Tiraque, Bolivia. In

Ecuador, the team conducted semi-structured interviews with key informants; interviews with men, women, and children; transect walks of farms; and discussions with village leaders and government authorities. Group meetings were held in three communities. A draft of the document is now complete. In-country research sites were identified (see below), as were research priorities. In Bolivia, a strong base of information, collected through the PA during project planning and in several PROINPA-led projects helped us identify several promising research activities. In year 1, additional data were collected in Bolivia using the following: a participatory social diagnostic, a review of literature on soil constraints in the area, a review of project experiences in the area, and intensive discussions with local decision makers and stakeholders.

Baseline data are now being collected in Ecuador and Bolivia. The research teams collaborated to prepare a survey instrument, design the sampling methodology, and validate the survey. Enumerators underwent comprehensive training.

The project identified data needs for modeling household livelihood alternatives and incorporated these needs into the survey instrument. Additional data needs were also identified, including cost of production, market access and alternatives, and price/risk information. Methods for collecting this information were designed and implementation will occur during the second and subsequent years of project. The team identified market constraints such as market power, asymmetric information, and high levels of risk—and incorporated analysis of these factors into subsequent research activities. In Ecuador, the markets for dairy products, medicinal plants, and higher-valued Andean fruits were identified as problematic. In Bolivia, a study of the forage market is being conducted in the project's second year. Producers in the upper sections of the watershed haul forage some 30-40 km where they exchange it for animal manure which is then returned to the higher elevations. The economic and environmental impacts of such a system will be studied.

The data needs for the watershed modeling have been completely specified and much of the data are now available in digital form. In both Ecuador and Bolivia, the physical limits of the watersheds were decided upon. A protocol for the project GIS was established: ECOCIENCIA will hold and update the master GIS for the Ecuador site; any spatially referenced data will be added to this master. In Bolivia, PROMIC is assembling the appropriate data bases, with inputs from PROINPA and other sources. Rainfall, soil, and other physical data have been assembled for both Ecuador and Bolivia.

**Objective 3:** *Build social capital, enhance local governance and contribute to economic and social stability in resource-degraded, relatively remote rural areas.*

Because of the vast size of the upper Chimbo watershed in Ecuador, two specific sub-watersheds were identified for modeling, demonstration-experiments, and community involvement—the Illangama River watershed in Upper Guanujo and the Alumbre River sub-watershed in Chillanes. These demonstration plots and additional on-farm research will begin in year 2 of the project. The Tiraque watershed in Bolivia is more compact than the Chimbo in Ecuador, and will be modeled in its entirety. For the purposes of the agronomic research, the Tiraque watershed has

been divided into three zones: one at high elevation (>3800 meters), one at medium (3300-3800 meters), and one at relatively low elevations (3000-3200 meters).

In Ecuador, several sensitization efforts were undertaken to build local support and capacity for watershed management activities (see below). Cooperative agreements with local authorities and other institutions were formalized. A plan for training in watershed management is now complete; partnerships were forged with a number of institutions with experience in this area (the national council of hydrology resources; FAO; and RANDI-RANDI, a well-known NGO with prior SANREM experience).

In Bolivia, several steps were undertaken to build local ownership of the project and thus initiate a process of participatory watershed planning. Meetings were held with local authorities, the mayor and other representatives of government, and several decision-making committees in Tiraque and the surrounding communities. Twelve presentations were made to campesino groups. The feedback from these participants indicates extreme interest in the project and concern for economic, social and environmental sustainability in the area. Training needs for stakeholders were identified.

### **III. Degree and Non-Degree Training Activities**

See Degree and Non-Degree Training tables.

### **IV. Networking activities**

- The Ecuador team conducted a workshop attended by representatives of several projects dealing with sustainable agriculture, watershed management, reforestation activities, biodiversity, etc. This meeting was held in Guaranda, Ecuador on June 30, 2006. Local media, including print, radio, and television covered the event. Several promising connections were made with the Fondo Ecuatoriano Popularum Progressio (a reforestation and watershed management investment fund), Plan International, and other NGOs.
- The Ecuador country team submitted a proposal to the Ecuadorian FUNDACYT (Fundación para la Ciencia y Tecnología) for additional resources related to the SANREM Project in Bolivar. This project was accepted, but the level of funding is not known yet.
- In Bolivar, Ecuador, meetings have been held with local and regional governmental authorities to sensitize people about the project and its goal and to solicit inputs on project structure.
- In Tiraque, Bolivia, meetings were held with local and regional governmental authorities to sensitize people about the project and its goal and to solicit inputs on project structure. Several NGOs working in the area have agreed to support the project.

### **V. Project Impact**

- Findings from the assessment of the soils in Ecuador confirm the importance of the project. The high altitude soils of Alto Guanujo are fairly resistant to erosion and appear

to be tolerating intensifying land use reasonably well; however, the older soils of Chillanes, many on slopes of 100 percent or more (i.e., a slope angle of 45 degrees or more) are suffering disastrous degradation that has already reduced productivity and will destroy the agricultural base of the central watershed within the next two-three decades if unchecked. Soils of this type in this environment should be minimally disturbed and covered with vegetation at all times.

- The participatory assessment in Ecuador found remarkable agreement about the priorities for action in the Chimbo watershed: steps to increase productivity and profitability of agriculture, more diversified income streams on and off the farm, improve capacity to manage water resources, as well as reforestation and the protection of biodiversity.
- It was found that soil organic matter content in the Chimbo watershed generally decreased with increasing altitude, indicating the importance of conserving the soils at lower altitudes since they represent greater carbon sequestration capacity, but also a high risk of degradation due increasing acreage under annual crop cultivation.

## ***LTR-4: Adapting to Change in the Andes: Practices and Strategies to Address Climate and Market Risks in Vulnerable Agro-Ecosystems***

Principal Investigators: Corinne Valdivia and Jere Gilles, University of Missouri

Host Countries: Peru, Bolivia

### **I. Executive Summary**

The research team from Bolivia, Peru and the U.S. met in April to implement the project, and in September to design the field and participatory research. Two research sites were identified in May and collaboration from eight communities in Bolivia and Peru confirmed in June and July. Protocols, which included community participatory assessments and household surveys, were developed, tested, and applied in seven communities located in two municipalities in the Central and Northern Altiplano ecosystems. They recorded baseline information on livelihoods, resources, ecosystem characteristics, and perceived changes. Collaborating communities in Peru were identified through participatory assessments. Instruments that integrate vulnerability, natural resource management, and knowledge, aspirations, skills, attitudes and practices (KASAP) were developed and are being tested. Field experiments were designed to assess practices in soils and pest management in the Bolivian Altiplano, and to measure biodiversity of potatoes. CIPCA was identified as the collaborator to carry out participatory rural appraisals (PRAs) in Apolobamba. The sites were identified and the protocol for assessment developed. Assessments will be carried out in year 2. The climate research included securing data and analysis to describe the climatology of the North and Central Bolivian Altiplano. The major focus this year was Objective 1, development of a shared understanding on the drivers of change. The baseline assessment conducted also provides information for Objective 2 on perceptions, Objective 3 on practices, and Objective 4 on market strategies. Non-degree training focused on Community Participatory Assessment techniques, training of enumerators, and on participatory research methods. Four students were identified for long term training in the U.S. and started in the Fall of 2006. In Bolivia, recruitment of undergraduate students to conduct field research for their *licenciatura* thesis began. Networking with USAID Title II institutions in Bolivia, the Climate Change Program in this country, UNDP and WFP started with their participation in a Stakeholder meeting in April. Collaboration with CIP is currently taking place in climate research, integrated pest management, and impact assessment of rural development projects in the Altiplano of Peru and Bolivia.

### **II. Research Outputs, Results, and Impacts by Objective**

**Objective 1:** *Develop a shared understanding of the ecosystem and the social and economic drivers of change in highland vulnerable communities by identifying measures and indicators of ecosystem and livelihood wellbeing. This objective addresses multiple scales, in order to focus on the interactions, and comprised five activities.*

1. Community, household, and individual livelihoods strategies ex-ante and ex-post.

a. Baseline Assessment of Community Household and Individual Livelihoods and Production Systems.

*Sites:* Two municipalities were chosen based on UNDP high vulnerability ranking, Umala in Central Altiplano, and Ancoraimes in the Northern Altiplano. Communities were contacted, and seven agreed to collaborate in the research. In Umala, participating communities are San Jose Llanga, San Juan Circa, Vinto Coopani, and Kellhuiri. In Ancoraimes, Chichaya, Karkapata, Chojñapata, Cohani, and Calahuancani agreed to cooperate. These represent the ecological conditions of each municipality. Communities vary in altitude from 3,700 to 4,200 m msl.

*Instruments:* A Community Participatory Assessment (CPA) protocol and a household survey were developed and tested in Umala and Ancoraimes. The framework for the participatory assessments developed in Bolivia was shared with co-investigators in Peru, as they developed their instruments. We submitted the protocols to the ME and IRB in June. IRB approval and training of six enumerators happened in July.

*Field Work:* Community meetings to explain the project and time commitment of collaborators took place in June. Household interviews started early August in Umala and Ancoraimes, and ended in mid and late September, respectively. Three hundred and thirty surveys were completed. All household homes have been geo-referenced. The database has been developed and data is being entered. In collaboration with CIP-ALTAGRO, a household survey is being implemented in twelve additional communities in Bolivia and Peru.

b. Participatory Assessments of Sources of Vulnerability:

*Sites:* In Bolivia, the CPA protocol was developed and tested in June. CPAs took place in Umala and Ancoraimes in July and August. The assessments capture climate, market, agricultural production, natural resources, and well-being sources of risk at present and in the past. Maps of community perceptions were developed. CIPCA, our collaborator in Apolobamba, the third site in Bolivia, consulted three communities, one in each the *municipios*, Pelechuco, Curva, and Charazani. All were interest in the project, and were visited in September to develop plans for conducting CPAs. Given the projects objectives the most appropriate *municipios* are Curva and Charazani. Entry into the communities had to be delayed due to a conflict between the *municipios* and the Bolivian government surrounding the management of the protected area. However we were assured by local authorities that this issue will not affect our project. In Peru, six Aymara communities were visited in Puno. Workshops were conducted in August with farmers in Santa María and Huariconse to present the project and to identify/describe the characteristics of their farming systems. As a result, Huariconse decided not to participate. An alternative community (Ayrumas) was identified. Meetings were also held with stakeholders to identify natural resource management problems at the regional level.

*Instruments:* The CPA instrument applied in Umala and Ancoraimes will be used in Apolobamba. This instrument was shared with colleagues at UNALM who developed their participatory assessment instruments. For the assessment in Puno the PASV (participatory



assessment of sources of vulnerability) and the Participatory Natural Resource inventory were conducted.

The community participatory assessments are the first step in the process of identifying changes and generating an exchange of ideas of what is driving change in their environment. These have been completed in all communities and are the basis for discussing the potential practices and strategies to consider in this program. This activity targets Ecosystem and Farm-Household levels.

## 2. Evaluate Past Climate Variability in the Andes.

The primary research questions were identified. A Ph.D student (Jeanne Thibeault) arrived at University of Connecticut (U Conn) and is reviewing background literature and learning about the project and its goals. The computing and data storage needed are now secured, and the U Conn team is now accessing the observational and model datasets needed for analysis. Initial analysis of observational data, gridded .5 degree for comparison with model output is in process. Comparison of the gridded data variability and trends with station data where it is available is ongoing, via discussions with collaborator Magali Garcia at UMSA. The station data analysis being performed at UMSA is the ground truth of the analysis at U Conn. The global model resolution is such that area integrated data is needed for comparison. At UMSA, climate data for the last thirty years was collected from 25 weather stations in the Bolivia Altiplano. Preliminary analysis suggests that there has not been a change in the quantity and distribution of rainfall in this period, but temperatures have been rising significantly. Research continues on this topic. Collaboration in the inter-phase between global and local has been established with CIP and is on-going. This activity aims to explain climate in North and Central Altiplano Ecosystems.

## 3. Assess organic matter under different management regimes and perceptions of soil quality.

Participatory workshops identified soil types and management regimes in seven communities of Ancoraimas and Umala. Soils were sampled in September based on these classifications, and brought to the U.S. for analysis of organic content in year 2. Experiments on soil amendments were designed. These were established in the four communities in Umala and two in Ancoraimas (Chojñapata and Chinchaya). Each plot will have four replications. Treatments consist of control, chemical fertilizer, cow manure, sheep manure, compost, cow manure plus fertilizer, and cow manure plus fertilizer plus residue. While the research is at the field level, the logic of selection aims to describe various production systems.

## 4. Diseases and Pests: Identify major plant pests, diseases and their incidence in recent years.

The CPA and household surveys captured information on perceptions of the problems with pests and diseases and current management practices. These are being prepared for publication. The assessments indicate that the most important problems are the potato weevil and the potato tuber moth in Ancoraimas and Umala. Results from the surveys will be analysed in year two. Field experiments are being designed to analyse differences between communities in one region, and between regions (Central and North Altiplano).

5. Identify production system, climate and biodiversity interactions. CPAs mapping exercises captured the perceptions of community representatives regarding changes in their production systems and natural resources, and used to discuss their ideas of causes for this change. These assessments are being summarized and synthesis will be developed in year two. PROINPA designed two case studies that examine the changes in production systems due to climate change; and designed a research protocol for the management and conservation of native potatoes. The maps developed were geo-referenced.

**Objective 2:** *Understand how livelihood strategies are developed in response to farmer perceptions of the relative risks of these changes and how these perceptions are linked to their assets (livelihoods) by evaluating farmer perceptions of Soil Conditions, Production System Changes, Pests and Diseases, and Climate Risks.*

1. Perceived risks and communication networks: climate, markets, agriculture, and environment. Community Participatory assessments and baseline survey examined risk perceptions and mapped the spatial distribution of these risks. Climate risks and changing climate identified as important risks in the PRA. The baseline survey looks at information sources.

2. Local perceptions of soil quality conditions and changes: participatory workshops in three communities in Ancoraimas and four in Umala. Local soil classifications were identified and sampled.

3. Community perceptions of environmental change: To elicit perceived changes in the environment a Participatory Community Assessment was conducted at each of the selected communities. The assessments will be summarized in year 2. The focus is on woody shrubs as these grow in fallow fields, but have been harvested at increasing rate for fuel and market. Community members were asked if and when changes took place, and what are the causes.

4. Community perceptions of climate change. Community participatory discussions took place in rural communities focusing on perceived changes in the risks related to climate, such as droughts, floods, and frosts. Climate risks were ranked in comparison with other types of risks faced by rural households. Maps were used to physically identify the areas where shocks occur, and determine if any changes have taken place in recent years. This will be compared with 35 years of data collected by the project from 25 weather stations in the Altiplano.

5. Community perceptions of changes in diseases and pests. We have collected community survey information about the perceptions of changes on the most important disease and insect problems in Ancoraimas and Umala and we are summarizing this information for publication. Based on these surveys, we have identified the Andean potato weevil and the potato tuber moth as priorities for participatory research. CPAs indicate that farmers perceive that the potato tuber moth and the potato weevil are more serious problems than in the past. Three field experiments were completely designed for Ancoraimas. Two are related to insect population dynamic, and the last one is based on IPM strategies applied at the community level. In all experiments, topoclimatic data will be collected.

6. Knowledge, perceptions, attitudes, and behavior of community livestock-rangeland-water interaction management and of environmental risk in Puno. Farmers' perceptions of risk were assessed from participatory meetings and workshops to describe knowledge, attitudes, skills, attitudes, and practices (KASAP). Farmers highlighted risks related to rangelands, water, and soil. Results indicate farmers' current perceptions (as compared to past), are that livestock quality has improved, access to agricultural land and rangeland, as well as water, have become more scarce, and soil fertility has decreased. They are interested in increasing cultivated forages. Regarding research impact, this activity was expected to increase the knowledge base and that it would generate aspirations and commitment to engage in similar types of research. The participatory method had to be changed because many women were unable to write things down.

**Objective 3:** *Link local and new knowledge to produce practices and information that provide alternatives for adapting to change. Develop practices (specific interventions in soils, disease and pest management, biodiversity, crop varieties) and dissemination strategies (networks to access new information). This objective addresses field, farm, and ecosystem levels, depending on the practice or knowledge information being developed.*

1. Evaluate the benefits of protecting biodiversity in fallow areas and of alternative tillage and manure strategies. Experiments were designed with local farmers to examine different types of soil amendments designed to improve organic content of soils.

2. On-farm diversification with adapted varieties. PROINPA purchased early maturing quinoa seed for distribution to farmers in Umala. Cooperating farmers identified for the quinoa trials. We also developed a study to evaluate traditional potato varieties and their use in Umala. The varieties will be evaluated by farmer participants and their characteristics will be documented for future reference.

3. Information: GIS applications for predicting farming systems. Analyses begun with CIP of likely range shifts and changes in risk in response to climate change forecasts for two important problems of potato, the potato tuber moth, and potato late blight. Risk maps are being developed for the Altiplano for these two problems that will also be generalized as new pest prediction models become available for application to the Andean potato weevil and other problems.

4. Pest and diseases management strategies. Experiments were designed to evaluate the CIP IPM package in Umala and Ancoraimes. We have initiated farmer participatory experiments in farmers' fields in September to facilitate farmers' evaluations of the impact of integrated pest management approaches for the two pests identified by farmers in Umala and Ancoraimes as most important: Andean potato weevil and the potato tuber moth.

5. Information on climate conditions and forecasts: integrating local and new knowledge. Protocols were designed in September for workshops with producers on climate and climate forecasts. The role of the media in communicating risks related to climate is currently being analysed for Bolivia and Peru. The findings from this analysis will be compared with the perceptions of risk identified by men and women in Umala and Ancoraimes.

6. Information dissemination networks. The baseline survey that was conducted in two municipalities will provide information on current sources of information for markets, climate and technology. The communication of risks through the media analysis is being conducted at MU with assistance of a doctoral student in agricultural economics.

**Objective 4:** *Develop market access through strategies and institutions that contribute to resilience. We define resilience as the ability of people and their environments to recover from shocks and stresses. The systems levels are farm household and market/governance issues.*

1. Market access and participation in the Altiplano. We communicated with MAPA (Market Access and Poverty Alleviation) project director to access the data on household surveys developed for the Altiplano region. Plans were developed for data analysis with UC, and a M.Sc. student from Universidad de los Andes was identified. In coordination with MAPA project and USAID, we will analyse the data to identify factors constraining market participation in Altiplano communities during year 2. With the ALTAGRO-CIP project, a household survey of livelihoods strategies and assets was developed. This is being applied to 600 households in 12 communities of the Altiplano of Peru and Bolivia, and will provide a regional perspective on how livelihoods are shaped by access to capitals and assets, as well as market integration. Data is being collected to analyse existing opportunities, as well as current challenges being experienced. The surveys capture information on shocks, markets and climates, which will lead to understanding the risks, occurrence of events, and impacts in terms of loss of assets.

2. Market assessment for native crops. A protocol was designed to characterize native potato varieties of commercial value in the Umala region. The baseline survey included questions to collect information about the potato varieties currently marketed and those currently consumed in Ancoraimas and Umala. Livelihood strategies currently pursued and the role of indigenous crops in these will be assessed with the household survey data that have been collected.

3. Access to credit. Baseline surveys and the CPAs in Ancoraimas and Umala collected information on current sources of credit used by households in the communities. This will be analysed in year 2.

4. Coalition building for market participation. While this activity will be undertaken in year 2, discussions took place in La Paz about the approach. Jan and Cornelia Flora will provide leadership in this activity both in Peru and Bolivia. We also communicated with CIP Papa Andina to learn their approaches in the *Mesas de Concertación* to develop market linkages between producers and retail markets. This year, we identified a M.Sc. student in Agricultural Economics, from Ecuador, who will be working on a review of the literature on market linkages and participatory approaches, such as the *Mesas de Concertación*. The baseline surveys have collected information on producer associations and market participation in each commodity, as well as the perceptions of households regarding markets and their risks.

The activities completed this year under Objective 4 will provide a baseline on current conditions regarding the role of markets and the market risks faced by farmers, and how they rank these risks, when compared to others they face. Objective 4 activities were not the focus of year 1, but

Objective 1 and 2 activities ensured that we captured the baseline information for markets and perceived risks.

**Objective 5:** *Capacities and Capabilities. Our underlying approach is to share capacities across disciplines, across countries, rural communities, research and development communities, and stakeholders. The approach also leads to identifying mechanisms to increase capabilities, the ability to act, such as coalition building and strengthening networks. The level of this objective is governance, in research and education, as well as in market participation and networks of information.*

1. Team and stakeholder integration – information sharing (out-scaling) – Two meetings took place in April in La Paz, where all the team members from the U.S., Bolivia, and Peru participated. Institutional and research presentations, site visits, and a retreat took place to organize the research activities across sites and countries. A stakeholder meeting was held at the end of four days of meetings. Stakeholders invited included USAID Title II, non-profit organizations working under Title II in Bolivia, the United Nations Development Program (civil society participation and the small grants to communities to support practices to adapt to climate change), and the World Food Programme unit on vulnerability research. Later in the year, we interacted with the Climate Change Program of the Government of Bolivia. We visited with program officers on Economic Growth and Environment in Bolivia and Peru, and with Title II in Bolivia in order to identify areas of collaboration, or where the project could share skills with the Missions. An advisory board to the Bolivia Research Activity Committee (RAC) was created. This board will also provide advice on interacting with stakeholders.

2. Participatory interdisciplinary research: PROINPA and UMSA were responsible for coordinating the Umala and Ancoraimes research sites. We developed the protocol for community participatory assessments jointly to ensure that the approach at each site would be similar. Meetings with community officials and members were held to present the project. Both the CPA and the survey instrument were developed with all team members using as input the findings from the key informant CPA that was held in June. The team members working at both sites participated in the CPA training at both sites, and in the training of the survey. Coordination of this activity was done by UC. In September, a second meeting and field visits took place to coordinate the field research activities, set up field experiments, and the participatory research approach. Agreements with communities and municipalities took place in order to conduct the surveys and establish field experiments in Umala and Ancoraimes. We have developed farmer participatory projects for integrated pest management and soils research in Umala and Ancoraimes

3. Farmer and stakeholder coalitions – Most of this activity starts in year 2. This year C. Flora presented the approach to identify community assets and coalition building. In Peru to prepare for this activity in year 2, three preliminary tasks include: 1. KASAP instrument that includes a section on *social capital and coalition building* (both the survey and workshop protocols) as baseline information; 2. A study group on social capital and coalition building at UNALM with assistance of Prof. Cornelia Flora and Jan Flora as part of their collaboration with the Graduate Level Programs at UNALM; and 3. Researcher, faculty, student and farmer exchanges. Discussions took place in September to plan the coalition building activities for markets in

Bolivia. A M.Sc. student will focus on reviewing the *mesas de concertación* approach, and the participatory market chain approach being used in the Altiplano. This will be further developed in year 2.

### **III. Degree and Non-Degree Training Activities**

*Graduate:* Doctoral and masters students were identified at MU and U Conn. Three female and one male student started their programs this year in the U.S., one during the summer, and the rest during the fall. A doctoral student identified has obtained a Fulbright and will start in fall 2007, or before. UMSA has developed a Master's program on sustainable water management in arid zones. Potential graduate students interested in pursuing a degree in this program will be identified. Two M.S. students are supported through UC, and working on social sciences research. UNALM had a small symposium to identify students for the M.Sc. in Innovation, who would also conduct their research in the project during year 2.

*Undergraduate:* Profiles for student thesis research towards *licenciatura* were developed in September. Candidates have been identified and this should be completed in October. The description of six thesis research projects was developed and students are being identified from the Agronomy Department at UMSA. Two will be working on soils research, two on entomology, and two on biodiversity issues. Students are also being recruited to work on research projects with PROINPA in Umala, and with CIP in Puno.

*Modules:* Faculty from the U.S. will be participating in the teaching of classes in Bolivia and Peru. Planning took place this year between UNALM and ISU to participate in modules taught in the Innovation MSc, as well as discussions between MU and UC for short courses at Universidad de los Andes on agricultural economics and rural sociology topics related to sustainable development. There is interest also from UMSA in supporting the new MSc program in the School of Agriculture.

See attached tables for details.

### **IV. Publications, Presentations, and Other SANREM CRSP Products**

See Publications, Presentations, and Other Products table.

### **V. Networking Activities**

The stakeholders meeting in La Paz included representatives of the World Food Program, UNDP, USAID, Save the Children, Food for the Hungry, and Adventist Development Relief Agency. These groups were informed about our activities and asked for their input. In addition, WFP is providing us access to their data bases on vulnerability in the Altiplano. We have plans to identify areas of research of common interest to both, their unit and our project. We are working with UNDP to identify opportunities to access their funding of small projects for communities in the area of climate change. This will be further pursued in year 2, now that relations have been established with the communities. The UNDP program is especially interested in the Ancoraimas site. We are sharing our baseline instruments with ALTAGRO- CIP

and have assisted in the development of a survey that is being used in their development project. Around 20 communities in Peru and Bolivia will be interviewed. We plan to work together in the analysis of the surveys. We are also working with them to identify communities where ALTAGRO and SANREM will carry out and coordinate activities. ALTAGRO may locate its development project in some of the communities where we are working, which will allow us to leverage funds in sites with limited funding. There are sites, like Puno, Peru and Apolobamba, Bolivia that do not have enough funding for interventions. We are sharing our instruments with USAID Title II non-profits, because they capture the relationships among income increasing practices, environmental impacts, and household well-being. We are in the process of sending these to Save the Children in Bolivia.

We are establishing relationships with the universities in La Paz that have graduate programs in social sciences through Universidad de La Cordillera, and with a university in Puno through UNALM. We are also linking to the Climate Change Program in Bolivia through our colleagues at UMSA working on climate issues. We have also established collaboration between the University of Connecticut, UMSA, and CIP on downscaling to develop local climate forecasts, which goes beyond the activities identified in our proposal. Information on the project was shared with the International Potato Center's ALTAGRO project and the integrated pest management program of Bolivia's National Service of Agricultural Health and Food Safety.

An Agreement of Collaboration with Andean Institute of Science and Ethics (INACET) – associated to the National University of Altiplano (UNA) was developed in Peru. Similar agreements were also developed with other participant communities. An Advisory Committee with UNALM faculty was formed. Stakeholders in Puno including local NGOs and GOs were contacted.

Co-Investigators and students at Kansas State, UMSA and La Molina developed a proposal this year to participate in a seminar with other U.S. universities sponsored by the National Center for Economic Analysis and Synthesis on “Biodiversity, conservation and eco-system services in managed landscapes”.

We have met with the Environment office of the USAID Mission in Bolivia to share information and identify areas in which we can collaborate to strengthen activities in Apolobamba, the third Bolivian research site. We also are in communications with USAID MAPA project and USAID Mission to contribute research analysis of their data, useful to their program and our project. This led to establishment of an advisory board in Bolivia that will advise the Bolivian RAC on networking and stakeholder relationships.

## **VI. Project Impact Highlights (Bullets):**

Community Participatory assessments provide a space for dialogue and co-learning among participants, as a first stage in the impact pathway for Objective 1. This was implemented in ten communities of the Altiplano of Bolivia and Peru. Three hundred and eleven people, farmers and researchers, have participated in this in the last four months of the first year. From this dialogue, in all communities, climate risk was affecting their production systems. Local warming is having a negative impact on livelihoods, as crops that are protein sources like fava beans and quinoa

have been taken out of rotation. Responding to this loss of high protein content crops, the project is helping large numbers of farmers try short season varieties of quinoa in Umala. (Objective 3).

Using the community participatory assessments we have identified the most important plant pests in Ancoraimes and Umala, the potato tuber moth and Andean potato weevil. Relative importance of climate risk is high, especially higher temperatures and lack of water, among all risks identified by farmers. CPAs are a co-learning space where researchers have understood local perceptions and knowledge, such as the local definitions of soil quality (Objective 1).

Farmers perceive alternative high value crops (peas/onions) as a better way for them to increase food security, which was not considered in the original project design. This poses a question to the researchers (what is the role of these high value crops on existing biodiversity?) and a challenge (to identify market linkages to high income markets to value native varieties, often reaching low income elasticity markets where they face low prices).

We have reviewed and synthesized the most important observed and potential effects of climate change on plant disease risk (Garrett et al., 2006a), the potential for using new genomic tools for disease management (Garrett et al., 2006b), and sustainable responses to emerging diseases (Garrett and Cox, in press). We have reviewed the current status and needs for improvement in management of potato late blight in the developing world (Forbes et al., in review). This review provides researchers with perspective on how potato late blight management strategies must be adapted in tropical areas compared to the more common temperate studies.

Mutual learning between researchers and participants on natural resources use and management in Peru's Altiplano has begun at different levels: institutional, community, household, and individual. Collaborative interdisciplinary research involving agrarian and natural sciences with emphasis on cultural aspects, and based on a bottom-up approach, began with participation of members from both Universidad Nacional Agraria La Molina and Univ. Nacional del Altiplano (UNA) in Puno.

We established a stakeholder network in Bolivia, which will advise on uptake pathways and scaling up the research outputs both at the community level, and at the policy level.

Our integrated approach of livelihoods, assets, and biodiversity was shared with CIP ALTAGRO and was implemented in Puno (400 families surveyed) and Bolivia (200 families) in thirty communities of Peru and twenty in Bolivia. This broadens our analysis of livelihood strategies in a greater Altiplano region using a standardized approach.



## ***LTR-5: Agroforestry and Sustainable Vegetable Production in Southeast Asian Watersheds***

Principal Investigator: Manuel Reyes, North Carolina Agricultural and Technical State University

Host Countries: Indonesia, Philippines, Vietnam

### **I. Executive Summary:**

The SANREM CRSP project in South East Asia (SEA), Technology, Markets, Policy, Environment, Gender and Scaling (TMPEGS) completed several logistical tasks like: voting on country and theme coordinators, work-plans, budget, contracts; preparations, presentations, and attendance to several kick-off meetings; and site visits and selection. A village, Ngia Trung commune, Bu Dang District, Binh Phuoc Province was chosen by TMPEGS-Vietnam; three villages, Parkan Muncang, Sukaluyu, and Hambang, Nanggung Sub-district, Bogor, was chosen by TMPEGS-Indonesia; and a village, Sungco, Lantapan, Bukidnon was chosen by TMPEGS-Philippines. The Vietnamese site can be characterized as predominant perennial (tree) crops; the Indonesian site is a mix between perennial tree and annual (rice and vegetable) crops; and the Philippines site is a predominant annual (vegetable) crops.

From the participation of several stakeholders, specially the small scale farmers both women and men (SSFWM), the following were observed by TMPEGS: For the Technology objective, all countries concluded that VAF maybe a potentially beneficial practice to improve SSFWM quality of life. Proper vegetable production methods have good prospects of increasing SSFWM incomes in Indonesia and the Philippines whereas, for Vietnam, vegetables are useful to improve health of SSFWM through better nutrition. Introduction of improved and indigenous vegetables, drip irrigation, and integrated pest management are technologies that may improve vegetable and tree production. No-tillage may be useful in Indonesia and the Philippines, but may not be applicable for Vietnam. A “no tillage human powered” equipment was designed and a prototype has been fabricated and tested. Initial prototype tests look promising. For the Marketing objective, rapid market assessments were conducted in all countries. Indonesian and Philippine collaborators identified several common vegetable species grown by SSFWM that have good potentials for income generation while Vietnamese collaborators found that vegetables are rarely grown by villagers. For the Policy objective, initial Vietnamese results revealed that there are important benefit-sharing and credit policies that may impact VAF farming systems. Philippine collaborators were successful in convincing local legislators in the municipality to enact policies that will be pro-SSFWM and pro-VAF. For the Environmental and socio-economic impact objective, a socio-economic household baseline survey and a research report were completed in Indonesia. The Vietnamese team finished the socio-economic baseline and nutrient survey, while the Philippine collaborators completed the survey questionnaire. The Indonesian team reported on demographic and farm characteristics, household income and expenditures, and labor availability for their three villages. Vietnamese collaborators completed the baseline survey while the Philippine team designed a baseline survey questionnaire. For the Gender objective,

the Indonesian and Philippine teams have interesting but opposite results. In Indonesia, the role of women in agriculture is limited to production activities, whereas in the Philippines, women and men have equal responsibilities and roles in agricultural production and marketing. Lastly, for the Scaling-up objective, Indonesia completed a comprehensive vegetable manual in Bahasa, while Philippine collaborators completed a questionnaire and training needs analysis instrument.

## **II. Research Outputs, Results, and Impacts by Objective:**

**Objective 1 on Technology:** *Develop economically viable and ecologically-sound vegetable-agroforestry systems. (Co-Coordinator: Dr. Manuel Palada, AVRDC-WVC and Dr. Agustin Mercado, ICRAF-WAC)*

*Major Tasks Completed:* (a) A comprehensive baseline survey questionnaire was developed by TMPEGS-Vietnam ('V'), TMPEGS-Indonesia ('I'), and TMPEGS-Philippines ('P') on vegetable priority species, current practices and species management improvement in agroforestry system. 'I' completed the survey and submitted a report, 'V' completed the survey, and 'P' will complete the survey by November. 'V' also completed a nutritional household survey. (b) Focus group participatory discussions with stakeholders especially with small scale farmers both women and men (SSFWM) about Vegetable agroforestry (VAF), Introduction of indigenous or new vegetables, Drip irrigation, Integrated pest management, and No-tillage (VIDIN) technologies were conducted by 'V', 'I', and 'P'. (c) 'V', 'I' and 'P' successfully negotiated with local farmers for VIDIN experiments to be conducted in their field. (d) VAF experiments began at experimental research stations in AVRDC-Taiwan, in 'I' (Bogor Agricultural Experiment Station), in 'V' (Southern Forest Research Sub-Institute), and in 'P' (ICRAF-Philippines). (e) 'V', 'I', and 'P' designed different types of farmer-based VAF experiments for year 2. (f) 'P' designed, fabricated and preliminary tested a no-till equipment prototype; and collected data needed for drip design and soil and water assessment tool modeling.

*Key Research Findings:* (a) Vegetable AgroForestry (VAF) studies: 'V', 'I', and 'P' stakeholders especially SSFWM agreed that VAF maybe an option to improve their livelihood. 'V' found that most SSFWM have cashew trees and vegetables are not abundant on the site. Integration of vegetables with cashew trees may benefit SSFWM and will be useful for home consumption to improve SSFWM nutrition and for soil conservation. In addition, 'V' will also integrate cacao with cashew. 'I' found a mix of land uses. VAF through 'kebuns' (small gardens) are common on the site. 'P' has several SSFWM growing vegetables for local markets and introduction of trees may provide long term benefits to SSFWM. (b) Introduction of indigenous or new vegetables: 'V', 'I', and 'P' identified current vegetables and trees produced by SSFWM. All countries concluded that evaluation of shade tolerant vegetables and vegetable trees are needed. Furthermore, all countries identified an extensive list of current vegetables and trees produced by SSFWM. (c) Drip irrigation: 'V', 'I', and 'P' identified drip irrigation may be a possible solution to alleviate water competition between trees and vegetables, and improve water use efficiency, and improve vegetable yield and quality. Cost effectiveness of drip technology needs to be studied as well. (d) Integrated Pest Management (IPM): all countries identified a need for IPM since vegetables require extensive pesticide use. 'I' conducted a participatory appraisal of their pests which enabled 'I' to plan for research trials for year 2. 'V' identified that cashew worm

and termites are serious pests and recommended to do IPM work on this instead of doing minimum tillage study. Note in the proposal only 'I' provided budget for IPM. (e) No-tillage: 'P' conducted a preliminary test of a human powered no-tillage equipment prototype and recommended some modifications to improve it. The test showed good prospects for the equipment. 'P' also found that 'Syngenta', a private company, is studying no-till corn at the 'P' site, with two farmers agreeing to conduct a no-till vegetable study in their farms. 'V' concluded that no-tillage may not impact the 'V' site and recommended to shift the funds to conduct an IPM study. (g) Other technology: 'I' stakeholders requested fertilizer recommendations be prepared for several vegetables and 'I' will do this for SSFWM.

*System Level:* Farm and Field.

*Development Impact Following Pathway with the TOP Table:* All Knowledge, Attitudes, Skills, Aspirations, and Capabilities (KASAC) listed in 'TOP-Technology' are being impacted by year 1 tasks in various degrees. For example, SSFWM in VIP saw the need to study the cause and effect relations of soil, light, and water competition between trees and vegetables (K). Attitudes on ancestral crops and cropping practices about VAF are renewed (A). Experiments on VAF are adapted to introduce or improve SSFWM skills in VAF (S). SSFWM aspirations for stable income by practicing sound soil and water conservation through VAF is being nurtured (A). Access of SSFWM to high yielding or indigenous tree and vegetable cultivars is being commenced or enhanced (C). These KASAC changes will lead to improved soil and water conservation, and increase yield, income, and nutrition.

*Extent to Which Project Timeline is Met, Obstacles Encountered and Actions Proposed to Respond to Obstacles:* Most project timelines were met, but, because of a six-month delay in fund release, 'V' could not complete analysis of base line survey. The major obstacle was the very late release of project funds. The solutions were: (a) host country institutions used their own funds, but those funds were insufficient for them to complete all year 1 tasks; (b) VT granted carry-over of year 1 funds and insured that year 2 contracts were out by first week of September 2006; and (c) NC A and T will expedite year 2 contracts and release of advance funds to host country partners. Another obstacle was 'P' concluded during proposal writing that there was no need for a 'P' baseline study because of previous studies conducted in SANREM I and II and by ICRAF-Philippines. However, last March 'P' identified this need. The solution was to reallocate project funds and identify an additional partner. Hence, 'P' baseline survey will start in year 2.

**Objective 2** on Marketing: *Develop a market value chain at the local, regional, and national levels that builds upon existing marketing strategies (Coordinator: Mubarik Ali, AVRDC-WVC).*

*Major Tasks Completed:* (a) A comprehensive market baseline survey questionnaire was developed by 'V', 'I, and 'P'. 'I' completed the survey and submitted a report, 'V' completed the survey, and 'P' will complete the survey by November. (b) Rapid Market Assessment (RMA) was conducted by all countries. 'I' completed a report, and 'P' reported preliminary findings. (c) 'P' collected 82 published and gray literatures about marketing with 79 percent of the materials coming from the Philippines. (d) 'I' conducted an informal mini training on general marketing issues and its impact will be analyzed in year 2.

*Key Research Findings:* (a) 'I' and 'P' identified vegetable species usually planted by SSFWM. In 'V' most of the area is planted with perennial crops, hence very little vegetables are grown by SSFWM. (b) 'I' identified potential indigenous vegetable species that are marketable and can be grown under trees. (c) 'V' concluded that it is not economically feasible for SSFWM to pursue commercial vegetable production because of very small land sizes, full shading by perennial cashew trees, and competition from 'Dalat', a large commercial vegetable producing area 'excellent' quality vegetables in the highland. Hence, the focus of market studies will be on cashew and cacao, and the integration of vegetables will be for home consumption to improve SSFWM nutritional diet. 'I' found that SSFWM grow vegetables on small area in dry land and in small gardens, and that it may be economically feasible for SSFWM to produce vegetables for commercial markets. SSFWM may sell their vegetables in Bogor and Jakarta. 'P' observed that SSFWM grow vegetables primarily for the market and allocate almost entire farms to this purpose and have good marketing outlets. Trees are hardly grown for commercial purposes. (d) 'I' and 'P' both reported vegetable marketing practices, market channels, and marketing concerns and problems of SSFWM. There are similarities like both have the inability to demand reasonable prices for their vegetables, and differences as well, like 'I'-SSFWM plant only in a relatively small scale compared with 'P'-SSFWM, hence skills in grading, sorting, and quality control for 'P'-SSFWM may be relatively better than 'I'-SSFWM, which impact the quantity and quality of vegetables sold.

*System Level: Governance/Policy*

*Development Impact Following Pathway with the TOP Table:* RMA study indicated that Markets needs significant intervention to empower SSFWM. To meet Market-KASAC, TMPEGS need to conduct training to improve post harvest handling and storage of VAF products, facilitate organization of SSFWM cooperatives, and identify better market chains.

*Extent to Which Project Timeline is Met, Obstacles Encountered, and Actions Proposed to Respond to Obstacles:* Most project timelines were met, but, because of a six month delay in fund release, 'V' could not complete analysis of RMA, and 'P' did only preliminary analysis of RMA survey. The major obstacle was the very late release of project funds. The solutions were: (a) host country institutions used their own funds but those funds were insufficient for them to complete all year 1 tasks. (b) VT granted carry-over of year 1 funds and insured that year 2 contracts were out by first week of September 2006. (c) NC A and T will expedite year 2 contracts and release of advance funds to host country partners.

**Objective 3** on Policy: *Identify policy options and institutional frameworks that promote sustainability of vegetable-agroforestry production and reward environmental services (Coordinator: Delia Catacutan, ICRAF-WAC).*

*Major Tasks Completed:* 'V' compiled about seven documents on government policies and regulation relating to forestry sectors. 'P' met with the mayor and officials of Lantapan; conducted round table discussion with policy stakeholders; compiled and analyzed municipal laws related to VAF system, facilitated the agreement by local policy makers to legislate pro-SSFWM policies for VAF, through a comprehensive natural resources management strategy and investment plan; and compiled extensive national policy documents specific to tree farming and

vegetable production. 'I' is not conducting policy research. In the proposal 'V' and 'P' committed to 'Policy' research. 'I' opted not to.

*Key Research Findings:* 'V' initial results revealed that there are important benefit-sharing and credit policies in the forestry sector that have important implications to the research on VAF farming systems. 'P' found that there were no specific policies that promote vegetable production and tree farming and reported that local legislators were regretful of this gap since Lantapan is known as the vegetable basket of the region and legislators will work to enact such policy. Furthermore, 'P' concluded that many national policies are more applicable to large holders and agribusiness companies with very little benefit to SSFWM. Lastly, 'P' reported that many national policies are ineffective unless local governments submit to localize such policies, which implies the important of pro-active policies at the local level.

#### *System Level: Policy/Governance*

*Development Impact Following Pathway with the TOP Table:* From studies conducted by 'P' and 'V', policies have been identified that will impact SSFWM. Local legislators in 'P' realized the policy gap for VAF systems (K), regretted the 'gap' and agreed to legislate local policy beneficial to VAF-SSFWM (A), applied their training in policy analysis and planning (S), saw that Lantapan must set the example on proper VAF-SSFWM incentives (A), and if policy gets enacted will provide VAF-SSFWM incentive for the site (C). The above illustrates how the 'policy' tasks accomplished in year 1 follow the TOP table impact pathway.

*Extent to Which Project Timeline is Met, Obstacles Encountered and Actions Proposed to Respond to Obstacles:* Most project timelines were met, but, because of a six month delay in fund release, 'V' could not complete analysis of literature gathered on policy. The major obstacle was the very late release of project funds. The solutions were: (a) host country institutions used their own funds but those funds were insufficient for them to complete all year 1 tasks. (b) VT granted carry-over of year 1 funds and insured that year 2 contracts were out by first week of September 2006. (c) NC A and T will expedite year 2 contracts and release of advance funds to host country partners.

**Objective 4** on Environmental and Socio-Economic Impact: *Assess the short and long-term environmental and socio-economic impacts for farm families adopting integrated vegetable-agroforestry systems. (Co-Coordinator: Robin Marsh, UC-Berkeley and Victor Ella, UPLB).*

*Major Tasks Completed:* (a) A household survey method and questionnaire were thoroughly reviewed and discussed by several TMPEGS scientists with coordination by country coordinators and Robin Marsh. (b) A comprehensive socio-economic baseline survey questionnaire was developed by 'V', 'I', and 'P'. (c) 'V' and 'I' administered the socio-economic survey. (d) 'I' completed a well-analyzed socio-economic research report of the three villages they surveyed. (e) 'P' started gathering parameters for the Soil and Water Assessment Tool Model.

*Key Research Findings:* (a) 'V' initial results showed that cashew is the major cash crop in the area and planted mainly as a monoculture. Only a very small portion is planted with annual

crops. Hence, the Manupali Model (MM) which was the initial model identified to be used in the proposal, may not be the appropriate socio-economic model to be used in the site. MM deals with crop choices and SSFWM could not and will not replace cashew. (b) 'I' completed an extensive socio-economic baseline study of three villages in Kecamatan, Nanggung and reported that: (i) Kecamatan has relatively good accessibility to lucrative urban centers in Jakarta and Bogor, endowed with rich mineral and forest resources and an ideal climate for agricultural development; (ii) farmers in Kecamatan are primarily SSFWM who are on or below the poverty line with very limited market linkages and technical assistance. (c) 'I' also reported on demographic data, farm characteristics, household income and expenditure, gender role, and labor availability.

*System Level:* Farm household/enterprise and watershed

*Development Impact Following Pathway with the TOP Table:* Various socio-economic baseline data were gathered at VIP. When fully completed, these data are essential to assess: (i) what VAF experiments to conduct, (ii) existing values of SSFWM on VAF and soil and water conservation, (iii) skills and training for SSFWM on VAF, (iv) ambitions or dreams of SSFWM and how relates to VAF, and (v) power or lack thereof of SSFWM to adopt VAF or soil and water conservation technologies. This assessment is necessary in knowing what VAF will do for farm families who adopted it. Will VAF improve their short and long term socio-economic and environmental condition?

*Extent to Which Project Timeline is Met, Obstacles Encountered, and Actions Proposed to Respond to Obstacles:* Most project timelines were met, but, because of a six month delay in fund release, 'V' could not complete analysis of base line survey. The major obstacle was the very late release of project funds and 'P' concluded during proposal writing that there was no need for a 'P' baseline study because of previous studies conducted in the site. The actions proposed or done to respond to obstacles were discussed in Objective 1.

**Objective 5 on Gender:** *Provide mechanisms to ensure women's involvement in decision-making and sustainable production and marketing practices to improve their socioeconomic wellbeing within the vegetable-agroforestry system (Coordinator: Ma. Elena Chiong-Javier, DLSU)*

*Major Tasks Completed:* (a) A comprehensive gender baseline survey questionnaire was developed by 'V', 'I', and 'P'. (b) 'V', 'I', and 'P' collected important information needed for gender analysis and for identifying women's role in farming and marketing. (c) 'V' and 'I' completed the Gender baseline survey, (d) 'P' gathered literature on organization, women and narrative research, a professorial lecture on "Women's Role in Agricultural Production and its Health Consequences," and a completed M.Sc. thesis on multiple roles of women in Songco Village.

*Key Research Findings:* (a) 'I' concluded that women's involvement in agriculture is limited to certain activities like nursery care, maintenance and fertilization, and harvesting. Involvement of women is dependent on whether the household can afford to hire labor. Furthermore, gender's role is probably restricted by socio-cultural factor with expenditures for agricultural inputs mostly the domain of men. Lastly, it is very difficult for women to make decisions on how

money is spent. (b) 'P' preliminary results were opposite of 'I'. 'P' reported that in majority of cases women alone handled crop or seed selection, setting aside of planting materials for next cropping cycle, growing of subsistence crops in a separate plot, preparing lunch and fetching water. Women have a big role in weeding and crop care, purchasing of farm inputs, drying, cleaning of produce, contacting buyers, hiring transportation, and selling produce. 'P' concluded that women and men see themselves as partners in accomplishing farm life.

*System Level:* Farm Household/Enterprise

*Development Impact Following Pathway with the TOP Table:* Initial results showed existing gender differentials in SSFWM practices (K). Both 'I' and 'P' varied in appreciation by SSFWM of gender roles in agriculture (A), or training of women in communication, farming techniques, and organizational management (S), social recognition of women also varied (A), and empowerment of women were different as well (C). The above shows how KASAC data have been gathered in 'P' and 'I', which will lead to the desired goal of equality between gender contribution and benefits in VAF system.

*Extent to Which Project Timeline is Met, Obstacles Encountered, and Actions Proposed to Respond to Obstacles:* Same as previous objectives, mainly delayed release of funds.

**Objective 6 on Scaling-up:** *Build host country capacity to manage and disseminate integrated vegetable-agroforestry system. (Coordinator: Ma. Victoria Espaldon, UPLB).*

*Major Tasks Completed:* (a) 'P' developed a baseline survey questionnaire and training needs analysis instrument. (b) 'I' published a 'Vegetable Manual Guide in Bahasa'

*Key Research Findings:* 'I' found a need by SSFWM for a vegetable production guide and produced it.

*System Level:* Field

*Development Impact Following Pathway with the TOP Table:* Literature published by 'I' is important for SSFWM training and know how in vegetable production (K and S of KASAC). This may be a spark to ultimately build host country capacity to manage and disseminate VAF system technology.

*Extent to Which Project Timeline is Met, Obstacles Encountered and Actions Proposed to Respond to Obstacles:* Project timeline is met.

## **V. Networking Activities**

Kickoff meetings in Vietnam, Indonesia, and the Philippines, together with several meetings with small scale farmers both women and men (SSFWM) greatly strengthened the SANREM-SEA-TMPEGS team spirit.

Meetings with USAID-MISSIONS in Vietnam, Indonesia, and the Philippines went very well. Reyes gave an overview of the project and then recorded the suggestions and comments of MISSIONS staff. In Vietnam, Reyes met with Mr. David Brunel and Mr. Dennis Zvinakis in Hanoi, and also visited with the state department and met with Consul General Seth in Ho Chi Minh City; in Indonesia, Reyes and Luther met with Mr. Prijanto Santoso and Mr. Agus; and in the Philippines, Reyes met with Mr. Oliver Agoncillo, and two other MISSIONS staff. Also, some USAID-MISSIONS staff in Indonesia and the Philippines attended the kick-off meetings, and provided guidance and advice on project direction.

Several non-degree training activities, focus group discussions, rapid market assessments, and many more activities were conducted to illicit participation from SSFWM. Trusts were built between host country, AVRDC, ICRAF, Australian and US scientists, SSFWM, local government officials, and staff from non-governmental and private organizations and host country universities.

A Danish student contacted SANREM in Vietnam and, through several months of e-mail exchanges, decided to do his M.S. thesis in Vietnam with minimal funding from SANREM.

Through funding provided by NC A and T's Future's grant project, NC A and T's Dean of School of Agriculture and Environmental Sciences and current SANREM board of directors Chair (Dr. Alton Thompson) will visit and be hosted by top administrators from Nong Lam University, Bogor Agricultural University, University of the Philippines at Los Baños, University of the Philippines-Open University, and Chiang Mai University in January 2007. The Chancellor of UPLB, Rector of NLU, Vice-Chancellor of BAU, and a top administrator from Chiang Mai University will meet in Washington DC, and visit NC A and T and VT in March 2007. All these networking were sparked by SANREM-CRSP funding.

The relationship with Central Mindanao University (CMU), Philippines began when Reyes and TMPEGS Philippine team visited CMU's President and other top administrators May 2006. Gender organization research in the Philippines will be conducted in collaboration with CMU.

## **VI. Project Impact Highlights**

There are no highlights to report at this time.





**Appendix D: Training and Publications Tables, FY 2006**



## SANREM CRSP Degree Training Participants: FY 2006

Student Name	Sex (M/F)	Nationality	Discipline	Country(s) Supported	Sandwich Program (Y/N)	Program			Funding (\$)		SANREM CRSP Advisor/PI (degree granting institution)
						Start Date	End Date	Degree	SANREM CRSP	Non-SANREM CRSP	
Amy Duchelle	F	USA	Forestry	Bolivia	N	Aug-03	Jun-08	PhD	Y	Y	P. Pacheco (University of Florida)
Catherine LaRochelle	F	Canada	Agricultural economics	Bolivia	N	Sep-06	Aug-06	PhD	Y	Y	Jeff Alwang, Darrell Bosch (Virginia Tech)
Diego Pacheco	M	Bolivia	Political Science	Bolivia	N	Sep-05	May-08	PhD	Y	Y	E. Ostrom (Indiana University)
Jeanne Thibeault	F	USA	Geography/Climate	Bolivia	N	Sep-06	Sep-09	PHD	Y	Y	A. Seth University of Connecticut)
Olga Yana (UC)	F	Bolivian	Sociology	Bolivia	N	Sep-06	Sep-06	MS	Y	Y	Elizabeth Jiménez (Universidad de la Cordillera)
Patricia Uberhuaga	F	Bolivia	Economist	Bolivia	N	Aug-05	Jul-08	PhD	Y	Y	P. Pacheco (The Royal Veterinary and Agricultural University, Denmark)
Porfidia Ajata (UC)	F	Bolivian	Economics	Bolivia	N	Sep-06	Oct-06	MS	Y	Y	Elizabeth Jiménez (Univ. Andina Simón Bolívar)
Javier Aguilera Alcón	M	Bolivian	Soil Science	Bolivia	N	Aug-06	Sep-10	Ph.D.	Y	Y	Peter Motavalli (University of Missouri Columbia)
Dely Chávez	F	Ecuador	Soils and water	Ecuador	N	Aug-06	Sep-06	BS	Y	N	Franklin Valverde (Universidad Estatal de Bolívar)
Ghenti Constadini	M	Albania	Agricultural economics	Ecuador	N	Sep-06	Jun-06	PhD	Y	Y	Jeff Alwang (Virginia Tech)
Julia Pryde	F	US	Engineering	Ecuador	N	Apr-06	Sep-06	MS	Y	N	Mary Leigh Wolfe (Virginia Tech)
María Figueroa	F	Ecuador	Agricultural Economics	Ecuador	N	Sep-06	Aug-08	MS	Y	Y	C. Valdivia (University of Missouri Columbia)
Martha González	F	Ecuador	Social science	Ecuador	N	Aug-06	Sep-06	BS	Y	N	Víctor Barrera (Universidad Estatal de Bolívar)
Rachel Melnick	F	US	Plant pathology	Ecuador	N	Jan-06	Sep-06	PhD	Y	Y	Paul Backman (Penn State)
Robert Andrade	M	Ecuador	Agricultural economics	Ecuador	N	Aug-06	Sep-06	MSc	Y	Y	Jeff Alwang (Virginia Tech)
Víctor Barrera	M	Ecuador	Social science	Ecuador	Y	May-06	Jun-06	PhD	Y	Y	Jeff Alwang (Universidad Politécnica de Madrid)
Anurag Mishra	M	Indian	Watershed Management	India	N	Aug-05	Sep-08	PhD	Y	Y	Mostaghimi/Benham (Virginia Tech)
Jessica Perdew	F	USA	Ag Economics	Indonesia	N	Aug-05	Jun-05	MS	Y	Y	Shively, Gerald (Purdue )
Moussa Keita	M	Mali	Local Development	Mali	N	Jan-04	Jun-06	Maitrise	Y	Y	Moore/Cissé (Delta-C)
Frank Van Laerhoven	M	Netherlands	Political Science	Mexico	N	Aug-03	Jul-07	PhD	Y	Y	E. Ostrom (Indiana University)
Janice B. Sevilla	F	Filipino	Envi. Science	Philippines	N	Nov-06	Mar-09	M Sc.	Y	N	Victoria Espaldon (Univ of the Philip at Los Banos)

Student Name	Sex (M/F)	Nationality	Discipline	Country(s) Supported	Sandwich Program (Y/N)	Program			Funding (\$)		SANREM CRSP Advisor/PI (degree granting institution)
						Start Date	End Date	Degree	SANREM CRSP	Non-SANREM CRSP	
Jerico Tolentino	M	Philippines	Computer Science	Philippines	N	Jan-06	Sep-07	Diploma	Y	N	Jean Saludadez (Univ of the Philip-Open University)
Laarni Lacandula	F	Filipino	Environmental Science	Philippines	N	Oct-06	Mar-07	PhD	Y	N	Victoria Espaldon (Univ of the Philip at Los Banos)
Dileep Birur	M	India	Ag Economics	Philippines, Vietnam	N	Jan-05	Jun-05	PhD	Y	Y	Shively, Gerald (Purdue)
Priya Bhagowalia	F	India	Ag Economics	Philippines, Vietnam	N	Sep-04	Jun-05	PhD	Y	N	Shively, Gerald (Purdue )
Aksarapak Wongcharoen	F	Thailand	Ag. and Applied Econ	Vietnam	N	Sep-04	Aug-06	MA	Y	N	Ian Coxhead (University of Wisconsin)
Evelyn Lwanga	F	Uganda	Political Science	Uganda	N	Aug-01	May-07	PhD	Y	N	E. Ostrom (Indiana University)
Pam Jagger	F	Canada	Political Science	Uganda	N	Sep-03	Sep-08	PhD	Y	Y	E. Ostrom (Indiana University)
Erin Frank	F	USA	Plant Pathology	USA	N	Aug-06	Sep-06	MSc	Y	Y	Karen Garrett (Kansas State University)
Lisa Rees	F	USA	Agricultural Economics	USA	N	Jun-06	Aug-09	PhD	Y	Y	C. Valdivia / L. Marks (University of Missouri Columbia)
Shauna P. Dendy	F	USA	Plant Pathology	USA	N	Jun-06	Sep-09	MS/PhD	Y	Y	Karen Garrett (Kansas State University)
Diep Phan	F	Vietnam	Ag. and Applied Econ	Vietnam	N	Sep-02	Dec-07	PhD	Y	Y	Ian Coxhead (University of Wisconsin)
Marcia Salazar	F	Ecuador	Ag Economics	Vietnam, Latin America	N	Aug-05	Aug-06	MS	Y	N	Shively, Gerald (Purdue )
Erin McDonald	F	USA	Veterinary Medicine	Zambia	N	Jun-05	May-08	DVM	Y	Y	Benjamin Lucio/Alfonso Torres (Cornell University)
Kandiwa, Vongai	F	Zimbabwean	Development Sociology	Zambia	N	Sep-04	Jul-09	PhD	Y	Y	Parfait Eloundou-Enyegue (Cornell University)
Lydia Gatere	F	Kenyan	Soil and Crop Sciences	Zambia	N	May-06	May-10	PhD	Y	N	Johannes Lehmann (Cornell University)
Samuel Bell	M	Australian	Applied Economics and Management	Zambia	N	Sep-05	May-10	PhD	Y	N	Duane Chapman (Cornell University)
Sarah Katt	F	USA	Business	Zambia	N	Aug-04	May-06	MBA	Y	Y	NA (Cornell University)

### **SANREM CRSP Non-Degree Training, FY 2006**

<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
<b>Bolivia</b>					
Short Course	February, June and July 2006	Field researchers-Bolivia	4 (1 females, 3 males)	Patricia Uberhuela (CERES/CIFOR grad student)	Planning and data collection for the PEN study, research process and techniques
Short Course	June 7-9, 2006	Community members in Chimore and Chapare in Cochabamba-Bolivia	??	CERES	Research methods and data collection techniques
Workshop	June-06	Co-investigators and staff	8 (4 females, 4 males)	MU – PROINPA	Geo-reference training
Workshop	June-06	Co-investigators, staff, and key informants from Umala Communities	33 (19 females, 14 males)	MU-UC-PROINPA-UMSA	Mapping, risk perceptions, eliciting strategies
Workshop	July 13, 2006	NGO technicians, local government	40	Consejo Provincial de Bolívar y CAMREM	Water quality management
Workshop	July 20, 2006	NGO technicians, local government	20	CONCOPE	Introduce project and its objectives to decision makers in Bolívar
Workshop	July -06	Enumerators and field coordinators	12 (6 females, 6 males)	Universidad de la Cordillera	To train enumerators in survey methodology.
Workshop	July-06	Enumerators and field coordinators	12 (6 females, 6 males)	Universidad de la Cordillera	Evaluation of 1st pilot survey.
Workshop	Aug-06	Enumerators and field coordinators	12 (6 females, 6	Universidad de la Cordillera	Evaluation of 2nd pilot survey.

<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
			males)		
Workshop	Aug. 06	Farmers from Chinchaya and Carcapata in Ancoraimes	20 (8 females, 12 males)	UMSA	Community perceptions and farming systems
Workshop	Sep. 06	Farmers from Chojñapata in Ancoraimes	10 (5 females, 5 males)	UMSA	Community perceptions and farming systems
Workshop	Sep. 06	Farmers from Chinchaya, Carcapata and Chojñapata in Ancoraimes	40 (18 females, 22 males)	UMSA	Identification of agricultural problems at the community level and farmers perceptions
Workshop	Sep. 06	Farmers from Umala Municipality (San José de Llanga, San Juan Circa, Vinto Coopani y Kellhuiri communities)	54 (27 females, 27 males)	PROINPA	Rural Rapid Appraisal for cropping systems, technology demands, research needs, and perceptions
Workshop	Sep. 19, 2006	NGO technicians, local government	30	Consejo Provincial de Bolívar	Disseminate findings from baseline assessment
<b>Ecuador</b>					
Field Day	09/9/05	Community Members and Genebank Managers	150 (110 females, 40 males)	UGA, UNORCAC (Union de Organizaciones Campesinos e Indigenas de Cotacachi)	In situ conservation; Seed Fair and Exchange held in collaboration with local organizations.
Field day	June 26- 30,2006	Decision makers, farmers, students	77 farmers 25 technicians 10 decision makers 10 students	INIAP	Methods for sampling biodiversity and generating primary information for base-line study
Seminar	June 12, 2006	INIAP personnel	40	ECOPAR, ECOCIENCIA	Natural resource management
Workshop	June 15, 2006	INIAP personnel	14	Project coordinator-INIAP	Introduce SANREM project to INIAP personnel

<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
Workshop	June 26, 2006	Representatives of government organizations, NGOS, universities, etc.	75	Fundación Antisana and Ohio State University	Payments for environmental services and other approaches to watershed management
Workshop	July 26, 2006	Farmers from Culebrillas	30	Technician-INIAP- SANREMCRSP	IPM training Introduce project
Workshop	August 2, 2006	Farmers from Pucarapamba	45	Technician-INIAP- SANREMCRSP	IPM training Introduce project
Workshop	Aug 11 - 31, 2006;	Various country representatives	20	FONAG - InWent	Watershed and water resource management
Workshop	Aug 13, 2006	Farmers from Bola de Oro	39	Project coordinator -INIAP	Soil management and alternative conservation methods
Workshop	Sep. 6 – 7, 2006	Local governments, technicians	14	TNC	Techniques and methods for ecological censuses
Workshop	09/07/05	community members and policy makers	25 (5 females, 20 males)	UGA, UNOPAC (Union de Organicaciones de Cayambe)	Impact of climate change on mountain glaciers highlighted issues of water for agriculture
<b>Honduras</b>					
Field day	October 20, 2005	Students from the Agricultural University of Honduras	35 (15 female; 20 male)	Center for Environmental Farming Systems (NCSU)	Research methods and priorities in agroecology
<b>Indonesia</b>					
Seminar	September 12, 2006	Students, faculty and staff of Bogor Agricultural University	50 (17 females and 33 males)	AVRDC-The World Vegetable Center at Bogor Agricultural University	The Focus of Research in Sustainable Vegetable Production Systems
Short Course	August 22, 2006	Farmers, farmer groups, extension agents, RW03 Women Farmer Group (FG)	15 women	ICRAF and volunteer professional from Winrock International's Farmer-to- Farmer Asia Program (USAID DC-funded)	i) importance of market channel, ii) farmers based market entities, and iii) enhance quality/quantity of products to match market specification.



<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
Short Course	August 23, 2006	Farmers, farmer groups, extension agents, market agents, Lestari Farmer Group	24 (5 female, 15 male, and 4 extension agents)	ICRAF and volunteer professional from Winrock International's Farmer-to- Farmer Asia Program (USAID DC-funded)	i) importance of market channel, ii) farmers based market entities, and iii) enhance quality/quantity of products to match market specification.
Short Course	September 11, 2006	Farmers, farmer groups, students, women farmers	15 (5 females, 10 males)	Bogor Agriculture University AVRDC-The World Vegetable Center, ICRAF, Nanggung, Indonesia	Producing vegetable transplants for vegetable- agroforestry on-farm trials
Workshop	May 2, 2006	Researchers and graduate students from Bogor Agricultural University USAID/Indonesia ICRAF-Indonesia, AVRDC	20 (7 females and 13 males)	Bogor Agricultural University Mars Inc.; North Carolina NC A and T SU; AVRDC; ICRAF-Indonesia; USAID/Indonesia	Introduce the project and research activities and to discuss and plan for the project implementation
<b>Kenya</b>					
Short Course	July, 2006	Field researchers-Kenya	5 (3 F, 2 M)	Esther Mwangi (IFPRI)	Assembly of "resource and recourse" diagram
Short Course	Sept 2006	Community members in target settlements in the Kakamega forest who will participate in study-Kenya	7 (3 F, 4 M)	KEFRI	Data collection methods, Participatory Rural Assessment, NRM, gender analysis; and leadership skills
<b>Mexico</b>					
Internship	June 05, 2006- September 5, 2006	Undergraduate students from the Univ. of Chapingo (Mexico)	3 (3 female)	Center for Environmental Farming Systems (NCSU)	Diversified organic production, sustainable agriculture, and principles of agroecology
Workshop	August 19 and 20, 2006	Participants in the survey project-Mexico	6 (4 F, 2 M)	Instituto de Investigaciones Sociales (IIIS), UNAM, Mexico	Survey on forest communities in Mexico
Workshop	August 11, 2006	Participants in the IFRI field work-Mexico	5 (4 F, 1 M)	Instituto de Investigaciones Sociales (IIIS), UNAM, Mexico	To introduce participants to the concept and methodology of IFRI

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<b>Peru</b>					
Workshop	June-06	Co-investigators and staff	14 (7 females, 7 males)	MU-UC	Community participatory assessments
Workshop	Aug. 06	Enumerators from Puno	4 (2 Female, 2 Male)	UNALM	Field data collection
Workshop	Aug. 06	Farmers from Santa Maria	6 (3 Female, 3 Male)	UNALM	Community perceptions, farming systems and natural resource management
Workshop	Aug. 06	Farmers from Huariconse	40 (20 Female, 20 Male)	UNALM	Community perceptions, farming systems and natural resources management
Workshop	Aug. 06	Stakeholders of Puno	20 (8 Female, 12 Male)	UNALM	Identification of natural resource problems at the regional level
Workshop	Sep. 06	Enumerators from Puno	4 (2 Female, 2 Male)	UNALM	Field data collection
<b>Philippines</b>					
Field day	September 21, 2006	Small scale farmers both women and men and SANREM scientists		AVRDC-The World Vegetable Center at Indigenous Vegetable demonstration plots, Department of Agriculture Northern Mindanao Integrated Agricultural Research Center, Lantapan, Philippines	Introducing farmers to indigenous vegetables found in the Philippines and in other countries
Short Course	March 9, 2006	Graduate students and undergraduate majors, university faculty, NGO guests	Around 50, mostly females	De La Salle University- Manila, Philippines	The role of women farmers: “Women’s Role in Agricultural Production and its Health Consequences: Issues for Research”

<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
Workshop	May 16-17, 2006	USAID/Philippines; UP-LB; Open University of the Philippines; Don Bosco Technical College; De La Salle University; ICRAF- Philippines; AVRDC Farmer groups; Mayor and Vice-Mayor of Lantapan National Irrigation Admin.	About 20 (7 females and 13 males)	University of the Philippines at Los Banos University of the Philippines- Open University Don Bosco Technical College De La Salle University ICRAF-Philippines AVRDC; Farmer groups North Carolina A and T SU	Introduce the project and research activities to local stakeholders, policy makers, other researchers; and to discuss and plan for the project implementation
Workshop	August 1-2, 2006	Researchers (including project leader)	4 (3 females, 1 male)	De La Salle University	Qualitative research methodologies for market and gender analysis
<b>Uganda</b>					
Short Course	Between April-June, 2006	District Forest Office; National Forest Authority- Uganda	4 (1 F, 3 M)	UFRIC	Forest mensuration, communication skills, biodiversity and monitoring; and community roles in decentralized forest mgmt
Short Course	Aug 2006	Community members-Uganda	4 (1 F, 3 M)	UFRIC	Roles/responsibilities of communities/stakeholders in decentralized environments; tree and soil management
Short Course	Aug 2006	Community members in two target settlements in the Mabira forest-Uganda	30 (10 F, 20 M)	UFRIC	Trees, water, and soil management and the roles and responsibilities of communities/stakeholders in decentralized environments
Short Course	September, 2006 (10 days)	Enumerators to assist with PEN data collection-Uganda	10 (3 F, 7 M)	Pam Jagger (IU grad student), Center for International Forestry Research	Data collection and survey techniques

<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
<b>USA</b>					
Seminar	March 20, 2006	Faculty and students	About 110 (50percent female)	Mars Inc and NCNC A and TSU	The story of sustainable cocoa: Reducing poverty, improving lives, protecting the environment one chocolate bar at a time
Seminar	April 17, 2006	Faculty and students	About 20 (5 females and 15 males)	AVRDC and NCNC A and TSU	AVRDC-The World Vegetable Center's research and development on good agricultural practices for safe vegetable production
Seminar	April 17, 2006	Faculty and students	50 (13 females and 37 males)	AVRDC and NCNC A and TSU	AVRDC-The World Vegetable Center's vision of the role of horticulture in poverty alleviation
Seminar	June 13, 2006	Faculty and students	6 (1 female and 5 males)	Virginia Tech and NCNC A and TSU	Building Local Networks and Social Infrastructure for Natural Resources Management Governance: Inciting Social Capital Formation
<b>Vietnam</b>					
Fulbright exchanges	2005-06	Dr. Le Quoc Phuong	1	University of Wisconsin	Research and capacity building in economic analysis for Vietnamese economic development and policy
Fulbright exchanges	2005-06	Dr. Phan Thi Nhiem	1	University of Wisconsin	Research and capacity building in economic analysis for Vietnamese economic development and policy
Short Course	August 17, 2006	NLU researchers, students	10 (6 Female, 4 Male)	Nong Lam University	Household survey methods, data coding and baseline establishment

<b>Program type (workshop, seminar, field day, short course, etc.)</b>	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider (US university, host country institution, etc.)</b>	<b>Training Topic</b>
Short Course	September 6, 2006	NLU researchers, students	12 (5 female, 7 male)	Nong Lam University	Methods for household and nutrient surveys, data coding and database establishment
Short Course	September 7, 2006	NLU researchers, students	7 (4 female, 3 male)	Nong Lam University	To provide guideline for the market survey.
Workshop	May 12, 2006	Researchers from: Nong Lam University; Forest Science Sub-Institute and Southern Sub-Institute for Forest Inventory and Planning of MARD; Dept of Ag and Rural Dev. Dong Nai Province; Dept of Ag and Rural Dev. Binh Phuoc Province	28 (9 females, 19 males)	Nong Lam University Mars Inc. North Carolina NC A and T SU Forest Science Sub-Institute in Southern of Vietnam. Southern Sub-Institute for Forest Inventory and Planning of MARD	Introduce the project and research activities to local stakeholders, policy makers, other researchers; and to discuss and plan for the project implementation
<b>Zambia</b>					
Field day	Sep. 8-21, 2006	Existing producer groups, community members from Chitungulu, Zokwe, Mapamba, Kazembe, Luero, Chikwa, Tembwe, Kambombo, Mwasemphangwe, Chikomani, Zumwanda and Magodi (Chama and Lundazi)	759 (296 female and 463 male)	Producer Group Coordinator; Depot staff, Key community personnel	Conservation farming, quality control of produce and marketing, bushfires and their disadvantages, organic vegetable production, results of the baseline survey and HIV/AIDS awareness.
Short Course	June 20-July 26, 2006	villagers	522 (263 female, 259 male)	Erin McDonald, Cornell University	Improved poultry nutrition, husbandry, and disease prevention and diagnosis.
Short Course	July 2006	COMACO Extension Officers	7 (2 female, 5 male)	Erin McDonald, Cornell University	Common bacterial, viral, fungal, nutritional, and parasitic diseases of poultry. Post-mortem examinations, and routine fecal parasite

<b>Program type</b> (workshop, seminar, field day, short course, etc.)	<b>Date</b>	<b>Audience</b>	<b>Number of Men and Women Participants</b>	<b>Training Provider</b> (US university, host country institution, etc.)	<b>Training Topic</b>
					analyses.
Workshop	May 22- 31, 2006	Village representatives and transformed poachers	Approximately 25 males	Wildlife Conservation Society, South Luangwa Area Management Unit (SLAMU)	The roles and responsibilities of the safari hunting monitoring scouts
Workshop	July 17-21 and July 26- August 3, 2006	Program Against Malnutrition, Forestry Development, ZAWA, CARE, WCS	10, then 3 for advanced training	Guy Picton Phillip, WCS	GIS training and skills development

## SANREM CRSP Publications, Presentations, and Other Products, FY 2006

<i>Category</i>	<i>Bibliographic Citation</i>
Articles Published in Refereed Publications	<p>Badini, Oumarou, Claudio O. Stockle, Jim W. Jones, Roger Nelson, Amadou Kodio, and Moussa Keita. 2006. A simulation-based analysis of productivity and soil carbon in response to time-controlled rotational grazing in the West African Sahel region. <i>Agricultural Systems</i>. Forthcoming.</p> <p>Garrett, K. A., S. P. Dendy, E. E. Frank, M. N. Rouse, and S. E. Travers. 2006a. Climate change effects on plant disease: Genomes to ecosystems. <i>Annual Review of Phytopathology</i> 44:489-509.</p> <p>Garrett, K. A., S. H. Hulbert, J. E. Leach, and S. E. Travers. 2006b. Ecological genomics and epidemiology. <i>European Journal of Plant Pathology</i> 115:35-51.</p> <p>Ha, D.T. and G.E. Shively. 2005. "Coffee vs. Cacao: A case study from the Vietnamese Central Highlands." <i>Journal of Natural Resources and Life Sciences Education</i>. <b>34</b>: 107-111.</p> <p>Ha, D.T. and G. Shively. 2006. Coffee Boom, Coffee Bust, and Smallholder Response in Vietnam's Central Highlands. <i>Review of Development Economics</i>, forthcoming.</p> <p>Hepperly, P., Douds, D., and R. Seidel. 2006. The Rodale Institute Farming Systems Trial 1981 to 2005: Long Term analysis of organic and conventional maize and soybean cropping systems. Pages 15-31 in <i>Long Term Field Experiments in Organic Farming</i>. J. Raupp, C. Pekrun, M. Oltmanns, and U. Kopke eds. ISOFAR, Verlag Dr. Koster, Berlin 198 p.</p> <p>Nazarea, V. 2006. Local Knowledge and Memory in Biodiversity Conservation. <i>Annual Review of Anthropology</i> (October, 2006).</p> <p>Rios, Ana and Gerald Shively. 2006. Farm size and nonparametric efficiency measurements for coffee farms in Vietnam. <i>Forests, Trees, and Livelihoods</i>, forthcoming.</p> <p>Roncoli, Carla, Christine Jost, Carlos Perez, Keith Moore, Adama Ballo, Salmana Cissé, and Karim Ouattara. 2006. Carbon sequestration from common property resources: Lessons from community-</p>

	<p>based sustainable pasture management in north-central Mali. <i>Agricultural Systems</i>. Forthcoming.</p> <p>Shively, Gerald E. 2006. "Externalities and labour market linkages in a dynamic two-sector model of tropical agriculture." <i>Environment and Development Economics</i>. 11(1):59-75.</p> <p>Southgate, D., T. Haab, J. Lundine, and F. Rodriguez. "Responses of Poor, Rural Households in Ecuador and Guatemala to Payments for Environmental Services," to be resubmitted in October 2006 to <i>Land Economics</i>, for second review.</p> <p>Twumasi, Y.A., A. Manu, T.L. Coleman, B. Schmid, and A. Moustapha. 2005. Use of geo-spatial data for sustainable management of solid waste in Niamey, Niger. <i>Journal of Sustainable Development in Africa</i>. Vol. 8. No.1</p>
Books/Book Chapters	<p>Coxhead, I. 2006. "Globalization and the poverty–environment link in Asian agriculture." In A. Balisacan and N. Fuwa (eds): <i>Agricultural Development in Asia: Ideas, Paradigms and Policies</i> (Singapore: ISEAS, in press).</p> <p>Forbes, G. A., N. J. Grunwald, E. S. G. Mizubuti, J. L. Andrade-Piedra, and K. A. Garrett. In review. Potato late blight in developing countries. Chapter in R. Peters, (editor) <i>Current Concepts in Potato Disease Management</i>. Research Signpost, Kerala, India.</p> <p>Garrett, K. A., and C. M. Cox. 2006. Applied biodiversity science: Managing emerging diseases in agriculture and linked natural systems using ecological principles. Chapter in R. Ostfeld, F. Keesing, V. Eviner (eds) <i>Cary Conference XI: Infectious disease ecology: the effects of ecosystems on disease and of disease on ecosystems</i>. Princeton University Press. In press.</p> <p>Nazarea, V., J. Camacho, and N. Parra. 2006. <i>Recetas Para La Vida: Cocinas, Consejos, y Costumbres de Fugones de Los Andes</i>. Compilers. Quito, Ecuador: Abya Yala Press.</p> <p>Rhoades, R. 2006. <i>Desarrollo con Identidad: Comunidad, Cultura, and Sostenibilidad en los Andes</i>. Editor. Quito, Ecuador: Abya Yala Press.</p> <p>Rhoades, R. in press. <i>Mama Cotacachi: History, Local Perceptions, and Social Impacts of Climate Change and Glacier Retreat in the Ecuadorian Andes</i>. In Benjamin Orlove (Ed). <i>Darkening Peaks: Mountain Glacier Retreat in Social and Biological Contexts</i>. Berkeley: University of California Press</p>



	<p>(projected, October, 2007).</p> <p>Rodríguez, F. and D. Southgate. 2006. “Local Resolution of Watershed Management Trade-Offs: The Case of Cotacachi, Ecuador,” in R. Rhoades (ed.), <i>Development with Identity: Community, Culture, and Sustainability in the Andes</i>. Cheltenham: CAB International, 2006.</p> <p>SANREM-Andes. 2005. <i>El Canton Cotacachi: Espacio and Sociedad</i>. Quito: Ediguías C. Ltda.</p>
Theses and Dissertations	<p>Adiong-Verbal, Xyle Fe. 2006. Multiple Role Performance of Upland Women Farmers: Socioeconomic Characteristics and Perceived Consequences. (Unpublished Masters Thesis) Manila: De La Salle University.</p> <p>Demeke, B., “Essays on Environmental and Development Policy Analysis in Developing Countries”. University of Wisconsin-Madison, Department of Agricultural and Applied Economics, PhD. Dissertation (2005).</p> <p>Salazar, Marcia. 2006. <i>An Economic Analysis of Smallholder Coffee Production in Guatemala, Honduras, Nicaragua, and Vietnam</i>. Unpublished M.S. Thesis, Department of Agricultural Economics, Purdue University, West Lafayette, IN.</p> <p>Yao, Richard. 2005. “Impacts of Irrigation Development on Agricultural Productivity, Resource Allocation and Income Distribution: A Longitudinal Analysis from Palawan, the Philippines.” Unpublished M.S. Thesis, Department of Agricultural Economics, Purdue University, Indiana.</p>
SANREM CRSP Annual Reports and Highlights	<p>Southgate, D. “Sharing Experiences with Watershed Management in Ecuador” (SANREM lessons-learned document), August 2006.</p>
Extension Publications (large)	<p>Poultry Health and Management: A guide to raising healthy village poultry. Compiled by Erin McDonald, with special thanks for illustrations to the Network for Smallholder Poultry Development. Cornell University, Wildlife Conservation Society, USAID, SANREM-CRSP, Virginia Tech.</p> <p>Susila, Anas. 2006. <i>Panduan Budidaya Tanaman Sayuran</i>. (Vegetable Manual Guide in Bahasa, pp.128)</p>

Conference Proceedings	<p>Jervis, M. <i>Memorias del Taller sobre Experiencias del Manejo de Cuencas Hidrográficas en el Ecuador</i>. Quito: Fundación Antisana, November 2006</p> <p>Manu, A. 2005. Simulating urban growth patterns of a developing country city using computational neural networks. In Proceedings of the Seventh Biannual Africa GIS Conference (on CD ROM). . Tshwane (Pretoria), South Africa.</p> <p>Moore, Keith M., Salmana Cissé, and Abdoulaye Touré. 2005. “Building Social Infrastructure for Decentralized NRM”. Proceedings of the International Farming Systems Association Global Learning Opportunity. Rome, Italy. November 2005.</p> <p>Rhoades, R. 2005. Are Traditional Mountain Governance Principles still relevant in a Global World? In Leslie Taylor and Anne Ryall (Eds). <i>Governance and Decision-Making in Mountain Areas</i>. Proceedings of a Conference held June 4-8, 2005 in Banff, Alta. Banff Center. pp. 237-244.</p> <p>Twumasi, Yaw A., A. Manu, T.L. Coleman. 2005. Remote sensing and GIS application in coastal zone management: a case study of Ghana. <i>In Proceedings of the Seventh Biannual Africa GIS Conference (on CD ROM). 31st October – 4th November. Tshwane (Pretoria), South Africa.</i></p>
SANREM CRSP Working Papers	<p>Andersson, K., and E. Ostrom. 2006. “An Analytical Agenda for the Study of Decentralized Resource Regimes.” For submission to <i>Governance</i>. An earlier version of this paper was presented at the Midwest Political Science Association meetings, Chicago, IL, April 20, 2006 and the 2006 meetings of the International Society of New Institutional Economics in Boulder, CO, on September 23, 2006. Earlier version/old title: “Decentralized Natural Resource Governance from a Polycentric Perspective,” was presented at the Midwest Political Science Association meetings, Chicago, IL, April 20, 2006.</p> <p>Demeke, B., and I. Coxhead (2006). “Modeling spatially differentiated environmental policy in a Philippine watershed: tradeoffs between environmental protection and poverty reduction.” Manuscript, Penn. State U. and U. Wisconsin-Madison.</p>
World Wide Web Sites and Documents	<p><a href="http://www.oired.vt.edu/sanremcrsp/">http://www.oired.vt.edu/sanremcrsp/</a> - SANREM CRSP Website</p>

	<a href="http://repatriation.uga.edu">http://repatriation.uga.edu</a> - repatriation and In situ Conservation of Indigenous Crops
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## **Appendix E: List of Acronyms**



## List of Acronyms

A	Aspirations
A	Attitudes
ADRA	Adventist Development and Relief Agency International Title II USAID
AVRDC-WVC	Asian Vegetable Research and Development Center – The World Vegetable Center
C	Capabilities
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CEFS	Center for Environmental Farming Systems
CERES	Center for the Study of Economic and Social Reality (Bolivia)
CI	Conservation International
CIFOR	Center for International Forestry Research
CIP	International Potato Center
CIPCA	Centro de Investigación y Promoción del Campesinado
COMACO	Community Markets for Conservation
CPA	Community Participatory Assessments
CRC	Collaborating Research Centers
CRSP	Collaborative Research Support Program
CTC	Community Trading Centre
DLSU	De La Salle University
FFH	Food for the Hungry, Title II USAID
‘I’	TMPEGS –Indonesia – sometimes Indonesia
ICRAF-WAC	International Center for Research in AgroForestry – The World Agroforestry Center
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFPRI	International Food Policy Research Institute
IFRI	International Forestry Resources and Institutions Research Program
IPM	integrated pest management
ISU	Iowa State University
K	Knowledge
KASAC	Knowledge, Attitudes, Skills, Aspirations, and Capabilities
KASAP	Knowledge Attitudes Skills Aspirations and Practices
KEFRI	Kenya Forestry Research Institute
KSU	Kansas State University
MAPA	USAID Market Access and Poverty Alleviation Project
MARD	Ministry of Agricultural Research and Development
MM	Manupali Model
MU	University of Missouri Columbia
NACs	National Advisory Committees
NCSU	North Carolina State University
NLU	Nong Lam University
NRM	Natural Resource Management
‘P’	TMPEGS-Philippines – sometimes Philippines
PES	Payments for environmental services

PI	Principal Investigator
PR	Participatory Research
PRA	Participatory Rural Appraisals
PROINPA	Fundación PROINPA
PWES	Payments for watershed environmental services
RMA	Rapid Market Assessment
S	Skills
SA	Sustainable Agriculture
SANREM	Sustainable Agriculture and Natural Resources Management
SE Asia	Southeast Asia
SSFWM	small scale farmer both women and men
STC	Save the Children, Title II USAID
TMPEGS	Technology, Marketing, Policy, Environmental and Socio-economic impact, Gender, and Scaling-up
TOP	Targeting Outcomes of Programs
TSBF	Tropical Soil Biology and Fertility Institute
U Conn	University of Connecticut
UC	University of California
UC	Universidad de la Cordillera
UFRIC	Uganda Forestry Resources and Institutions Center
UMSA	Universidad Mayor San Andrés
UNALM IPPS	Universidad Nacional Agraria la Molina Instituto de la Pequeña Producción Sustentable
UNAM	Universidad Nacional Autónoma de México
UNAM-IIS	Instituto de Investigaciones Sociales of the Universidad Nacional Autónoma de Mexico
UNDP	United Nations Development Programme
UPLB	University of the Philippines at Los Baños
‘V’	TMPEGS-Vietnam – sometimes Vietnam
VAF	Vegetable AgroForestry
VIDIN	<u>V</u> egetable agroforestry, <u>I</u> ntroduction of indigenous and improved vegetables, <u>D</u> rip irrigation, <u>I</u> ntegrated pest management, and <u>N</u> o-tillage technologies
VT	Virginia Tech
WCS	Wildlife Conservation Society
WFP	World Food Programme
WTA	Willingness to accept (conservation payment)
WTP	Willingness to pay (for environmental services)
ZAWA	Zambian Wildlife Authority

## Collaborating Institutions

### U.S. Universities and NGOs

Cornell University	University of California-Berkeley
Ecoagriculture Partners, Inc.	University of Colorado
Florida A&M University	University of Connecticut
Iowa State University	University of Denver
Indiana University	University of Georgia
Kansas State University	University of Missouri
North Carolina A&T State University	University of Wisconsin
North Carolina State University	Virginia Polytechnic Institute and State University
Ohio State University	Washington State University
Pennsylvania State University	Winrock International Institute for Agricultural Development
Purdue University	
Rodale Institute	
Texas A&M University	

### Non-U.S. Universities and NGOs

Bogor Agricultural University, Indonesia	Fundacion Antisana
Central Queensland University	Hue University, Vietnam
Centro de Investigacion y Promocion del Campesinado	INIAP
De La Salle University	Nong Lam University, Vietnam
Don Bosco Technical Collage	National Agrarian University-La Molina
	PROINPA Foundation Universidad de La Cordillera

### IARCs

The World Vegetable Center (AVRDC)  
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)  
Center for International Forestry Research (CIFOR)  
International Food Policy Research Institute (IFPRI)  
International Potato Center (CIP)

### Private Sector

World Cocoa Foundation (WCF)